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Standard Specifications for Road and Bridge Construction

Prepared by

NORTH DAKOTA DEPARTMENT OF TRANSPORTATION

BISMARCK, NORTH DAKOTA
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I hereby certify that this Standard Specifications Book was prepared under the Office of Project Development, compiled from specifications prepared, examined, adopted and implemented by the North Dakota Department of Transportation in accordance with established procedures, and as approved by the Federal Highway Administration.

Chad M. Orn, P.E.
Office of Project Development

07 Mar 2023
Date

These North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction, 2023, are hereby Approved for application on highway and related construction contracts as referenced in the contract plans or specifications, and they shall apply as noted and amended by those documents.

Approved,

Matthew Linneman, P.E.
Deputy Director for Engineering

03/09/23
Date

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Working Titles having a masculine gender such as workman, workmen, and foreman, and pronouns such as he, his, and him are utilized in these Specifications for the sake of brevity and are intended to refer to persons of either sex.

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SECTION 101
ABBREVIATIONS AND DEFINITIONS

101.01 WORDING OF THE SPECIFICATIONS

The North Dakota Department of Transportation has written the *Standard Specifications for Road and Bridge Construction* (Standard Specifications) with an emphasis on the active voice. In a sentence written in the active voice, someone acts on something. For example: “The Engineer will take a sample.” A similar sentence in the passive voice—“A sample will be taken”—would be unclear about who was responsible for taking the sample.

The Standard Specifications also make use of the imperative mood. The imperative mood is used when the party issuing an instruction and the party receiving it are already understood. In the Standard Specifications, the Department is stating its requirements or directions for work to the Contractor; such statements have the same force as if they contained the word “shall.” In an imperative sentence such as, “Place the concrete,” the Department is indicating that it requires the Contractor to place the concrete. Before award of the contract, imperative statements are directed to the Bidder. Between award and execution of the contract, imperatives are directed to the lowest responsible Bidder; and after execution, to the Contractor.

The Department will identify parties other than the Bidder or Contractor to whom it gives a responsibility in the Standard Specifications. In phrasings where the responsible party has already been clearly identified or in factual statements when it is not important to do so, the Department may use the passive voice.

When these specifications indicate that work shall be “required, requested, directed, authorized, ordered, permitted, suspended, approved, accepted, or rejected,” it shall be understood that these expressions and others similar to them are followed by the phrase, “by the Engineer.”

101.02 ORGANIZATION OF THE SPECIFICATIONS

A. General.

With the exception of Section 100, "General Provisions," and Section 800, "Materials," the sections of the Standard Specifications are written in a six-part format. Each section contains the following primary subsections:

XXX.01 Description
XXX.02 Equipment
XXX.03 Materials
XXX.04 Construction Requirements
XXX.05 Method of Measurement
XXX.06 Basis of Payment

The subsections contain varying numbers of titled subordinate subsections composed of higher and lower levels, as in an outline.

B. Hierarchy of Organization.

The requirements of a subsection apply to subordinate subsections. In addition, many subsections begin with a lower-level subsection called "General." The requirements of "General" subsections apply to the associated same-level subsections that follow; they do not apply to the higher level.

All of the provisions of Section 100, “General Provisions,” of the Standard Specifications apply to all portions of the contract.

C. Titles or Headings.
The titles or headings of sections and subsections are for the convenience of referencing and have no bearing on the meaning or interpretation of the text.

D. References.
The specifications rely on many cross references, both to internal sources in the specifications and external sources in other contract documents, Department manuals, and other industry resources. If the contract documents reference an external publication, the Department intends that the reference be to the most recent issue, including interim publications before the date of the advertisement, unless the contract specifies otherwise.

When a test procedure uses the prefix “ND”, the proper test procedure can be found in the Department’s *Field Sampling and Testing Manual*, which is available on the Department’s website: www.dot.nd.gov.

Each contract item listed in the contract references to a section number from the specifications; therefore, all of the provisions of that referenced section that are relevant to the proper completion of the contract item are binding upon the Contractor. This includes the requirements found in the “General” subsections as well as those specific requirements listed thereafter.

Within the specifications, references to other sections and subsections of the specifications apply the same as if they were a part of the specification section or subsection from which they were referenced. A cross-reference to a specific subsection of these specifications includes all general requirements of the section of which the subsection is a part.

101.03 ABBREVIATIONS

Wherever the following abbreviations are used in the contract documents, their meaning shall be as follows:

AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AC	Asphaltic Cement
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ADA	Americans with Disabilities Act
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISI	American Iron and Steel Institute
ANLA	American Nursery and Landscaping Association
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance-of-Way Association
ARTBA	American Road and Transportation Builders Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	ASTM International
ATSSA	American Traffic Safety Services Association
AWPA	American Wood Protection Association

AWWA	American Water Works Association
AWS	American Welding Society
BIA	Bureau of Indian Affairs, U.S. Department of the Interior
BMP	Best Management Practices
CADD	Computer-Aided Drafting Design
CARS	Construction Automated Records System
CFR	Code of Federal Regulations
CMC	County Major Collector
CPM	Critical Path Method
CRS	County Rural Society
CRSI	Concrete Reinforcing Steel Institute
DBE	Disadvantaged Business Enterprise
EEO	Equal Employment Opportunity
ESAL	Equivalent Single Axle Load
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration, U.S. Department of Transportation
HDPE	High-Density Polyethylene
IES	Illuminating Engineering Society
ISSA	International Slurry Surfacing Association
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
IMSA	International Municipal Signal Association
LED	Light Emitting Diodes
MASH	Manual for Assessing Safety Hardware
MUTCD	Manual on Uniform Traffic Control Devices
NCHRP	National Cooperative Highway Research Project
NDCC	North Dakota Century Code
NDDEQ	North Dakota Department of Environmental Quality
NDDoH	North Dakota Department of Health
NDDOT	North Dakota Department of Transportation
NDPDES	North Dakota Pollutant Discharge Elimination System
NEC	National Electrical Code
NEMA	National Electric Manufacturers Association
NEPA	National Environmental Policy Act
NHTSA	National Highway Traffic Safety Administration
NPCA	National Precast Concrete Association
NRMCA	National Ready-Mix Concrete Association
NTCIP	National Transportation Communications for ITS Protocol
NTPEP	National Transportation Product Evaluation Program
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor
PCA	Portland Cement Association
PCC	Portland Cement Concrete
PCI	Precast/Prestressed Concrete Institute
PCN	Project Control Number
PVC	Polyvinylchloride - PVC Pipe
QA	Quality Assurance
QC	Quality Control
SAE	SAE International
SCM	Supplementary Cementitious Material
SFN	State Form Number

SG	Specific Gravity
SHPO	State Historic Preservation Office
SSPC	The Society for Protective Coatings
SWPPP	Storm Water Pollution Prevetion Plan
UL	Underwriters Laboratory, Inc.
USACE	United States Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VMA	Voids in Mineral Aggregate

101.04 DEFINITIONS

Wherever the following terms are used in the contract documents, their meaning shall be as follows:

Act of God. An unforeseeable act, event, or happening resulting from natural causes such as earthquake, tornado, or other cataclysmic phenomena.

Actual Quantity. The quantity of a **contract item** measured by the **Engineer** in accordance with Section 109.01, "Measurement of Quantities."

Addendum. A document issued by the Department after the advertisement and before the bid opening that modifies or supplements the proposal package and will become part of the contract.

Advertisement. A public announcement inviting **proposals**. The **advertisement** will identify how to get a copy of the **proposal package**, how to submit a proposal, and the date, time, and place of the **bid opening**.

Award. The **Department's** acceptance of a **proposal**.

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

Bidder. An individual, or legal entity submitting a **proposal**.

Bid Documentation. All writings, working papers, computer printouts, charts, and all other data compilation that contain or reflect information, data, or calculations used by the **Bidder** to prepare the submitted **proposal**, such as material relating to the determination and application of the following:

1. Equipment rates,
2. Overhead rates and related time schedules,
3. Labor rates,
4. Efficiency or productivity factors,
5. Arithmetic extensions, and
6. Subcontractor and material supplier quotations.

The Bidder may include manuals that are standard to the industry in the **bid documentation** by reference and must show the name and date of the publication and the publisher.

Bid Opening. The public opening of **proposals** at the date, time, and location identified in the **advertisement**.

Bid Item List. A list of the bid items and estimated quantities in the **proposal forms**. The **bid item list** becomes the list of **contract items** after execution of the **contract**.

Bid Unit Price. The price per unit for a **contract item** submitted by the **Bidder** on the **proposal forms**. After **award** the bid unit price becomes the **contract unit price**.

Bridge. A single-span or multiple-span **structure** including supports, erected over a depression or obstruction such as water, **highway**, or railway; and having a track or passageway for carrying traffic or other moving loads; and having a length measured along the center of **roadway** of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes.

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

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

Business Day. Any **calendar day**, except Saturdays and **holidays**.

Calendar Day. Every day shown on the calendar. A day begins and ends at midnight.

Certificate of Compliance. A certificate provided by the **Contractor** to the **Engineer** in accordance with Section 106.01, "General Methods of Materials Acceptance."

Change Order. A written order from the **Department** to the **Contractor**, and signed by both parties, detailing **contract** revisions for work within the scope of the original contract.

Clue. A potential source of **material** identified in the **proposal package** and, if used, is considered a **Contractor**-furnished material source.

Cofferdam. A temporary or removable structure designed to hold the surrounding earth, water or both out of the excavation.

Constraint (CPM only). A restriction placed on an activity in the schedule that may override logic or restrict or distribute **float** for a network or sub-network of logic.

Construction Limits. The area from the beginning station to the ending station of the **project** and between the slope stakes or as shown on the **plans**.

Contract. The written agreement between the **Department** and the **Contractor** setting forth the obligations of the parties for the performance of the prescribed **work**.

The **contract** includes the following:

1. **Addenda**
2. **Bid Item List**
3. **Change Orders**
4. **Contract Bond**

5. **Contract Items (Pay Item)**
6. **Contract Time**
7. **Project Plans** and **Standard Drawings**
8. **Proposal Forms**
9. **Proposal Package**
10. **PS-1 (Price Schedule for Miscellaneous Items)**
11. **Request for Proposals**
12. **Standard Specifications** and **Supplemental Specifications**
13. **Special Provisions**
14. **Supplemental Agreements**
15. **Work Drawings**
16. **Work Orders**

Contract Amount. The total amount of the **contract**, including all contract revisions to date.

Contract Bond. The security, executed by the **Contractor** and the **surety** or sureties, furnished to the Department to guarantee complete execution of the **contract** and all **supplemental agreements** and the payment of all legal debts pertaining to project construction.

Contract Item (Pay Item). A specific unit of the **work** for which the **contract** provides a price. During the bidding process, the term “bid item” may be used to describe these items.

> **Major Contract Item.** A **contract item** having a **contract** value greater than 5 percent of the original **contract amount**.
>
> **Minor Contract Items.** A **contract item** that is not a **major contract item**. A **minor contract item** in the original **bid item list** becomes a **major contract item** when its total cost increases to more than 5 percent of the original **contract amount**.
>
> **Specialty Item.** Any designated **contract item** that requires specialized knowledge, abilities, or equipment not ordinarily required with the major type of work specified in the **contract**.

Contract Unit Price. The price included in the **Contract** for a **contract item**.

Contract Time. The amount of time allowed for completion of the **contract**, including authorized time extensions. The **contract time** will be a number of working days, a number of **calendar days**, a completion date, or a completion date with a minimum number of working days. The contract time may include milestones.

Contractor. The individual, or legal entity contracting with the **Department** for performance of prescribed **work**.

Employee. Any person working on the **project** covered by the **contract** that is under the direction or control of, or receives compensation from, the **Contractor** or a **subcontractor**.

Subcontractor. An individual, or legal entity with whom the **Contractor** sublets part of the **contract** in accordance with Section 108.01, "Subletting of Contract."

Superintendent. The **Contractor's** authorized representative in responsible charge of the **work** in accordance with Section 105.02, "Contractor Requirements."

Surety. The legal entity or individual, other than the **Contractor**, executing a **proposal guaranty** or **contract bond**.

Critical Activity. An activity with zero or negative **total float**.

Critical Path. The longest continuous sequence of **work** establishing the scheduled completion date of the **project** or a **milestone**.

Critical Path Method. An electronic system of planning, scheduling, and control which combines all relevant information into a single master plan, permitting the establishment of the optimum sequence and duration of operations; utilizing an arrow diagram drawn to show the interconnected individual tasks involved in constructing the **project**.

Culvert. Any **structure** under the **roadway** with a clear opening of 20 feet or less measured along the center of the roadway.

Data Date. The date from which a schedule is calculated and, in schedules other than the initial schedule and baseline schedule, the date up to which progress is reported.

Department. The North Dakota Department of Transportation or its representatives.

Director. The **Director** of the **Department** acting directly or through authorized representatives.

Engineer. The Deputy Director for Engineering of the **Department**, acting directly or through an authorized representative, who is responsible for engineering supervision of construction.

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

Materials & Research Engineer. The head of the **Department's** Materials & Research Division.

Director. See **Department**.

Divided Highway. A **highway** with separated **roadways** for traffic in opposite directions.

Driving Lane. The portion of the **highway**, excluding **shoulders**, normally used to accommodate the movement of vehicular traffic.

Employee. See **Contractor**.

Engineer. See **Department**.

Equipment. All machinery, tools, apparatus, and supplies necessary for maintenance, construction, and completion of the **work**.

Expressway. A divided arterial **highway** for through traffic with full or partial control of access and generally with grade separations at intersections.

Extra Work. Work not provided for in the **contract** but considered essential by the **Engineer** for satisfactory completion of the contract within its intended scope.

Falsework. Scaffolding or other temporary structural support for concrete formwork.

Federal-Aid Project. A **project** that is constructed entirely or partially with federal funds.

Field Sampling and Testing Manual. A **Department** publication that can be found at https://www.dot.nd.gov/divisions/materials/testingmanual.htm

Float/Total Float. The number of days by which an activity may be delayed without delaying the **project** or a **milestone**.

Force Account. Payment for **contract** revisions per approved costs and additives in accordance with Section 109.03, "Compensation for Contract Revisions."

Haul Road. Highways, **streets**, or **roads** designated by the **Department** in accordance with Section 107.08, "Haul Roads," for use by the **Contractor** to haul **material** to or from the **project**.

Highway, Street, or Road. A general term indicating a public way used by vehicles and pedestrians. Includes entire area within the **right of way**.

Holidays. State of North Dakota **holidays** are as follows:

1. Every Sunday;
2. New Year's Day, January 1;
3. Martin Luther King, Jr. Day, the third Monday of January;
4. Presidents Day, the third Monday of February;
5. Good Friday, the Friday before Easter Sunday;
6. Memorial Day, the last Monday in May;
7. Independence Day, July 4;
8. Labor Day, the first Monday in September;
9. Veterans Day, November 11;
10. Thanksgiving Day, the fourth Thursday in November;
11. Christmas Day, December 25; and
12. Every day appointed as a public holiday by the President of the United States or the Governor of the **State**.

If January 1, July 4, November 11, or December 25 fall on a Sunday, the following Monday is a holiday.

If January 1, July 4, November 11, or December 25 fall on a Saturday, the previous Friday is a holiday.

Laboratory. See **Department**.

Major Contract Item. See **Contract Item**.

Materially Unbalanced Bid. See **Unbalanced Bid**.

Materials. Any substances, products, supplies, assemblies, or raw materials specified for use in the performance of the **work**.

Mathematically Unbalanced Bid. See **Unbalanced Bid**.

Median. The portion of a divided **highway** separating the **traveled ways**.

Milestone. A dated specified in the **contract**, such as the date that the **contract time** expires.

Minor Contract Item. See **Contract Item**.

Notice to Bidders. A notice issued by the **Department** of projects available for **proposals** in an upcoming **bid opening**.

Notice to Proceed. The **Department's** notice to the **Contractor** to begin the **work** in accordance with Section 108.04, "Notice to Proceed."

Original Contract Amount. The original amount of the **Contract** is the **total sum bid**. Does not include extra work, eliminated work, or differences in estimate versus actual quantities. This amount does not change during the life of the **Contract**.

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

Plan Quantity. The quantity of a **contract item** shown on the **bid item list** and the **plans**.

Plans. The **project plans** and **standard drawings** that show the location, character, and dimensions of the prescribed **work**, including layouts, profiles, cross sections, and other details.

> **Project Plans.** A set of plans addressing the **work** required for the **project**. At the time of **advertisement**, the **project plans** may include the following: a vicinity map, a summary of quantities, notes, signing information, traffic control plans, and detailed drawings.
>
> **Standard Drawings.** An approved set of drawings showing standard details of construction and **materials** for the **work** on a **project**.

Predecessor. An activity that is defined by schedule logic to precede another activity. A **predecessor** may control the start or finish date of its **successor**.

Project. The specific section of **highway** on which construction is to be performed under the **contract**.

Project Control Number (PCN). A number generated by the **Department** for **project** tracking. Found on the cover sheet of the **plans**.

Project Number. A number generated by the **Department** containing coded **project** data. Found on the cover sheet of the **plans**.

Project Site. All areas used by the **Contractor** in the performance of the **work**.

Project Plans. See **Plans**.

Proposal. (Commonly referred to as Bid) A **Bidder's** offer on **Department** forms, to perform the work at the prices quoted.

Proposal Forms. The **Department**-provided forms on which a **Bidder** must prepare and submit its **proposal** for the **work**. That portion of the **proposal package** labeled as "**Proposal Form**" containing certifications, affidavits, acknowledgements, and the **bid item list**. The proposal forms are prepared and submitted by the Bidder and is then considered a proposal.

Proposal Guaranty. The security furnished to guarantee the Bidder will enter into the contract if the **proposal** is accepted.

Proposal Package. All documents made available to prospective **Bidders** by the **Department** before the opening of **proposals**. These documents will become part of the **contract**.

PS-1. (Price Schedule for Miscellaneous Items) A schedule of predetermined unit prices in the contract that provides for payment of miscellaneous contract items.

Qualified Laboratory Program. See Section 106.10, "Qualified Laboratories And Testing Personnel".

Relationship. The interdependencies among activities. **Relationships** link an activity to its **predecessors** and **successors**. A schedule's relationships are sometimes referred to as the logic of the schedule. Examples of relationships are finish-to-start, start-to-start, and finish-to-finish. Relationships are implied in bar chart schedules and explicit in CPM schedules.

Request for Proposals. A publication addressing the **work** required for the **project**. The request for proposals may include the **supplemental specifications**, the **special provisions**, labor rates, the **proposal forms**, and the Required Contract Provisions Federal-aid Construction Contracts.

Responsive Proposal. A **proposal** that meets all requirements of the **proposal package**.

Responsible Bidder. A **Bidder** who has met all of the Department's prequalification requirement and actually submits a bid on a project.

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

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

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

Roadway. The portion of a **highway** including **shoulders** for vehicular use.

Shoulder. The portion of the **roadway** adjacent to the **traveled way** for accommodation of stopped vehicles for emergency use and for lateral support of **base course** and **surface course**.

Sieve. U.S.A. Standard Sieve, as defined in ASTM E 11. The specified percent passing for each sieve is measured by weight.

Special Provisions. See **Specifications**.

Specialty Item. See **Contract Item**.

Specifications. The compilation of written requirements for performance of the **work**, including the following:

> **Standard Specifications.** A book of **specifications** approved for general application and repetitive use.
>
> **Supplemental Specifications.** Approved revisions to the **standard specifications**.
>
> **Special Provisions.** Revisions or additions to the **standard specifications** and **supplemental specifications** that cover special conditions for the **project**.

Stabilization. The modification of soils or aggregates by incorporating **materials** that increases load-bearing capacity, firmness, or resistance to weathering or displacement.

Standard Drawings. See **Plans**.

Standard Specifications. See **Specifications**.

State. The State of North Dakota acting through its authorized representative.

State Aid Project. A **project** that is constructed entirely with State Funds or State and local subdivision funds.

Station. When used as a definition or term of measurement, a station is 100 linear feet.

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

Subcontractor. See **Contractor**.

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

Subgrade. The top surface of an embankment or cut section on a graded **roadway**. It is the foundation for the **subbase**, **base course**, and **surface course**.

Substantial Completion. A **project** is substantially complete when it is open for safe and convenient use by the traveling public, and all necessary safety features are in place; or, if not to be opened to traffic, when it is ready for the subsequent project.

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

Successor. An activity that is defined by schedule logic to succeed another activity. The start or finish date of a **successor** may be controlled by its **predecessor**.

Superintendent. See **Contractor**.

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

Supplemental Agreement. A written agreement for the performance of work that is beyond the scope of the original **contract** but which the **Department** elects to perform in conjunction with the existing contract. The Department and the Contractor must sign a **supplemental agreement** before it can become a contract revision.

Supplemental Specifications. See **Specifications**.

Surcharge. Additional fill **material** above the proposed grade line for the purpose of adding weight.

Surety. See **Contractor**.

Surface Course. One or more layers of a **pavement structure** designed to accommodate the traffic load; the top layer of which resists skidding and traffic abrasion. The top layer is sometimes called “Wearing Course.”

Technical Certification Program. See Section 106.10, “Qualified Laboratories And Testing Personnel”.

Traffic. Vehicles, pedestrians, and other modes of transportation.

Total Sum Bid. The total amount of a **proposal**; the sum of the price extensions for all **bid items**.

Total Contract Amount. Calculated from the **Original Contract Amount** plus or minus any extra work, eliminated work, and differences between estimated and actual quantities. This amount can change throughout the life of the **Contract**.

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

Unbalanced Bid. A **proposal** that does not reflect the true cost of providing the **material**, equipment, and labor required to complete the **bid item**.

Materially Unbalanced Bid. A **proposal** in which there is a reasonable doubt that **award** to the **Bidder** submitting the **mathematically unbalanced bid** will result in the lowest ultimate cost to the **Department**.

Mathematically Unbalanced Bid. A proposal containing **bid items** that do not reflect reasonable actual costs plus a reasonable proportionate share of the **Bidder's** anticipated profit, overhead costs, and other indirect costs, which the Bidder anticipates for the performance of the items in question.

Work. The providing of all labor, **materials**, equipment, and incidentals necessary to complete the **project** in accordance with the **contract**.

Work Drawings. Supplemental design sheets or similar data, such as drawings, diagrams, illustrations, samples, schedules, or calculations, that the contract requires the Contractor to submit to the Engineer in accordance with Section 105.08, "Work Drawings." Once the Department has reviewed a work drawing, it becomes part of the contract.

Work Order. A written directive from the Engineer to the Contractor to perform changed work, extra work, or other additional work.

SECTION 102
BIDDING REQUIREMENTS AND CONDITIONS

102.01 QUALIFICATION OF BIDDER
The Department will only consider a proposal from a prequalified Bidder. Obtain online prequalification from the Department. Instructions for the online submittal can be found on the Departments website. The Department must receive the *Contractor's Prequalification Statement* at least 10 business days before the bid opening.

The Department may check any statements submitted by a Bidder on the *Contractor's Prequalification Statement* and obtain additional pertinent information from other sources. The Department may disqualify a Bidder for any reason stated in Section 102.13, "Disqualification of Bidder".

102.02 CONTRACTOR'S LICENSE
The Department will not require a Bidder to have a contractor's license from the State to submit a proposal; however, the Department will only award a contract to a Bidder that has an appropriate contractor's license from the State.

102.03 ISSUANCE AND CONTENTS OF PROPOSAL PACKAGE
The Department will issue the proposal package in accordance with the advertisement and notice to bidders. The notice to bidders is available on the Department's website (www.dot.nd.gov).

The Department will issue all addenda no later than 4:00 p.m. central time 2 business days before the bid opening, except the Department may withdraw the project from the bid opening at any time. Before submitting a proposal, check the most current proposal package, including addenda.

The proposal package will contain the following:

1. The request for proposals, which contain the following:
    a. The proposal forms, which contain the following:
        (1) The location and description of the work;
        (2) A list of bid items and estimated quantities;
        (3) The contract time; and
        (4) The date, time, and location of the bid opening.
    b. The supplemental specifications,
    c. The special provisions, and
    d. Other requirements that vary from or are not contained in the standard specifications;
2. The plans;
    a. The project plans, and
    b. The standard drawings.
3. The standard specifications;
4. Any addenda; and
5. Other documents designated in the proposal package.

102.04 INTERPRETATION OF QUANTITIES IN BID ITEM LIST
The quantities in the bid item list are estimates only that the Department prepares for comparing proposals. The Department will measure and pay for accepted quantities of work in accordance with Section 109, "Measurement and Payment."

102.05 EXAMINATION OF PROPOSAL PACKAGE AND PROJECT

Examine the proposal package and the project, including locations identified in the proposal package, before submitting a proposal. The Department will consider a Bidder's submission of a proposal as conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered; the character, quality, and scope of work to be performed; the quantities of materials to be furnished; and the conditions and requirements of the proposal package. Make such independent investigation and examination as necessary to be satisfied as to conditions to be encountered in the performance of the work and with respect to possible local material sources, the quality and quantity of material available from such property, and the type and extent of processing that may be required to produce material conforming to the contract. Independent investigation and examination includes knowledge of the State's physical geography, geology, and hydrology, and of the available publications on that subject matter.

If conditions at the project site are inconsistent with the proposal package or there are discrepancies, conflicts, errors, omissions, or ambiguities within the proposal package, immediately submit a request for explanation to the Department's Construction Services Division. The Department must receive requests for explanation in adequate time to allow the Department to reply. The Department will issue interpretations by addendum and make them available on the Department's website and the Bid Express website at least 2 business days before the bid opening. Before the Department's approval and execution of the contract, any statements, explanations, or representations concerning the project made by any of the Department's employees or agents are not binding, unless specifically included in the proposal package.

102.06 SUPPLEMENTAL INFORMATION

A. General.

Any information that is not included in the proposal package is considered supplemental information and will not become part of the contract.

The Department provides supplemental information on an "as-is" basis. Supplemental information is data that is used or generated by the Department for use in project development and is not part of the proposal package and will not become part of the contract.

Items designated as supplemental information are preliminary only and may differ from final design details. The Department does not warrant supplemental information to be free of errors or deficiencies and does not warrant the information as being fit for any particular use.

Refer to the contract for final construction information for bidding and construction purposes.

Any available supplemental information will be located on the Department's website alongside the proposal package. If no supplemental information is available, a statement to that effect will be included in the area that would contain the supplemental information.

B. Soil Information and Boring Logs.

The Department does not warrant or guarantee the sufficiency or accuracy of the boring logs or the interpretations made or opinions of the Department as to the type of materials and conditions that may be encountered.

General soil and rock strata descriptions and indicated boundaries are based on a geotechnical interpretation of all available subsurface data and may not reflect the actual

subsurface conditions between individual borings or between sampled strata within the bore hole. The laboratory data and the in-place data can be relied on only to the degree of reliability inherent to the standard test method. The observed water levels or soil moisture conditions may vary considerably with time according to climatic conditions including temperature, precipitation, and wind, as well as other non-climatic factors.

Make independent subsurface investigations, as necessary, to become satisfied with the conditions to be encountered on the project.

C. Electronic Design Data.

Electronic design data is subject to change by the Department without notice.

The use of electronic design data in preparation of a proposal or in performance of the work does not allow relief from obligations under the contract or from complete and proper fulfillment of the contract requirements. The Department does not warrant or guarantee the accuracy of the electronic design data or the consequences related to the use, retention, distribution, alteration, or deletion of the electronic design data.

The use of electronic design data does not entitle the Contractor to compensation or an extension of time for damages or losses which could be attributed to the use of electronic design data.

Electronic design data will be accessible through the Department's ftp site. A notice will be placed with the remaining supplemental information with instructions detailing how to access the electronic design data.

102.07 PREPARATION OF PROPOSAL

A. General.

Prepare the proposal using the Bid Express website in accordance with Section 102.07 B, "Electronic Proposal," unless the notice to bidders states that the Department will accept a paper proposal in accordance with Section 102.07 C, "Paper Proposal."

Acknowledge the receipt of all addenda in accordance with the proposal forms.

Execute the proposal as follows:

1. For an individual, signed by that individual;
2. For a partnership, signed by a partner;
3. For a corporation, signed by an officer of the corporation with the officer's title;
4. For a joint venture, signed by a legally qualified representative of each of the parties to the joint venture; and
5. For an individual, a partnership, a corporation, or a joint venture, signed by anyone having a power of attorney. Provide a copy of the power of attorney with the proposal, or arrange with the Department to file the power of attorney with the Department before submitting the proposal.

B. Electronic Proposal.

1. Electronic Bidding Credentials.

A Digital ID is required to electronically sign proposals.

If a Bidder does not have a Digital ID, create a Digital ID and set up bidding privileges by following the instructions on the Bid Express website (www.bidx.com). Begin the Digital ID creation process a minimum of 7 business days before the bid opening.

2. Submitting an Electronic Proposal.

Prepare the proposal using Bid Express as follows:

1. Download the most current "Proposal Files" and "DBE Roster File" from the Bid Express website (www.bidx.com).
2. Use the Bid Component for AASHTOWare Project Bids to prepare and submit the proposal forms. Follow the Bid Component software instructions and review the help screens provided on the Bid Express website to ensure that the bid item list is prepared properly. Provide a unit price for each bid item.

If the proposal forms contain alternate or optional bid items, provide unit prices for those bid items as follows:

a. For alternate bid items, provide a unit price for each bid item included in the Bidder's preferred alternate.
b. For optional bid items, provide a unit price for all bid items under all options.

The user's Digital ID must be on file and enabled by Bid Express. The use of the Digital ID constitutes the Bidder's signature for execution of the proposal. The Department is not responsible for the Bidder's inability to submit a proposal using AASHTOWare.

C. Paper Proposal.

The Department will only consider a paper proposal if the proposal package states that the Department will accept a paper proposal.

Enter a unit price in numerals for each bid item on the bid item list, except as not required in the case of alternate bid items. Enter the product of each unit price and respective quantity. Enter the total sum bid at the bottom of the last page of the bid item list.

The paper bid item list may be a computer-printed bid item list from the current version of Expedite. Execute the proposal by signing and notarizing in ink and in the space provided on the proposal forms.

102.08 BID LIMITATION

If the Bidder desires to submit a proposal on more than one project as part of the same bid opening (date and time), and desires to avoid receiving an award of more projects than the Bidder is equipped to handle, the Bidder may submit proposals on multiple projects and limit the total amount of work awarded to the Bidder on selected projects by completing the "Bid Limitation" section in the proposal forms.

The bid limitation can be made by declaring the total amount of work or total number of projects.

If a Bidder makes a limiting statement on any proposal, the statement will apply to all proposals submitted by the Bidder as part of that bid opening. If the bid limitation statements on more than one proposal differ, the Department will use the lower bid limitation amount or number.

Do not attempt to reserve the right to choose the contract or contracts.

When considering all projects with bid limitations, the Department will select those proposals that provide the lowest overall cost to the Department.

102.09 PROPOSAL GUARANTY

A. General.
Provide a proposal guaranty in the form of an annual bid bond in accordance with Section 102.09 B, "Annual Bid Bond," a single project bid bond in accordance with Section 102.09 C, "Single Project Bid Bond," or a certified or cashier's check in accordance with Section 102.09 D, "Certified or Cashier's Check." Contact the Department's Construction Services Division to obtain bond forms.

B. Annual Bid Bond.
Before submitting a proposal, file an executed annual bid bond with the Department on the *Annual Bid Bond* (SFN 50231), in an amount equal to 10 percent of the total sum bid, and from a surety company authorized to do business in the State. Execute the annual bid bond as principal.

The annual bid bond applies to all proposals submitted by a Bidder in a calendar year.

C. Single Project Bid Bond.
Upon request, the Department may allow the Bidder to file a single project bid bond with the Department before the bid opening.

Before the date and time of the bid opening, submit an executed single project bid bond on the *Bid Bond – Single Project* (SFN 14196), in an amount equal to 10 percent of the total sum bid, and from a surety company authorized to do business in the State. Execute the single project bid bond as principal.

D. Certified or Cashier's Check.
Upon request, the Department may allow the Bidder to file a certified check or cashier's check before the bid opening.

Before the date and time of the bid opening, submit a certified check or cashier's check in an amount equal to 5 percent of the total sum bid and from a solvent bank.

102.10 SUBMISSION OF PROPOSAL

Submit the proposal so that the Department receives the proposal before the date and time of the bid opening. The Department will allow the following two methods of submitting a proposal:

A. Electronic Proposal.
Follow the instructions on the Bid Express website to submit an electronic proposal. If submitting an electronic proposal, do not sign, notarize, or submit a paper proposal.

The Department will not consider proposals submitted electronically as received until the date and time of the bid opening.

B. Paper Proposal.
The Department will only consider a paper proposal if the notice to bidders states that the Department will accept a paper proposal.

Seal the executed paper proposal in an envelope and label the envelope with the following:
1. The Bidder's name,
2. The Project Number, and
3. The date and time of the bid opening.

Submit the sealed envelope to the Department.

If the Department receives a proposal after the bid opening, the Department will return the unopened proposal to the Bidder.

102.11 BID OPENING

The Department will publicly open and announce proposals at the bid opening.

102.12 IRREGULAR PROPOSAL

The Department will consider a proposal irregular and reject it if:
1. The Bidder fails to prepare the proposal in accordance with Section 102.07, "Preparation of Proposal", or submit the proposal in accordance with Section 102.10, "Submission of Proposal".
2. The Bidder fails to provide an executed proposal guaranty in accordance with Section 102.09, "Proposal Guaranty".
3. The Bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award. This does not apply to bid limitations made in accordance with Section 102.08, "Bid Limitation".
4. The Bidder fails to complete the "Non-Collusion and Debarment Certification" section of the request for proposals.

The Department may consider a proposal irregular and reject it if:
1. The Bidder fails to comply with any requirements of the proposal package.
2. The Bidder makes unauthorized additions to the proposal forms, makes unauthorized conditional or alternate proposals, or there are irregularities of any kind that could make the meaning of the proposal incomplete, indefinite, or ambiguous.
3. The Bidder fails to acknowledge addenda as required in the proposal forms.
4. The Department cannot determine a unit price for every bid item, except in the case of authorized alternate bid items.
5. The Department determines that any unit price is materially unbalanced.
6. On a paper proposal, the Bidder fails to type or use ink to enter all information on the bid item list.
7. For a paper proposal, the check code printed on the bottom of the printout of the Expedite-generated bid item list is not the same on every page of the printout.
8. The Bidder fails to comply with the Disadvantage Business Enterprise (DBE) requirements.

102.13 DISQUALIFICATION OF BIDDER

The Department will disqualify a Bidder and reject their proposal(s) for the following reasons:
1. A Bidder fails to obtain prequalification in accordance with Section 102.01, "Qualifications of Bidder".
2. The Department finds evidence of collusion among Bidders. The Department will not recognize a participant in collusion as a Bidder for future projects until that Bidder obtains prequalification.

3. A Bidder submits more than one proposal for the same project as an individual, firm, or corporation under the same or different name.
4. Any other reason deemed proper by the Department.

The Department may disqualify a Bidder and reject their proposal(s) for the following reasons:

1. The Bidder has incomplete work that the Department determines might hinder or prevent prompt completion of proposed work.
2. The Bidder fails to promptly pay or satisfactorily settle all claims for labor and material on another Department contract, including those projects where the Bidder is a party to a joint venture that has failed to settle such claims.
3. The Bidder defaults on another Department contract.
4. The Bidders fails to repay the Department for overpayments on another Department contract.
5. The Bidder fails to perform satisfactory work on another Department contract as follows:
   a. Fails to comply with contract requirements or Engineer's directives.
   b. Fails to complete work on time.
   c. Performs substantial corrective work before acceptance.
   d. Performs work that requires pay reductions.
6. The Attorney General of the State or Department determines that the Bidder has questionable moral integrity.
7. The federal government has disbarred the Bidder from performing work on federal contracts.

SECTION 103
AWARD AND EXECUTION OF CONTRACT

103.01 CONSIDERATION OF PROPOSALS

A. General.
After the Department opens and announces the proposals, the Department will compare the proposals based on each total sum bid, and will publicly announce the results. The Department reserves the right to reject any or all proposals, waive technicalities, or to advertise for new proposals.

B. Requests to Withdraw Proposals.
To request a withdrawal of a proposal after the bid opening due to a bid error, notify the Department that an error occurred by submitting a written request to the Department with the following information:

1. All bid documentation related to the error(s); and

2. A notarized affidavit or declaration signed under penalty of perjury that describes the specific error(s) and certifies that any submitted bid documentation were the only ones used in the preparation of the proposal.

The Department will not consider requests received after 5:00 p.m. central time on the second business day after the bid opening. The Department will review the request to determine the validity of the claimed error, and will evaluate applicable laws to determine if relief from forfeiture is warranted. If the Department determines that an error did occur and the law allows relief, the Department will relieve the Bidder of the responsibilities of award and release the Bidder of the obligations under the proposal guarantee. If the Department determines that an error did not occur or that the law does not allow relief, the Department may award the contract and if the Bidder refuses to execute the contract, the Bidder shall forfeit its proposal guaranty in accordance with Section 103.07, “Failure to Execute Contract.”

103.02 AWARD OF CONTRACT

If the Department awards a contract, the Department will select the responsible Bidder with the lowest total sum bid and a proposal that complies with the proposal package. The Department will make an award no more than 30 calendar days after the bid opening, unless both parties agree in writing to an extension, and will notify the successful Bidder by providing a contract, contract bond form, and other required documents to be returned in accordance with Section 103.06, “Execution and Approval of Contract”.

Submit an initial schedule of proposed progress on *Proposed Progress Chart* (SFN 7721) within 10 business days after the bid opening. The *Proposed Progress Chart* shall meet all time and scheduling requirements in the proposal package.

The Department will not execute the contract with a Bidder that does not have a contractor's license in accordance with Section 102.02, "Contractor's License."

For foreign (out-of-State) corporations, obtain a certificate of authority to do business in the State from the Secretary of State’s Office. The Department will not execute the contract with a foreign corporation that does not have this certificate of authority.

If the successful Bidder fails to submit the *Proposed Progress Chart* or fails to obtain a contractor's license or a certificate of authority to do business in the State, the Department will cancel the award, and the Bidder will forfeit the proposal guaranty.

103.03 CANCELLATION OF AWARD

The Department reserves the right to cancel the award of any contract before execution without liability.

103.04 RELEASE OF PROPOSAL GUARANTY

After the Department compares the proposals, the Department will release the Bidders of all obligations under the proposal guaranties, except for the responsible Bidders with the three lowest total sums bid. The Department will release the Bidders with the three lowest total sums bid of all obligations under the proposal guaranties as follows:

A. After the Department executes a contract, or

B. If the Department approves a request to withdraw a proposal in accordance with Section 103.01, "Consideration of Proposals."

If the Department allows a certified check or cashier's check in accordance with Section 102.09, "Proposal Guaranty," the Department will return those proposal guaranties in accordance with State law.

103.05 CONTRACT BOND

A. General.
Obtain from a responsible surety a contract bond in an amount equal to the original amount of the contract. On the form provided by the Department, submit to the Department proof of contract bond in accordance with Section 103.06, "Execution and Approval of Contract." If the contract bond is voided or becomes no longer in force before final acceptance, immediately notify the Department, obtain another contract bond in an amount equal to the original, and submit to the Department proof of the contract bond on the form provided by the Department.

B. Payment.
After both parties execute the contract, the Department will pay for the contract bond as follows:

1. Submit to the Engineer a written request for payment for the "Contract Bond" contract item. Include, with the request, a receipted invoice from the surety showing the amount paid for the contract bond and the date of payment.

2. The Department will pay the Contractor the contract unit price for the "Contract Bond" contract item or the paid invoiced amount, whichever is less. If the contract unit price is greater than the paid invoiced amount, the Department will pay the difference in the final progressive estimate.

103.06 EXECUTION AND APPROVAL OF CONTRACT

Return to the Department the signed contract, proof of contract bond, and other required documents within 15 calendar days after the notice of award. The Department will review the

signed contract, proof of the contract bond, and other required documents. If the Department approves, the Director will sign the contract making it fully executed and binding on the two parties.

If another party is providing funding for the project, the Department may not approve the contract until the Department receives concurrence from the participating party.

103.07 FAILURE TO EXECUTE CONTRACT

If the successful Bidder fails to return a signed contract, proof of the contract bond, and other required documents in accordance with Section 103.06, "Execution and Approval of Contract," the Department may cancel the award and the successful Bidder forfeits its proposal guaranty to the Department. The Department may then award the contract to the responsible Bidder with the next lowest total sum bid or re-advertise the project.

103.08 ESCROW OF BID DOCUMENTATION

A. General.

If the bid item list contains an "Escrow of Bid Documentation" contract item, the low Bidder shall provide a legible copy of its bid documentation for storage at a depository chosen by the Bidder and approved by the Department. The successful Bidder may choose one of the following depositories: a banking institution, other bonded document storage facility, or in a secure location at the Department's headquarters.

For subcontracts at any tier equal to or greater than $750,000, obtain from the subcontractor all bid documentation used to prepare the subcontractor's bid for the portion of the work reflected in the subcontract. The subcontractor's bid documentation requirements shall be the same as for the Contractor, except it shall be submitted within 5 days of approval of the Prime Contractor's Request to Sublet. Submit to the Department the bid documentation and affidavit in a separate sealed container, including the subcontractor's name and address on the container.

B. Affidavit.

Provide an affidavit with the bid documentation. The affidavit shall be signed by the Bidder or by an individual authorized to sign for the Bidder in accordance with Section 102.07.A, "Preparation of Proposal, General," and listing each enclosed document, including the author, date, nature, and subject matter of each document. The affidavit shall attest that the signer has personally examined all bid documentation, that the affidavit lists all bid documentation, and that all bid documentation is included in the submission to the Department.

C. Submittal and Return of Bid Documentation.

Submit the affidavit and bid documentation to the Department within 5 business days after the bid opening. Place the affidavit and bid documentation in a sealed container and clearly mark the container with the following:

1. The label, "Bid Documentation,"
2. The Bidder's name and address,
3. The date of submittal, and
4. The NDDOT project number and PCN.

If the responsive Bidder with the lowest total sum bid has already submitted the bid documentation and the Department rejects that Bidder's proposal or cancels the award, the

Department will return the bid documentation. If the Department awards to the next lowest responsive Bidder, the Department will notify that Bidder to submit its affidavit and bid documentation. The next lowest responsive Bidder shall submit the affidavit and bid documentation within 5 business days after the date of notification by the Department. If the Department rejects this proposal and subsequent ones or cancels this award or subsequent ones, the above procedures will continue until the Department awards, approves, and executes a contract.

D. Duration and Use.

After the Department approves and executes the contract, the Department and the Contractor will jointly deliver the sealed container and affidavit to the depository for placement in a safety deposit box or other secure accommodation. The depository must be located in Bismarck, North Dakota, unless otherwise approved by the Department. Provide escrow instructions to the depository consistent with this section.

The agreement with the depository will reflect that the bid documentation and affidavit will remain in escrow during the life of the contract, until the Contractor notifies the Department of intent to file a claim in accordance with Section 104.04 "Notice of Intention to File a Claim (NOI)" or the Contractor initiates litigation or arbitration against the Department related to the contract. Notification of the Contractor's intention to file a claim, or initiation of litigation or arbitration against the Department, will be sufficient grounds for the Department to obtain the release and custody of the bid documentation. The Department may open sealed escrowed bid documentation submitted by a subcontractor if it is related to the issues detailed on the NOI, or if the investigation into the issue indicates that relevant information may be found in subcontractor escrow documents. If the Contractor has not submitted notification of intent to file a claim or initiated litigation or arbitration, and the required statutory time to file a claim has elapsed since the submission of the final estimate, the Department will instruct the depository to release the sealed container to the Contractor.

In accordance with the affidavit attesting that the sealed container placed in escrow contains all of the materials relied upon to prepare the proposal, the Contractor waives its right to use any bid documentation other than that placed in escrow in any claim or litigation arising out of this contract.

E. Refusal or Failure to Provide Bid Documentation.

If the successful Bidder fails to provide the bid documentation in accordance with Section 103.08.C, "Submittal and Return of Bid Documentation," the Department will reject the proposal or cancel the award, and the Bidder will forfeit the proposal guaranty.

If the Contractor fails to submit a subcontractor's bid documentation, the Department may withhold progressive estimates.

F. Confidentiality of Bid Documentation.

The bid documentation and affidavit in escrow are and will remain the property of the Contractor. The Department has no interest in or right to the bid documentation, unless the Department receives a notification of the intention to file claim from the Contractor or litigation ensues between the Department and Contractor. In the event of a claim or litigation, the bid documentation and affidavit will become the property of the Department. The Department will return to the Contractor the bid documentation and any copies made by the Department at the conclusion of litigation or once the Contractor signs the final payment statement.

G. Payment.

The Contractor shall be responsible for the payment of the depository rent. After the Department has deposited the bid documentation and the two parties have executed the contract, the Department will pay the Contractor the contract unit price for the “Escrow of Bid Documentation” contract item.

The contract unit price for the “Escrow of Bid Documentation” contract item includes the costs of all data compilation, container, depository rent, and any other costs associated with the escrow, including escrow of subcontractor bid documentation. The Department will not charge a depository rent for the use of its facility.

SECTION 104
SCOPE OF WORK

104.01 INTENT OF CONTRACT

The intent of the contract is to state the roles, responsibilities, and obligations of the Department and Contractor regarding the construction, execution, and completion of the work. Provide all resources required to complete the work and execute the work in accordance with the contract.

104.02 CONTRACT REVISIONS

A. General.

The Department may revise the contract as necessary to satisfactorily complete the project at any time between the date of contract execution and the date the Department issues the final payment statement to the Contractor. Contract revisions neither invalidate the contract nor release the surety. Perform the work as revised. Proceed with the revised work only when directed by the Engineer; continue with all work unaffected by the revision.

If circumstances arise that may necessitate a contract revision, immediately notify the Engineer in accordance with Section 104.03, "Contractor Requested Contract Revisions". Failure to provide notice as specified in Section 104.03 constitutes a waiver of entitlement to compensation or a time extension and releases the Department from responsibility for providing compensation or a time extension for any related claims filed under Section 104.04, "Notice of Intention to File a Claim (NOI)", and Section 104.05, "Claims for Adjustment".

If the Department revises the contract the Department will determine compensation in accordance with Section 109.03, "Compensation for Contract Revisions," and a time extension in accordance with Section 108.06, "Determination of and Extensions to the Contract Time." The Engineer will issue a change order to document the nature of the contract revision, including any determined compensation, any time extension, or both.

Sections 104.02 B, C, and D contain wording mandated by FHWA. As the terms "modification," "change," "adjustment," or "alteration" are used in them they shall mean a contract revision.

B. Differing Site Conditions.

During the progress of the work, if subsurface or latent physical conditions differing materially from those indicated in the contract are encountered at the site or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract, are encountered at the site, notify the Engineer of the specific differing conditions in accordance with Section 104.03, "Contractor Requested Contract Revisions", before disturbing the site or performing the affected work.

Upon written notification, the Engineer will investigate the conditions, and if the Engineer determines that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the contract, an adjustment, excluding anticipated profits, will be made and the contract modified in writing accordingly. The Engineer will notify the Contractor of the determination whether or not an adjustment of the contract is warranted.

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

No contract adjustment will be allowed on work not affected by the changed conditions.

C. Significant Changes in the Character of Work.

The Engineer reserves the right to make, in writing, at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the contract nor release the surety, and the Contractor agrees to perform the work as altered.

If the alterations or changes in quantities significantly change the character of the work under the contract, whether such alterations or changes are in themselves significant changes to the character of the work or by affecting other work cause such other work to become significantly different in character, an adjustment, excluding anticipated profit, will be made to the contract. The basis for the adjustment should be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Engineer may determine to be fair and equitable.

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

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

1. When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction; or

2. When a major item of work, as defined in Section 101.04 “Definitions”, is increased in excess of 125 percent or decreased below 75 percent of the original contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

When an adjustment to the unit price is made due to a decrease in the original contract quantity to below 75 percent of the original quantity, the total payment made will not exceed the amount which would have been paid for 75 percent of the orginal quantity.

If the Contractor intends to request a contract revision for a significant change in the work, the Contractor shall notify the Engineer in accordance with Section 104.03, “Contractor Requested Contract Revisions”.

D. Suspension of Work Ordered by the Engineer.

If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the Contractor shall notify the Engineer in accordance with Section 104.03, “Contractor Requested Contract Revisions”, immediately after receipt of the notice to resume work.

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

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

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

E. Extra Work.

If the Contractor believes that the Department has required the Contractor to perform extra work that necessitates a contract revision the Contractor shall provide notice in accordance with Section 104.03, "Contractor Requested Contract Revisions".

F. Eliminated Items.

The Department may eliminate a contract item partially or completely. If the Contractor believes that such elimination will necessitate a contract revision, the Contractor shall provide notice in accordance with Section 104.03, "Contractor Requested Contract Revisions". The Department will reimburse the Contractor for costs incurred by the Contractor for eliminated items before notification of elimination in accordance with Section 109.03, "Compensation for Contract Revisions".

104.03 CONTRACTOR REQUESTED CONTRACT REVISIONS

A. Contractor Request, Work In Progress.

1. Contractor Request.

If the basis for a contract revision does not become apparent until the Contractor has commenced work affected by the circumstance and it is not feasible to stop the work, the Contractor shall immediately notify the Engineer that the work is continuing and that written notification of the intent to make claim for additional compensation as specified in Section 104.04, "Notice Of Intention to File a Claim (NOI)" will be submitted within ten calendar days.

If the request includes an extension to the contract time, submit a Contractor Request for Extension of Contract Time (SFN 14461) and follow the requirements of Section 108.06 B, "Extensions to the Contract Time."

2. Record Keeping.

For work that is continuing, provide the Engineer with updates of costs or delays related to the claim issues in accordance with Section 109.03 E, "Force Account", and Section 109.03 F, "Delay Costs".

If the request includes an extension to the contract time, submit a Contractor Request for Extension of Contract Time (SFN 14461) and follow the requirements of Section 108.06 B, "Extensions to the Contract Time."

The Engineer and Contractor shall maintain records in accordance with Section 109.03 E, "Force Account", and Section 109.03 F, "Delay Costs" of all costs and delays that may constitute a contract revision. Such record keeping shall start when the Engineer receives the Contractor's notice or when the Engineer orders the Contractor to begin work.

B. Contractor Request, Work Not Started.

If the Contractor believes the Contractor is entitled to additional compensation, the Contractor shall, prior to beginning the work which the claim will be based upon, notify the Engineer in writing of the intent to make claim for additional compensation as specified in Section 104.04, "Notice Of Intention to File a Claim (NOI)". Do not begin the work associated with the notice until ordered by the Engineer.

For work that is beginning under direction of the Engineer, provide the Engineer with updates of costs and delays related to the claim issues in accordance with Section 109.03 E, "Force Account", and Section 109.03 F, "Delay Costs".

104.04 NOTICE OF INTENTION TO FILE A CLAIM (NOI)

A. Submission of an NOI.

Follow the procedures specified in Section 104.03 A.1, "Contractor Request" or 104.03 B, "Contractor Request, Work Not Started", before submitting an NOI.

Within 10 calendar days of providing the notice required in Section 104.03 A.1, "Contractor Request" or immediately, as required in Section 104.03 B, "Contractor Request, Work Not Started", notify the Engineer of the intention to file a claim by submitting a signed *Notice of Intention to File a Claim* (SFN 16743). Define the basis for the compensation and time extension requested for each claim issue. Failure to notify the Engineer properly of the intention to file a claim constitutes a waiver of a claim for compensation or a time extension and releases the Department from responsibility for providing compensation or a time extension for any related claims filed under Section 104.04, "Notice of Intention to File a Claim (NOI)", and Section 104.05, "Claims for Adjustment".

If work related to the claim has begun and it is not feasible to stop the work, immediately provide notification to the Engineer that the work is continuing. For work that is continuing or for work that is beginning under direction of the Engineer, provide the Engineer with updates of costs and delays related to the claim issues in accordance with Section 109.03 E, "Force Account", and Section 109.03 F, "Delay Costs". Failure to provide the Engineer with access to the work and facilities for and assistance in record keeping constitutes a waiver of claim for compensation or a time extension and releases the Department from responsibility for providing compensation or a time extension for any related claims filed under Section 104.04, "Notice of Intention to File a Claim (NOI)", and Section 104.05, "Claims for Adjustment".

Notification of a claim, or the fact that the Engineer has kept records, does not prove or substantiate the claim's validity.

B. Dispute Resolution.

The Department will not participate in dispute resolution if the Contractor has not followed the notification process as specified in Section 104.04 A, "Submission of an NOI".

Within 30 calendar days of the completion of the work included in the NOI, submit the total amount of additional compensation requested and a detailed explanation of the requested compensation. For an NOI involving time, submit specific days requested and the basis of such claim as determined by an analysis of the construction schedules. Submit any supporting documentation that may be useful to the Department in determining the merit of the issue detailed in the NOI.

The Contractor may request a meeting, in writing, with the Project Engineer, District Engineer, and the Deputy Director for Engineering or the Director for Operations to review the documentation and attempt to resolve the dispute. The Department will arrange the meeting to convene no more than 30 calendar days after the Department has received the meeting request.

The Department will issue a written response to the Contractor no more than 30 calendar days after receiving the documentation or holding the meeting.

Time limits may be extended by mutual agreement.

If the Contractor disagrees with the Department's response, the Contractor may pursue a claim in accordance with Section 104.05, "Claims for Adjustment".

104.05 CLAIMS FOR ADJUSTMENT

A. Submission of the Claim.

Exhaust the process required by Section 104.04, "Notice of Intention to File a Claim (NOI)", before pursuing a claim.

The Department will only consider written claim submittals received within 90 calendar days from the time the Department submitted the final estimate to the Contractor, as outlined in Title 24 of the NDCC.

The Contractor, by signing the final payment statement, accepts the amount stated as full and final payment on the contract and waives all rights to any further payments for the contract.

Provide a claim submittal to the Engineer that contains, at a minimum, the following information for each claim issue included on the *Notice of Intention to File a Claim* (SFN 16743). Failure to supply the following information for each claim issue constitutes a waiver of claim for addional compensation for each submitted claim item.

1. A detailed narrative describing the issue, including:

    a. The dates, locations, and work affected by each claim issue.

    b. The date or dates when the conditions became evident, or the date or dates events occurred, that resulted in each claim issue.

c. The dates of all notices submitted by the Contractor to the Engineer and the dates of all responses issued by the Engineer for each claim issue.

d. The name and work assignment of each Department representative knowledgeable of the facts related to each claim issue.

e. The name and work assignment of each Contractor employee knowledgeable of the facts related to each claim issue.

f. References to the relevant provisions of the contract that support each claim issue and a statement of how the provisions support each claim issue.

g. Schedules and updates prepared in accordance with Section 108.03, "Progress Schedule," and Section 108.06, "Determination of and Extensions to the Contract Time", describe delays or time extensions related to each claim issue.

h. The identification of relevant project documentation and communications related to each claim issue.

i. A statement indicating whether each claim issue is based on provisions of the contract or on an alleged breach of contract.

j. For time extension claims, the number of days requested and the basis of each claim as determined by an analysis of the construction schedules.

2. Copies of all project documentation that support the narrative.

3. Bid documentation used to prepare the bid, if the contract did not require escrow of bid documentation in accordance with Section 103.08, "Escrow of Bid Documentation".

4. The amount of compensation requested and detailed explanations and calculations of the requested compensation in accordance with Section 109.03, "Compensation for Contract Revisions". The Department will not allow "total cost" claims.

5. Copies of information previously provided under Section 104.04 B, "Dispute Resolution".

The Contractor shall provide the Engineer, or an authorized representative, with access to examine and copy all Contractor records pertinent to the justification of the claim and to the substantiation of all costs related to the claim.

After the Contractor submits the claim submittal, the Department may consider additional information or documentation from the Contractor related to the claim issues. The Department will make a determination as to the inclusion of the additional information as part of the claim.

B. Certification of the Claim.

Include a signed and notarized certificate of claim, in the form set forth below, with the claim submittal. Failure to provide this certification constitutes a waiver of the Contractor's right for claim for compensation and a time extension.

CERTIFICATE OF CLAIM

The undersigned is duly authorized to certify the enclosed documentation on behalf of (*Contractor*).

(The *Contractor*) certifies the following:

1. That (*the Contractor*) has submitted the documentation in good faith;

2. That the information provided is accurate and complete to the best of the (*Contractor's*) knowledge and belief;

3. That (*the Contractor*) has provided the Engineer access to examine and copy all Contractor records, documents, work sheets, payrolls, invoices, depreciation schedules, and other data which are pertinent to the justification of the claim and to the substantiation of all costs related to the claim;

4. That the compensation and time extension requested accurately reflects the contract revision for which (*the Contractor*) believes the department is responsible; and

5. That (*the Contractor*) calculated the costs related to the claim in accordance with Section 109.03, "Compensation for Contract Revisions," and the delays in accordance with Section 108.06, "Determination of and Extensions to the Contract Time."

, NAME
, TITLE
, COMPANY
, DATE
, SIGNATURE
Subscribed and sworn before me this ____ day of, 20__

NOTARY PUBLIC _____
My Commission Expires:

C. Department's Response to Claim.

After receipt of a properly submitted claim, the Department will give written notification to the Contractor indicating approval, partial approval, or disapproval of the claim for compensation or time extension requested in accordance with NDCC Chapter 24-02.

D. Conditions Precedent to Contractor's Demand for Arbitration.

No right shall exist to demand arbitration against the Department until the Contractor complies with the requirements specified in Section 104.02, "Contract Revisions", Section 104.03, "Contractor Requested Contract Revisions", Section 104.04, "Notice of Intention to File a Claim (NOI)", Section 104.05, "Claims for Adjustment", and NDCC Chapter 24-02.

All arbitration hearings shall be conducted in Bismarck, North Dakota, unless relocated by mutual agreement.

E. Conditions Precedent to Subcontractor Claims.

No subcontractor may maintain a claim action against the Department for payment relating to the work without presenting the claim to the Contractor and obtaining the Contractor's written certification of the following:

1. The Contractor has reviewed the subcontractor's claim and has determined it is fully documented and supported in accordance with the contract;

2. The Contractor will pay the subcontractor in the event of a favorable resolution of the subcontractor's claim; and

3. The subcontract and any releases or waivers executed by the subcontractor do not bar payment to the subcontractor.

In addition to the claim submittal requirements in Section 104.05 A, "Submission of the Claim", the subcontractor's claim submission must include a copy of the subcontract and any releases or waivers signed by the subcontractor in favor of the Contractor. The Contractor may not assign or otherwise dispose of the Contractor's interest in the subcontractor's claim without prior written consent of the Engineer.

104.06 DEPARTMENT INITIATED CLAIMS

If the Department assesses a claim against the Contractor, the Engineer will immediately provide written notification to the Contractor. The Department may pursue a claim against the Contractor for the following reasons:

A. Unpaid royalty for material removed from Department controlled sources;

B. Materials, supplies, and services obtained from the Department;

C. Products and materials not meeting the contract requirements, including latent defects in the work discovered after final acceptance;

D. Judgments against the Contractor; and

E. Any reason deemed necessary by the Department.

If the Contractor does not pay the Department the amount of the claim within 30 calendar days after receipt of the written notification, the Department will withhold the amount of the claim from any payments due the Contractor under the Contract, except that the Department will immediately withhold the amount of a judgment against the Contractor by a court.

The Department may withhold payment on any Department project for claims related to another Department project.

104.07 VALUE ENGINEERING CHANGE PROPOSALS

A. General.

The Department will consider written value engineering change proposals (VECPs) that would benefit the Department and require a revision to the contract. The Department encourages VECPs for any aspect of a project but reserves the right to reject any submission with or without review. The Department will notify the Contractor in writing of its decision to accept or reject a VECP in whole or in part. This decision is final and not subject to appeal.

Do not base bid prices on the anticipated approval of a VECP. If the Department rejects a VECP, perform the work at the contract unit prices and as required by the contract.

The Department will notify the Contractor promptly in writing if the response date indicated on a VECP allows insufficient time for review. The Department bears no liability for costs or delays based on the Department's failure to respond by the date indicated on the VECP.

The Department bears no liability for costs or delays resulting from the rejection of a VECP including; development costs, loss of anticipated profits, increased material costs, labor costs, or any other cost.

The Department retains the right to use, duplicate, or disclose, in whole or in part, any information needed to implement a VECP. The Department also retains the right to use, in whole or in part, any accepted VECP on other Department projects without obligation to the Contractor.

The Contractor may restrict the Department's right to use or disclose information submitted with a VECP if the Department rejects the VECP. Propose such restrictions in writing with the VECP.

B. Preliminary VECP Meeting.

Meet with the Engineer before formally submitting a VECP to discuss the proposed revision to the contract and its potential benefits.

C. Conditions.

The Department will only consider a VECP when the following conditions are met:

1. The two parties have executed the contract in accordance with Section 103, "Award and Execution of Contract".

2. The likely benefit is sufficient to warrant review and processing.

3. The Contractor submits the VECP. The Department invites and encourages VECPs provided by subcontractors but will only consider those submitted through the Contractor.

4. The Contractor clearly labels the VECP as a "Value Engineering Change Proposal" or "VECP."

The Department will reject a VECP that has any of the following characteristics:

1. Requires excessive time or cost for review.

2. Results in an increase to the total contract amount.

3. Contains revisions to the contract that the Department has previously considered and rejected.

4. Proposes a lesser-quality material.

5. Contains revisions to the contract that the Department has previously accepted on another Department project, or is based on or similar to standard specifications, special provisions, or another set of plans.

6. Impairs essential functions or characteristics of a project, including service life, economy of operation, maintenance, appearance, safety, or other means of measuring the Department's cost or risk related to the performance of the project.

7. Proposes cost reductions resulting from corrections to contract errors identified by the Contractor.

8. Proposes the substitution of one contract item for another contract item.

9. Contains proposed revisions that are inconsistent with the Department's design policies and criteria for the contract.

10. Proposes the use of an aggregate source other than those identified in the Contract, or proposes the reduction of bitumen content by switching aggregate sources. The Contractor may use aggregate sources other than those identified in the contract, but the Department will not consider this type of proposal to be a VECP.

11. Any VECP containing experimental features.

12. The Department will not consider a VECP if the contract contains equivalent options.

D. Submitting a VECP.

To submit a VECP, provide two copies of the following to the Engineer:

1. A cover letter indicating the submission is a VECP.

2. A description of the difference between the existing contract and the proposed change and the comparative advantages and disadvantages of each. Where applicable, include effects on service life, economy of operations, maintenance, appearance, and safety.

3. Separate cost estimates for the affected parts of the contract, including the performance bond, with and without the proposed changes. Break the estimates down by pay item numbers, and indicate quantity increases or decreases and deleted pay items. Use current Department pay item names and numbers to identify proposed work not covered by the existing contract. In preparing the estimates, include overhead and profit within each affected pay item.

4. Preliminary drawings and specifications describing the proposed changes. Include an itemization of details, sheets, design standards, and specifications requiring changes or additions if the Department adopted the VECP.

5. Analysis in sufficient detail to identify and describe features of the contract requiring change if the Department adopted the VECP. Support design changes to engineered-elements by computations sealed by a professional engineer in the appropriate discipline. Provide a discussion of how these changes can be accomplished, and assess their effect on other contract elements.

6. The date by which the Department must execute a change order adopting the VECP to obtain the maximum benefit.

7. A statement detailing the VECP's effect on the scheduled completion date.

8. A description of previous use or testing of the same or a similar VECP and the circumstances and results. If submitted on another Department project, indicate the date, project number, and the action taken by the Department.

9. Provide any additional information requested by the Department within 10 business days of the date of request. The Department will consider the Contractor's failure to do so as cause for rejection.

E. Payment.

The Department will use a change order to incorporate changes resulting from an accepted and adopted VECP and to authorize payment. The Department will determine and make payment as follows:

1. As appropriate, the Department will change contract item quantities, add new contract items, eliminate contract items, or change the unit prices for contract items, as agreed.

2. The Department will pay the Contractor 50 percent of the net savings realized, calculated as the difference between the total contract amount with and without the VECP.

SECTION 105
CONTROL OF WORK

105.01 GENERAL
The Contractor is responsible for the successful performance of the work as required by the contract, whether the Contractor's personnel are performing the work or not.

The Engineer's decisions will be final on all questions regarding the quality and acceptability of materials furnished, work performed, rate of work progress, interpretation of the contract, and the acceptable fulfillment of the contract.

105.02 CONTRACTOR REQUIREMENTS
Keep one complete copy of the contract at the project during the performance of the work.

Give the work the constant attention necessary to facilitate progress. Cooperate fully with the Engineer.

Submit all project submittals and correspondence to the Engineer. If the contract allows the Contractor to correspond directly with other Department representatives, the Contractor shall submit a copy of all such submittals and correspondence to the Engineer at the same time the correspondence is submitted to the other Department representative.

Before starting the work, designate a qualified superintendent and notify the Engineer of the superintendent's contact information in writing. If replacing the superintendent, immediately notify the Engineer in writing. To be considered qualified the superintendent must be:

A. A responsible employee of the Contractor;

B. Capable of reading and understanding the contract;

C. Present at the project site while work is underway, including work by subcontractors, unless otherwise approved by the Engineer;

D. Authorized to:

    1. Represent and act for the Contractor;

    2. Attend project meetings, when required by the contract;

    3. Execute orders and directions of the Engineer; and

    4. Ensure subcontractors are performing work in accordance with the contract requirements.

105.03 COOPERATION WITH UTILITY OWNERS

A. General.
The vertical and horizontal utility locations shown in the plans are approximate. Plan locations should not be interpreted as exact for bidding or construction purposes.

Utility facilities shown on the plans, if any, are for reference purposes only and may not constitute an exhaustive representation of all utility facilities within the project. Notify the North Dakota One Call System (811) before starting the work, so they may locate and mark all utility facilities within the project. Receive utility locates for Department-owned, publicly-owned, and privately-owned utility facilities, whether on or off the One Call System.

Comply with Chapter 49-23 of the NDCC in determining the location of underground utilities.

B. Utilities Identified in Plans.

Notify all utility owners of the anticipated project schedule within two weeks of receiving notice to proceed. Coordinate adjustments and relocations with affected utility owners. The Contractor, the Engineer, and the utility owners shall agree to a schedule of the work and the adjustments and relocations before beginning the work.

Cooperate with utility owners in relocating and adjusting utility facilities to minimize interruption to service and duplication of work by utility owners.

The Department will provide utility conflict plans, if available. Utility conflict plans are not part of the contract and are for information purposes only.

C. Utilities Encountered During Work.

1. General.

Neither of the cases discussed in this subsection relieve the Contractor of liability that may arise under provisions of the NDCC.

2. Unidentified Encountered Utilities.

The Department will bear costs associated with revisions to the work as specified in Section 104.02 B, “Differing Site Conditions” only if the Engineer determines that both of the following conditions exist:

- the utility’s effect on the work was not identified in the contract; and
- the utility is in a location that affects the prosecution of the work to construct the project as designed.

3. Utility Conflicts Created Due to Actions Performed by the Contractor.

If utility coordination is required due to actions performed by the Contractor for the Contractor’s convenience; the Contractor must account for and protect the affected facilities. Before performing these actions, the Contractor must coordinate with the utility owner. The Department will not make additional payments to the Contractor nor the utility owner for utility relocation work created in this manner and will not provide additional time to the Contractor for completing the work.

If utility companies incur costs, the Department will not participate in those costs and will not make payment to the Contractor for those costs.

D. Scheduling.

1. General.

In order to minimize interference with traffic operations, the Contractor, Engineer, and utility owner shall agree to a detailed schedule before starting work.

2. **Utility Coordination Meeting.**
   If the contract requires a utility coordination meeting, arrange the meeting with the utility owners and the Engineer to occur no later than two weeks after the notice to proceed. At the meeting, provide an agenda and a tentative construction schedule for planning utility relocations and adjustments; after the meeting, publish minutes and distribute a copy to all meeting attendees.

E. Fire Hydrants.
Before starting work that affects a fire hydrant, coordinate with the local fire authority to determine if provisions need to be in place before starting the work. If provisions are necessary, obtain the approval of the local fire authority before beginning the work affecting the fire hydrant.

F. Damage and Interruptions.
If the Contractor causes damage to utility facilities, the Contractor is responsible for the costs of restoring or repairing the damaged utility facility to a condition equal to or better than the condition existing before the damage occurred. Immediately notify the utility owner of the damage or, if the owner is unknown, the One Call System. Do not conceal, attempt to conceal, or make repairs to the utility facilities until approved by the utility owner. If this damage causes interruption to utility service, continuously coordinate with the utility owner until the service is fully restored.

The Department will not pay the Contractor for the costs to restore or repair damaged utility facilities and will consider any delays resulting from this damage to be non-excusable in accordance with Section 108.06, "Determination of and Extensions to the Contract Time."

105.04 COOPERATION BETWEEN CONTRACTORS

The Department reserves the right to contract for and perform other work on or near the site of work. Coordinate the work and cooperate with the contractor for the other work.

The Contractor is responsible for all liability, financial or otherwise, in connection with the contract, and shall save the Department harmless from damages or claims resulting from inconvenience, delay, or loss due to the Contractor's failure to coordinate the work or cooperate with the contractor for the other work.

If a conflict occurs between the Contractor and the contractor for the other work, the Engineer will provide direction.

105.05 COORDINATION OF THE CONTRACT DOCUMENTS

Each contract document is an essential part of the contract; a requirement occurring in one is as binding as though occurring in all. The Department intends the contract documents to be complementary and to describe and provide for a complete work. In case of discrepancy between the contract documents, use the following order of precedence (each contract document is in descending order of precedence, for example, addenda take precedence over all the other contract documents):

A. Addenda,

B. Special provisions (for the purpose of this list, any other provisions in the request for proposals that are not part of the other contract documents in this list are considered special provisions),

C. Project plans,

D. Supplemental specifications,

E. Standard drawings,

F. Standard specifications.

For dimensions shown on the standard drawings and project plans, calculated dimensions take precedence over scaled dimensions.

If a discrepancy, conflict, error, omission, or ambiguity exists in the contract documents, immediately notify the Engineer. Do not take advantage of a discrepancy, conflict, error, omission, or ambiguity. The Engineer will make corrections and interpretations necessary to fulfill the intent of the contract.

105.06 CHARACTER OF WORKERS, METHODS, AND EQUIPMENT

A. Resources.
Provide sufficient resources to complete the work as required by the contract and within the contract time.

B. Removal of Personnel.
If any person employed on the project, whether a Contractor employee or not, is intemperate, prejudiced, abusive, or disorderly, the Engineer may direct the Contractor in writing to discharge the person from the work. Re-employ this person on the project only with the Engineer's approval. If the Contractor fails to remove a person as directed by the Engineer or to provide sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until the Contractor complies.

C. Alternative Methods and Equipment.
If the contract specifies the methods and equipment to perform the work, alternative methods and equipment may only be used with the approval of the Engineer. Submit a written request with a full description of the alternative methods and equipment being proposed and an explanation of reasons for making the change. If the Engineer approves of the alternative method or equipment, produce work in conformity with the contract requirements. The Engineer's approval does not change the basis of payment for the contract items involved or the contract time.

If the Engineer determines the work produced does not meet the contract requirements, discontinue alternative method or equipment and complete the remaining work with the specified methods and equipment. Repair or remove and replace the deficient work to the specified quality.

D. Welders.

1. General.
Before performing the work, all welders must obtain the applicable AWS qualification and the certification from the Department.

2. Qualifications.
Welders performing work as specified in Section 616, "Structural Steel," and Section 622, "Piling," must meet the qualification requirements of AASHTO/AWS D1.5, "Bridge Welding Code."

All other welders performing work on steel must meet the qualification requirements of AWS D1.1, "Structural Welding Code – Steel."

Welders performing work on aluminum must meet the qualification requirements of AWS D1.2, "Structural Welding Code – Aluminum."

3. Certifications.
To obtain Department certification, submit the applicable qualifications and test results to the Materials and Research Engineer at least 2 weeks before the welder starts work on the project. The test results must meet all of the following conditions:

a. Witnessed and signed by an AWS Certified Welder Inspector (CWI);

b. Conform to the example form for Welder, Welding Operator, or Tack Welder Qualification Test Record provided in AWS D1.1; and

c. Include the welder's name, welder's employee ID number from payroll, date tested, CWI name, testing firm name, and the test results.

If the qualifications and test results are acceptable, the Materials and Research Engineer will certify the welder.

The Department certification is active for 1 year and is eligible for up to three 1-year extensions. To obtain an extension, submit a written request to the Materials and Research Engineer with a signed statement that the welder has been actively engaged in performing the required welds within the previous six months. The Department may require a requalification test at any time.

105.07 CONFORMANCE WITH THE CONTRACT REQUIREMENTS

A. Performance of Work.
Perform the work in conformance with the contract requirements.

Perform the work to produce a product that is uniform in character and to conform to the required target value or tolerance range. This tolerance range is to accommodate occasional, unavoidable, and minor variations from the median zone.

When the contract contains the word or phrase "uniform," "uniformly," "in a uniform manner," or an equivalent to describe a required result or procedure and no test is specified, the degree of uniformity will be that which is obtained for quality work meeting industry standards.

If a portion of the work fails to meet the contract requirements but is adequate to serve the design purpose, the Engineer may accept work in place and process a contract price adjustment for that portion of the work. If the Engineer accepts the work:

- the Engineer will apply the contract price adjustments included in the contract; or

- if no contract price adjustments are included in the contract, the Engineer will determine a contract price adjustment factor and issue a contract revision documenting the basis of acceptance and the revision to the payment.

If the Engineer determines that a portion of the work does not conform with the contract and does not produce work that serves the design purpose, remove and replace or repair the work at no expense to the Department.

B. Removing Unacceptable or Unauthorized Work.
Remove and replace unacceptable work before final acceptance.

The Contractor will not receive compensation for work performed contrary to the Engineer's instructions, work beyond the construction limits, and work performed without the Engineer's permission. The Engineer may order this work removed, restored, or replaced at no additional cost to the Department. If the Contractor fails to remove, restore, or replace this work as ordered by the Engineer, the Engineer may have these actions performed by others and deduct the cost from monies due or to become due to the Contractor.

105.08 WORK DRAWINGS

A. General.

1. Coordination of Plans and Work Drawings.
The plans show the location and details of structures, lines, grades, and typical cross sections of the roadway. The contract may require the Contractor to supplement the plans with work drawings to reflect how the Contractor will perform the work.

If the contract requires work drawings, submit the work drawings to the Engineer for review and comments. The Contractor shall only start the work represented on the work drawing once the Engineer's review is complete and the Contractor has addressed any comments.

Submission of work drawings by the Contractor and review of work drawings by the Engineer do not constitute the Department's approval of or acceptance of the work represented on the work drawings and does not relieve the Contractor of any of the following:

a. Successful completion of the work;

b. Errors, omissions, or deviations from the contract requirements;

c. Accuracy of dimensions and details;

d. Agreement and conformity with the contract;

e. Proper and safe design done by the Contractor;

f. Proper and safe construction of the work; and

g. Any other contract requirements.

Do not change any requirements as shown in the contract documents without the Engineer's written authorization.

Provide work drawings on a maximum size of 11 inch × 17 inch sheets that clearly and legibly displays all details.

2. Cover Sheet Requirements.
With each submittal of work drawings, provide a cover letter that includes the following:

a. The Department's project number;

b. The Project Control Number (PCN);

c. The structure number from the plans, if the work drawing represents work related to a structure;

d. The Contractor's name;

e. The subcontractor name, if applicable;

f. Verification that the work drawings have been reviewed and approved by the Contractor performing the work;

g. A reference to the "Spec No.," "Code No.," and "Description" of the contract item or items represented on the work drawing;

h. An itemized list of any approved deviations from the contract documents; and

i. Any other information as required by the Engineer.

3. Additional Section 600 Work Drawing Submittal Requirements.
Provide work drawings on 11 inch × 17 inch sheets generated by a CADD system for the following:

- Section 600;
- Expansion joints; and
- Bridge bearings.

Use the minimum text sizes shown in Table 105-01.

Table 105-01

Dimensions and Notes	0.08 Inches
Detail Subtitles	0.09 Inches
Detail Titles	0.10 Inches

Number each sheet consecutively and include the following on the lower right hand corner of each sheet:

a. The Department's project number;
b. The structure number, if applicable;

c. The title of sheet;
d. The fabricator's name;
e. A brief description of the detail shown on sheet; and
f. An approval stamp that includes:
    1. The signature of the person approving the work drawing;
    2. The title of the person approving the work drawing; and
    3. The date of the approval.

Excluding the approval stamp requirements, no handwritten information will be allowed on the work drawings.

B. Work Drawing Submittal Requirements.

Submit work drawings by either of the following methods:

1. Paper Submittal.

Submit a cover letter and two copies of the work drawings to the Engineer.

2. Electronic Submittal.

To submit the work drawings electronically to the Engineer, post a cover letter and one electronic copy of the work drawing to the Department's managed file transfer (MFT) website. Follow the requirements of NDAC Title 28 for all submittals.

Contact the Engineer to receive instructions describing how to upload files to the MFT website.

C. Engineer's Response to Work Drawing.

Allow 21 days for the Engineer to review the work drawing. The Engineer will respond in one of the following ways:

- No Exceptions Noted;
- Returned for Correction;
- Not Required for Review; or
- Not Acceptable.

If the work drawing is returned stating "Returned for Correction" or "Not Acceptable", make necessary revisions and resubmit the work drawing as specified in Section 105.08, "Work Drawings".

After the Department has reviewed the work drawings, the Department will return the reviewed work drawing submittal to the Contractor as follows:

- If a paper submittal, the Engineer will return the reviewed drawings to the Contractor.

- If an electronic submittal, the Department will post reviewed work drawings on the MFT site and will send an email notification to the Contractor that the reviewed work drawings are available on the MFT site. Retrieve the reviewed work drawings from the MFT site within 30 calendar days. The Department will delete files from the MFT site after 30 calendar days.

Include the cost of drafting and submitting work drawings in the contract unit price for the relevant contract items.

105.09 AUTHORITY OF THE ENGINEER

The Engineer is the authority on the engineering details of the project and the administrative responsibilities for the satisfactory completion of the project.

The Engineer has authority to reject defective material or work that does not meet the contract requirements.

The Engineer has the authority to suspend the work for the following reasons:

A. The Contractor fails to carry out contract requirements;

B. The Contractor fails to carry out orders from the Engineer;

C. During periods of unsuitable weather;

D. For conditions considered unsuitable for performance of the work;

E. For other conditions or reasons in the public interest; or

F. For other reasons the Department and Contractor mutually agree on.

105.10 CONSTRUCTION STAKING

The Engineer will provide and set construction stakes and marks that establish lines, slopes, grades, and other engineering details, and provide the Contractor with all necessary information relating to them. The Department is responsible for the accuracy of construction stakes and marks established by the Engineer.

Notify the Engineer at least 14 calendar days before starting the work and provide a description of the staking necessary to start the work. After the work has begun, notify the Engineer at least 48 hours of the need for staking, excluding Saturdays and holidays, and provide a description of the needed staking. The Department is not responsible for delays in setting stakes if the Engineer does not receive the required notice.

Before starting the work, examine all stakes, measurements, and marks to determine their intent.

Protect and preserve all stakes and marks. If the Contractor destroys or disturbs stakes or marks, the Department will repair or replace the stakes and marks and will deduct the cost of repair or replacement from monies due or to become due the Contractor.

105.11 INSPECTION OF WORK

All material, the production of material, and each part or detail of the work is subject to inspection. Provide the Engineer access to all parts of the work and provide information and assistance as required by the contract to allow the Engineer to perform a complete and detailed inspection.

Remove or uncover portions of the work as requested by the Engineer. After examination, restore the work to the standard required by the contract. If the work is acceptable, the Department will pay for the costs of uncovering, removing, and restoring the work in accordance with Section 104.02, “Contract Revisions.” If the work is unacceptable, uncover, remove, and restore the unacceptable work. The Department will not pay the Contractor for the costs to uncover, remove, and restore unacceptable work.

Any work performed or materials used without inspection by the Engineer may be ordered removed or uncovered and replaced at the Contractor's expense, unless the Engineer failed to inspect after having been given notice that the work was to be performed.

When any unit of government, political subdivision, utility owner, or railroad company is to pay a portion of the cost of the work covered by this contract, its respective representatives also have the right to inspect the work. This act of inspecting does not make the unit of government or political subdivision, the utility owner, or the railroad company a party to the contract, and shall not interfere with the rights of either party to the contract.

105.12 MAINTENANCE DURING CONSTRUCTION

Maintain the project site in a satisfactory condition until the project is accepted.

If the contract requires the placement of material on or the use of an existing feature, such as subgrade, base course, pavement, or structure, maintain the existing feature.

If the Contractor fails to maintain the project site properly, the Engineer will notify the Contractor and the Contractor shall remedy the improper maintenance within 24 hours of receipt of the notice. If the Contractor fails to remedy the improper maintenance within 24 hours, the Department may proceed to maintain the project site, and will deduct the costs of the maintenance work from monies due or to become due the Contractor.

The cost of maintaining the work and project site during construction until acceptance is included in the contract unit prices of the contract items.

105.13 PROTECTION OF THE WORK

Protect project work from damage until the Engineer gives partial acceptance or project acceptance to the work as defined in Section 105.15, "Acceptance."

Until acceptance, rebuild, repair, or restore damage to the work at no cost to the Department, except as noted in this section.

If the damage is to items that will be permanently incorporated in to the work and are not substantially complete and is a result of acts of the public enemy, acts of government entities, or acts of God, the Contractor shall rebuild, repair or restore the work and the Department will pay the Contractor for the work in accordance with Section 109.03, "Compensation for Contract Revisions."

If the damage is to work that is substantially complete and is caused by public traffic, identify the party that is responsible for the damage, pursue all reasonable means to recover the costs of the damage, and repair the damage to the work. When the Contractor cannot recover the costs by reasonable means, the Department will pay the Contractor for the unrecovered costs as specified in Section 109.03, "Compensation for Contract Revisions."

If damage occurs after acceptance and before the Contractor signs the final payment statement, the Engineer may direct the Contractor to rebuild, repair, or restore the damaged work and the Department will pay the Contractor for the costs to rebuild, repair, or restore the damaged work in accordance with Section 104.02, "Contract Revisions."

105.14 OPENING TO TRAFFIC

If the contract provides for detours or road closures and the Contractor closed the road to traffic, the Engineer may order the Contractor to open certain sections of the road to traffic. Opening these sections does not constitute acceptance of the work or a waiver of any contract provisions. On those sections opened to traffic, the Department will pay the Contractor for the costs of maintaining the roadway for traffic in accordance with Section 104.02, "Contract Revisions."

If the Contractor is late in completing portions of the work according to the contract or progress schedule, the Engineer will notify the Contractor of the time period for completing these features. The Engineer may order all or a portion of the project opened to traffic if the Contractor fails to complete or make a reasonable effort to complete the late work. The Contractor remains liable or responsible for maintaining the work and shall conduct the remaining construction operations with minimal interference to traffic at no cost to the Department.

105.15 ACCEPTANCE

A. General.

After completion of the work or a segment of the work, notify the Engineer in writing to request final inspection for partial or project acceptance. Before requesting final inspection, remove all garbage, excess materials, temporary work, and equipment from the project or segment. The Engineer will respond to the Contractor's request within 5 business days to coordinate the final inspection of the work.

The Engineer will inspect the work to determine if the Contractor has completed the work as required by the contract.

If the inspection discloses any unsatisfactory work, the Engineer will provide the Contractor with written instructions for correcting the work. Upon correction of the work, request another inspection by the Engineer.

B. Partial Acceptance.

Partial acceptance occurs when a segment of the work such as a structure, an interchange, or a section of road is complete and accepted by the Engineer. The Engineer may require the completion of additional items of work related to the segment before issuing partial acceptance on a segment of the work.

C. Project Acceptance.

Project acceptance occurs when the project is complete and accepted by the Engineer.

If the Engineer determines the work is complete, the inspection will constitute the final inspection and the Engineer will notify the Contractor of project acceptance. Acceptance does not void or alter any contract terms.

Issuance of an acceptance letter constitutes the Engineer's satisfaction with the physical construction work associated with the contract. Upon project acceptance, the Department will begin a process to reconcile the project records. This process may require the Contractor to provide additional documentation or to assist with reconciling the project records. Final payment, as specified on Section 109.06, "Final Progressive Estimate and Payment" will not be made until the resolution of the records reconciliation process.

105.16 NO WAIVER OF LEGAL RIGHTS

Project acceptance does not prevent the Department from correcting any measurement, estimate, or certificate made before or after completion of the work. The Department may recover overpayments from the Contractor, surety, or both. A waiver on the part of the Department of any breach of any part of the contract is not a waiver of any other breach.

Without prejudice to the contract terms, maintain liability for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.

105.17 RIGHT OF WAY

The Department will furnish right of way before the work starts, except as indicated in the contract.

Before damaging or disturbing land monuments or property markers, allow the Engineer to witness or otherwise reference their location.

SECTION 106
CONTROL OF MATERIAL

106.01 GENERAL METHODS OF MATERIALS ACCEPTANCE

A. General.

Only use materials that meet the contract requirements. Unless otherwise specified, use new material for the work. Before delivery of the materials, notify the Engineer of the proposed source of material.

The contract may require either or both of the following as the basis for approval and acceptance of material:

1. Sampling, testing, and inspection.

2. A Certificate of Compliance.

If the value of the material is less than $5,000 and the material is not directly involved with the safety of a structure or roadway, the Engineer may waive the certificate requirement, or accept the material without sampling, testing, and inspecting.

B. Samples, Tests, and Inspection.

The Engineer will sample, test, and inspect materials in accordance with relevant contract requirements and will provide copies of all test results to the Contractor upon request. The Department will not pay for materials found to be unacceptable. Remove unacceptable materials at no cost to the Department.

The Engineer may sample, test, and inspect materials at any time before project acceptance, and will accept or reject materials based on inspections or test results.

If the contract requires the Contractor to perform sampling and testing, the Contractor shall provide the Engineer with copies of all sampling and testing results.

C. Certificate of Compliance.

1. General.

A Certificate of Compliance (CoC) states that the materials represented by the CoC comply with the contract requirements.

All materials manufactured off-site require either a Manufacturer or Contractor CoC. Materials listed in Table 106-01 require a Manufacturer CoC. All other materials require a Contractor CoC.

Submit a CoC electronically before incorporating the material into the work. Some materials require the submission of additional information as part of the CoC. When this is required, the contract documents will state the additional requirements.

The Department will not include quantities of material represented by a CoC on a progressive estimate until the Contractor has fully met the CoC requirements.

The Department may sample, test, and inspect material represented by a CoC at any time before project acceptance, and will accept or reject materials based on inspections or test results.

Retain records and information relating to material compliance with contract requirements for 4 years after the Contractor returns the signed final payment voucher. The Engineer may request receipt of records and information at any time during the record retention period.

2. Manufacturer Certificate of Compliance.

A Manufacturer CoC requires the signature of a person having the legal authority to act for the material manufacturer. The manufacturer and prime contractor must sign the Manufacturer CoC.

Provide Manufacturer CoC for the products shown in Table 106-01.

The entity batching Portland Cement Concrete is considered the manufacturer. When submitting CoC for Portland Cement Concrete, include all manufactured items used in batching concrete on the CoC.

Table 106-01
Manufacturer Certificates of Compliance

Section	Item
604	Prestressed Concrete Beams
606	Precast Reinforced Concrete Box Culverts
802	Portland Cement Concrete
804	Cement and Lime
820	SCM
830	Pipe and Drainage Structures
834	Structural Steel
836	Reinforcing Steel, Dowel Bars, and Tie Bars
840	Piling
846	Preservatives and Pressure Treatment Process for Timber (excluding materials provided under Sections 752 and 764)
858	Geosynthetics

Submit Manufacturer CoC using the form *Manufacturer Certificate of Compliance (SFN 61041)*.

3. Contractor Certificate of Compliance.

A Contractor CoC requires the signature of a person having the legal authority to act for the prime Contractor. The prime Contractor may require the manufacturer, supplier, or subcontractor to sign the Contractor CoC.

Submit Contractor CoC using the form *Contractor Certificate of Compliance (SFN 61040)*.

106.02 AGGREGATE SOURCES

A. General.

The proposal package may contain a materials pit list that references and describes possible sources of materials. The Contractor is not obligated to use any of these sources.

Work pits in a manner that conserves the available aggregate within the source. If possible, remove all aggregate material from the working portion of the source to eliminate the need to cover any unused material.

After completing the pit operation and restoring the area to a condition equal to or better than the original condition, inspect the pit with the surface owner and Engineer. If the surface owner and Engineer find the area acceptable, obtain a standard pit release signed by the surface owner and submit the release.

B. Department Controlled Sources.

1. General.

Only use material from Department controlled sources on the materials pit list. Request the use of a different Department controlled source before the bid opening in accordance with the explanation request requirements in Section 102.05, "Examination of Proposal Package and Project."

The materials pit list generally will show the gradation of the material, percent shale, and other characteristics of the material. The Department will analyze boring logs using accepted standard practices and calculate values based on the test results of samples from the exact locations shown on the materials pit list. The Department will not interpret the test results and will not be responsible for interpretations of the test results made by the Contractor.

The water tables shown on the boring logs may change with the seasons.

Because variations in quantity or quality of material from sample test results are usual and expected, and because it is difficult to determine the exact quantity or quality of material from an entire source based on sample test results, the Department does not warrant the quantity or quality of material from Department controlled sources.

Determine the quantity of equipment, processing, blending, and all other operations required to produce material that meets the relevant contract requirements.

If using Department controlled sources, fulfill all obligations imposed on the Department required by options or agreements contained in the materials pit list.

Remove all topsoil, to a maximum depth of 1 foot, or as specified in the materials pit list, and stockpile separately from the remaining overburden. After removing the aggregate material, replace the stockpiled excavated overburden and topsoil material within the open pit area. Uniformly distribute and smoothly grade the topsoil over the entire disturbed area, leaving the pit sides as flat as possible. Re-establish the natural direction of surface drainage as much as practical.

2. Department Owned Sources.

If electing to purchase material from a Department owned source, notify the Engineer and Gravel Propsecting Coordinator at Materials and Research Division in writing.

The Department will charge the Contractor a royalty for all aggregate taken from the pit and incorporated into the project. The proposal package will list the royalty for each class of aggregate for use on the project. If the list does not contain a royalty for a class of aggregate required by the contract, the Department will determine a fair market royalty and add it by change order to the contract unit price of the applicable contract item. The Department will own all material, including reject material, remaining in the pit at the completion of pit operations. Bury the remaining material as directed by the Engineer and reclaim the pit at no additional cost to the Department.

Replace or pay for any crop damage in a Department owned source. Before moving into a Department owned source, consult with the Engineer about what constitutes satisfactory operation and restoration of the source. Obtain the Engineer's approval of the operation and restoration plan for the source.

3. Department Optioned Sources.

The Department may acquire an option and may assign the right to take materials from the sources referenced in the proposal package. If exercising the Department's option to purchase materials under the terms and conditions provided in the option, notify in writing the surface owner, material owner, the Engineer and the Gravel Prospecting Coordinator at Materials and Research Division. Include a timeline for intended use with the written notification. Before moving into the source, the Contractor shall submit a copy of the written notification to exercise the Department's option and any other agreements negotiated between the Contractor and the surface owner and material owner regarding use of the Department optioned source. Comply with the requirements of Chapter 38-16 of the North Dakota Century Code.

At least 30 calendar days before moving into a Department optioned source, provide a written notification of the intended removal process and the proposed access plan to the Engineer, the surface owner, and the material owner. Agree upon an approximate date of payment for the material used and the reclamation completion date with the material owner and Engineer.

Pay applicable royalties to the material owner for all material processed in the crushing or screening operation, whether accepted or rejected, including all material remaining at the pit after completion of pit operations. Pit operations are complete when material is no longer needed from the pit for the project. Remove the processed material from the pit within 180 calendar days after completion of pit operations, or pay a storage fee to the material owner as outlined in the Department's material option agreement. If the Contractor fails to remove the material or pay the storage fee, ownership of the processed material will revert to the material owner. If the Contractor does not intend to keep the material, the Contractor shall dispose of the material, as agreed to with the material owner, after the Engineer determines the quantity of reject material. Submit a copy of the disposal agreement to the Engineer.

The royalty payment for the material includes the use of a reasonable area adjacent to the source for stripping and waste material stockpiles, a plant site not to exceed 8 acres, and an access route for ingress and egress to the source that is at least 50 feet wide.

The Engineer will determine the total amount of all processed, stockpiled, and rejected material and the royalty payment due the material owner. The Engineer will notify the Contractor and the material owner in writing of this information. Upon receipt of this information, make payment to the material owner in accordance with the terms of the agreement within 30 calendar days.

C. Privately Owned Sources.

Acquire the necessary rights to obtain material from privately owned sources and pay all related costs.

The materials pit list may include clues for privately owned sources. These clues are for use by all Bidders on an equal, competitive basis.

D. Aggregate Source Limitations.

Do not use material from aggregate sources located in the following areas:

1. In Dunn County, within the 7-mile radius from the center of Section 16-146-96;

2. In Stark County, within the 6-mile radius from the center of Section 28-138-97, and

3. In Slope County, within the 4-mile radius from the center of Section 26-134-101.

Before using material from aggregate sources located in the following areas, obtain written approval from the NDDEQ:

1. In Dunn County, outside the 7-mile radius and within the 30-mile radius of the center of Section 16-146-96;

2. In Stark County, outside the 6-mile radius and within the 10-mile radius from the center of Section 28-138-97;

3. In Slope County, outside the 4-mile radius and within the 8-mile radius from the center of Section 26-134-101;

4. In Slope County, within the 6-mile radius from the center of Section 29-135-98.

5. In Stark County, within the 3-mile radius from the center of Section 19-137-94;

6. In Stark and Hettinger Counties, within the 3-mile radius from the center of Section 9-136-94;

7. In Hettinger County, within the 3-mile radius from the center of Section 17-136-93;

8. In Stark County, within the 2-mile radius from the center of Section 30-137-92;

9. In Bowman County, within the 4-mile radius from the center of Section 31-131-103;

10. In Stark County, within the 4-mile radius from the center of Section 20-139-91;

11. In Hettinger County, within the 1-mile radius from the center of Section 28-135-91;

12. In Hettinger County, within the 2-mile radius from the center of Section 12-135-95;

13. In Golden Valley County, within the 2-mile radius from the center of Section 8-139-103;

14. In Golden Valley County, within the 2-mile radius from the center of Section 8-139-104;

15. In Billings County, within the 2-mile radius from the center of Section 18-137-102;

16. In Adams County, within the 2-mile radius from the center of Section 29-132-98;

17. In Adams County, within the 1-mile radius from the center of Section 23-131-97; and

18. In Grant County, within the 3-mile radius from the center of Section 2-131-90.

To obtain NDDEQ approval, sample and test for erionite fibers in accordance with NDDEQ guidance, including prior approval of a sampling plan and concurrence with the laboratory results. The NDDEQ guidance is available at: https://deq.nd.gov/Erionite/InformationForContractors.htm.

Submit test results to NDDEQ. NDDEQ will review the test results and provide a response within 10 business days of the postmarked date on the submitted test results. NDDEQ will base approval on the absence of erionite in the test results from the tested source.

Submit to the Engineer a copy of the written approval obtained from NDDEQ at least 10 business days before starting any mining or processing of aggregate in an NDDEQ approved source. Clearly mark the approved sources in the field to the satisfaction of the Engineer, and maintain these markings until the completion of pit operations.

Perform pit operations only within the area of the approved source. If the Department or NDDEQ determine that the Contractor is performing pit operations outside the area of an approved source, the Engineer will shut down the Contractor's pit operations. After a shutdown, obtain approval from the Department and the NDDEQ before using any material from the source.

Include the cost of providing labor, material, and equipment to test drill, obtain samples, and conduct laboratory testing related to these erionite sampling and testing requirements in the relevant contract items.

106.03 STORAGE OF MATERIALS

Store the materials to preserve their quality and fitness for the work. Locate stored materials to allow their prompt inspection. The Engineer may inspect and retest stored materials before use in the work. Obtain approval from the Engineer before storing materials or placing a plant and equipment at locations within the right of way other than those shown on the plans. Provide any additional storage and staging area outside the right of way, as necessary. Before using private property for storage and staging, obtain written permission of the property owner or lessee, define the restoration conditions in the written permission, and provide a copy of the written permission to the Engineer. The written permission from a property owner may specifically waive the restoration requirement. Restore storage and staging areas within the right of way as agreed to with the Engineer and outside of the right of way as defined in the written permission from the property owner, both at no cost to the Department.

106.04 HANDLING MATERIALS

Handle materials to preserve their quality and fitness for the work. Transport aggregates in vehicles constructed to prevent loss or segregation of materials after loading and measuring.

106.05 STOCKPILING AGGREGATE AND SALVAGED MATERIALS

Before stockpiling material, prepare the site as follows:

A. Clear and grub;

B. Grade to a firm, smooth, and well-drained condition; and

C. Maintain a bed of aggregate under the stockpiled material to prevent contaminating the stockpiled material with soil or foreign material.

Stockpile material to prevent segregation. Do not use equipment or methods that cause segregation, degradation, or contamination of the aggregate when constructing stockpiles or delivering material. Do not incorporate segregated, degraded, or contaminated material into the work.

Prevent aggregate of different types or sizes from adjacent stockpiles from intermingling.

Do not operate equipment on stockpiles of salvaged bituminous material that will remain the property of the Department or be used in hot recycled bituminous pavement. For material salvaged for these purposes, do not stockpile the material higher than 15 feet.

106.06 USE OF MATERIAL FOUND WITHIN THE RIGHT OF WAY.

The Engineer may authorize the use of excavated material within the construction limits that are suitable for contract items other than excavation on the project. The Department will pay the contract unit price for the excavation of the material and the contract unit price for the use of the excavated material. Replace the removed material with acceptable material, as determined by the Engineer, at no cost to the Department. The Department will not charge the Contractor for the materials used.

Only remove material from outside the construction limits on the right of way with the Engineer’s prior written approval. If approval is given, the Contractor and the Engineer will agree to the use of the material including the price the Department will charge the Contractor for the material. The agreement shall include conditions for the satisfactory restoration of the area. The Engineer will not approve the removal of material from easement areas.

Before removing material from outside the construction limits on the right of way, establish a restoration condition with the Engineer. After removing the material, restore the area of material removal to the restoration condition.

The Contractor may temporarily use material from any existing structure designated for removal in the erection of the new structure. Do not cut or damage temporarily used material without the approval of the Engineer.

106.07 DEPARTMENT PROVIDED MATERIAL

The Contract will specify the location for delivery or availability of Department provided material. For contract items that require the use of Department provided material, the contract unit price includes the cost of handling and placing the material.

Protect Department provided material delivered to the project. The Contractor is responsible for damage to Department provided material delivered to the project. The Department will deduct the following from monies due the Contractor:

A. The cost of shortages, deficiencies, and damage that may occur to the material after delivery; and

B. The cost of demurrage charges resulting from the Contractor's failure to accept the material at the contract-specified time and location of delivery.

106.08 BUY AMERICA

Standard Special Provision (SSP) 11 "Buy America" has replaced this section.

106.09 CONVICT LABOR

For materials produced by convict labor after July 1, 1991, only incorporate in a federal-aid project if:

A. Produced by convicts on parole, supervised release, or probation from a prison; or

B. Produced in a qualified prison facility having a cumulative annual production amount for such materials for use in a federal-aid project not exceeding the amount of such materials produced in such facilities for use in a federal-aid project during the 12-month period ending July 1, 1987.

A qualified prison facility is any prison facility where convicts, during the 12-month period ending July 1, 1987, produced materials for use in a federal-aid project.

106.10 QUALIFIED LABORATORIES AND TESTING PERSONNEL

Provide testing equipment meeting the requirements listed in the NDDOT Qualified Laboratory Program and testing personnel meeting the requirements of the NDDOT Technicial Certification Program (TCP).

The requirements for the NDDOT Qualified Laboratory Program and the Technicial Certification Program can be found at https://www.dot.nd.gov/.

SECTION 107
LEGAL RELATIONS AND RESPONSIBILITIES

107.01 LAWS TO BE OBSERVED

Keep fully informed of, observe, and comply with all of the following that affect those engaged or employed on the project, or affect the performance of the work:

A. Federal laws;

B. State laws;

C. Local laws and ordinances; and

D. Regulations, orders, and decrees of any authority having jurisdiction, including all legal requirements governing the safety, health, sanitation, and performance of work under the contract.

Indemnify and hold harmless the Department and its representatives against any claim or liability arising from the violation of any of the above listed items by the following parties or any employees of the following parties:

A. The Contractor;

B. A subcontractor at any tier;

C. A supplier of material or service; and

D. Any other engaged by the Contractor in the performance of the work.

The Contractor is solely responsible to provide, inspect, and maintain all safeguards, safety devices, protective equipment, and safety programs; and provide actions necessary to reasonably protect the life, health, and property of the Contractor, subcontractors, the State, the public, and each of the employees, officers, assigns, and agents of the Contractor, subcontractors, and the State, engaged or employed on the project.

Provide unrestricted access to the project site to any inspector of OSHA or other legally responsible agency involved in safety and health administration.

107.02 PERMITS, LICENSES, AND TAXES

A. General.

The Contractor is responsible for the following as required by the contract and the applicable laws and regulations:

1. Obtaining and submitting to the Engineer all permits and licenses;

2. Paying all charges, fees, and taxes; and

3. Giving all notices.

The costs of the above responsibilities are included in the contract unit prices of the contract items.

Include the costs of these responsibilities in the contract unit prices of the relevant contract items.

If a permitting agency requires the Contractor to submit documentation as a condition of a permit, the Contractor shall provide the Engineer with copies of the documentation.

B. Water Use Permits.

1. General.

Before withdrawing surface or ground water from any source, obtain a temporary water permit from the Department of Water Resources in accordance with Section 107.02.B.2, "Department of Water Resources."

If intending to withdraw water from the following waterways, obtain the applicable United States Army Corp of Engineers permits in accordance with Section 107.02.B.3, "United States Army Corp of Engineers," in addition to the temporary water permit from the Department of Water Resources.

a. MISSOURI RIVER – from the Montana-North Dakota state line to the North Dakota-South Dakota state line;

b. YELLOWSTONE RIVER – from the Montana-North Dakota state line to its mouth;

c. UPPER DES LACS LAKE;

d. RED RIVER OF THE NORTH – from Wahpeton, ND, to the Canadian border;

e. BOIS DE SIOUX RIVER – from the South Dakota-North Dakota state line to Wahpeton, ND; and

f. JAMES RIVER – from Jamestown, ND, to the North Dakota-South Dakota state line.

Obtain written permission to access a water source from all affected landowners. Before accessing surface or ground water from any source, submit to the Engineer a copy of the written permission for access, the temporary water permit from the Department of Water Resources, and, if applicable, the water permits from the United States Army Corp of Engineers.

2. Department of Water Resources.

To obtain a temporary water permit, complete an *Application for a Temporary Water Permit* (SFN 60158) and submit to the Department of Water Resources. The *Application for a Temporary Water Permit* is available on the Department of Water Resources website at:
www.swc.state.nd.us/.

For additional information from the Department of Water Resources, contact:

State Engineer
Department of Water Resources
State Office Building
900 East Boulevard Ave
Bismarck, ND 58505-0850
(701) 328-2754
swc@nd.gov

3. **United States Army Corps of Engineers (USACE).**
Obtain the applicable USACE water permits from the USACE after the Department makes an award. To obtain the applicable permits, complete USACE *Engineering Form 4345* and submit it to the USACE. *Engineering Form 4345* is available on the USACE website at: www.usace.army.mil/.

For additional information from USACE, contact:

United States Army Corps of Engineers
Bismarck Regulatory Office
1513 S. 12th St
Bismarck, ND 58504
(701) 255-0015

C. Storm Water Permits.

1. **General.**
If the total area of disturbance within the project site is 1 acre or greater, obtain the following permit or permits:

a. For areas of disturbance on non-tribal land, an NDPDES General Permit for Stormwater Discharges Associated with Construction Activity in accordance with Section 107.02 C.2, "NDPDES Permit."

b. For areas of disturbance on tribal land, an EPA Construction General Permit in accordance with Section 107.02 C.3, "EPA Construction General Permit (CGP)."

c. For areas of disturbance on both tribal and non-tribal land, both permits required in items a and b.

Submit a copy of the Storm Water Pollution Prevention Plan (SWPPP) to the Engineer at the preconstruction conference or before starting work. The SWPPP shall include erosion and pollution controls for all areas disturbed in the performance of the work.

2. **NDPDES Permit.**
To obtain an NDPDES General Permit for Stormwater Discharges Associated with Construction Activity, complete an *Application (Notice of Intent) to Obtain Coverage under NDPDES General Permit for Stormwater Discharges Associated with Construction Activity* (SFN 19145) and submit it to the NDDEQ. The *Application (Notice of Intent) to Obtain Coverage under NDPDES General Permit for Stormwater Discharges Associated with Construction Activity* is available on the NDDEQ's website at: https://deq.nd.gov/WQ/2_NDPDES_Permits/7_Stormwater/StW.aspx.

Review the Memorandum of Agreement (MOA) developed by the NDDEQ and the Department outlining procedures for NDPDES General Permit for Stormwater Discharges Associated with Construction Activity as they relate to Department projects. Download a copy of the MOA from the NDDEQ's website.

Fulfill all requirements as required by the NDDEQ. Submit to the Engineer a copy of the completed application package and, once obtained, the notice of permit coverage.

Submit a completed *Notice of Transfer/Modification of Coverage under (NDPDES) General Permit for Storm Water Discharges Associated with Construction Activity* (SFN 54242) to the Engineer. Submit this form when returning the signed final payment statement.

For additional information from the NDDEQ, contact:

North Dakota Department of Environmental Quality
Division of Water Quality
4201 Normandy Street
Bismarck, ND 58503-1324
(701) 328-5210

3. **EPA Construction General Permit (CGP).**
To obtain an EPA CGP, complete and submit the EPA's *Electronic Construction General Permit Notice of Intent*, which is available on the EPA's website at: https://www.epa.gov/npdes/electronic-notice-intent-enoi.

Fulfill all requirements as required by the EPA, Region 8. Provide the EPA's Notice of Intent (NOI) tracking number to the Engineer.

If the Department has notified the Contractor of final acceptance in accordance with Section 105.15, "Acceptance," but the project does not meet the requirements necessary to file a Notice of Termination (NOT) in accordance with the EPA's *National Pollutant Discharge Elimination System General Permit for Discharge from Construction Activities*, the Engineer will notify the Contractor when submission of an NOT is allowable.

For additional information from the EPA, contact:

Region 8 Storm Water Coordinator
U.S. Environmental Protection Agency, (80C-EISC)
1595 Wynkoop St
Denver, CO 80202-21129
(800) 227-8917 ext. 6082

107.03 AQUATIC NUISANCE SPECIES (ANS)

Reserved.

107.04 PATENTED DEVICES, MATERIALS, AND PROCESSES

Provide proof of legal agreement with the patentee or owner, if necessary, for use of a design, device, material, or process covered by letters, patents, or copyrights.

Indemnify and hold harmless the Department and any affected third party or political subdivision from claims or infringement on patents, copyrights, or trademarks.

Indemnify the Department for costs, expenses, and damages, which it may be obligated to pay because of an infringement during the performance of or after the completion of the work.

107.05 MATERIAL SOURCE APPROVAL

A. General.

Before disturbing an area as part of the work, provide the Engineer with a Certificate of Approval (COA). Areas requiring a COA include material source locations, access routes to public roads, stockpile locations, rock piles (riprap), plant sites, processing and staging areas, waste sites, and any other areas outside the project limits.

Areas for which a COA has been issued cannot be expanded without obtaining a COA for the expansion area.

Comply with all the conditions and requirements listed on the COA. A COA will be voided if avoidance areas, indicated on the COA, are disturbed.

The Engineer will reject material obtained from an area that does not have a valid COA or if the Contractor fails to comply with the conditions listed on the COA.

The Contractor is responsible for obtaining all permissions and permits. The Department will not provide payments or compensation for delays resulting from the Department review or the need to obtain permissions and permits.

Destruction of cultural resources prior to approval is considered Anticipatory Demolition [National Historic Preservation Act (NHPA), Section 110(k)(16 U.S.C. 470h-2], and a COA will not be issued.

B. Department Controlled Sources.

The proposal package will include COAs for Department controlled sources.

COA's for Department controlled sources that are located out of State will include additional conditions and requirements that must be met before the source can be used.

C. Privately Owned Locations.

A complete list of previously approved sites and downloadable COAs is available on the Department's website at: www.dot.nd.gov. If the list does not include a location, submit a *Material Source Approval Request* (SFN 58466) by following the directions included on the form. Upon receiving a complete *Material Source Approval Request*, the Department will guide the applicant through the approval process and will issue a COA if the approval process is completed successfully.

Typically, approval process takes up to 30 calendar days; however, this may take longer due to poor visibility, weather conditions, or the need to coordinate with outside agencies. The Department may require the Contractor to submit additional information before issuing a COA.

D. Out of State Sources.
COA's for privately owned areas located out of State, provide the Engineer with documentation showing the availability of the area for use in accordance with each state's review process.

107.06 DISCOVERIES

If the Contractor encounters one or more of the items included in the following list anywhere the Contractor performs the work, the Contractor shall immediately suspend the work and notify the Engineer of the encouter:

- Threatened or endangered species;
- Prehistoric dwelling sites;
- Human remains;
- Concentrated historic or prehistoric artifacts; or
- Vertebrate, invertebrate, plant and trace fossils.

If encountering one of the following, protect the location from further disturbance:

- Prehistoric dwelling sites;
- Human remains;
- Concentrated historic or prehistoric artifacts; or
- Vertebrate, invertebrate, plant and trace fossils.

Resume work in the location of the encounter only with written approval from the Engineer.

If the Contractor fails to notify the Engineer within 24 hours of the encounter, the Contractor shall be liable for all standby costs and all damage incurred.

107.07 RESPONSIBILITY TO THE PUBLIC

A. Maintaining Traffic During Performance of the Work.
Perform the work with minimal inconvenience to traffic. Provide for the safety and convenience of the public, including residents along the highway, and the protection of persons and property. Until the Engineer accepts the project in accordance with Section 105.15, "Acceptance," maintain the portion of the roadway used by traffic in a condition that safely and adequately accommodates traffic.

Unless the contract provides for detours or road closures, keep the roadway open to traffic during the performance of the work.

Provide temporary approaches or crossings and intersections with trails, roads, streets, businesses, parking lots, residences, garages, and farms, and maintain them in a safe condition. Before starting the work, meet with the Engineer at the project to coordinate the details and locations of access points and construction procedures.

The Department will provide snow removal to maintain traffic on portions of the project open to public traffic.

Provide, erect, and maintain all necessary barricades, warning signs, lights, and other traffic control devices to protect the work and safety of the public and the workers.

B. Maintenance of Traffic During Suspension of Work.

1. General.

An anticipated suspension is a suspension that the Department includes in the contract. If the contract includes an anticipated suspension, the contract will include provisions for preparing the project for the suspension.

During anticipated and unanticipated suspensions, the Department will provide snow removal to maintain traffic.

2. Anticipated Suspensions.

The Engineer will only suspend the work when the Contractor has met the provisions for preparing the project for the suspension. Once work has been suspended for an anticipated suspension, the Department will maintain temporary roads and project sections. Resume maintenance for the entire project once work resumes.

Replace or repair all work or materials lost or damaged during the suspension. The Department will pay the Contractor for the replacement and repair costs in accordance with Section 109.03, "Compensation for Contract Revisions."

3. Unanticipated Suspensions.

a. Suspensions for Department Convenience.

If a suspension is not anticipated by the Department and is not the result of the Contractor's failure to properly perform the work, the Department will pay for the cost of maintenance and additional work to resume operations at contract unit prices or as extra work. If the Contractor does not resume the work on or before the effective date of the Engineer's order to resume work, the Department will deduct any costs incurred for maintaining traffic after the effective date of the order from monies due or to become due the Contractor.

b. Suspensions due to Contractor's Actions.

If a suspension is not anticipated by the Department and is the result of the Contractor's failure to properly perform the work, the Contractor shall maintain and restore the roadway to accommodate traffic. The Department will not pay the Contractor for this maintenance work.

If maintenance or restoration work becomes necessary during a suspension, the Engineer will notify the Contractor and the Contractor shall respond as follows:

(1) Begin the maintenance and restoration work within 6 hours of the Engineer's notification and complete the maintenance and restoration work within 24 hours of the Engineer's notification. If the Contractor fails to begin the maintenance and restoration work within 6 hours of the Engineer's notification, the Department may do one or both of the following:

(a) Complete the maintenance and restoration work by other means, and deduct the cost of the maintenance and restoration work from monies due or to become due the Contractor.

(b) Apply a contract price reduction of $500 for the first hour or part of an hour, and $250 per each additional hour or part of an hour, beyond the initial 6 hours.

(2) If the maintenance or restoration work affects public safety and the Engineer directs, begin the maintenance and restoration work immediately. If the Contractor fails to begin the maintenance and restoration work immediately, the Department will have the maintenance and restoration work completed and will deduct the cost of the maintenance and restoration work from monies due or to become due the Contractor.

Beginning maintenance or restoration work means having equipment or personnel at the location of the maintenance or restoration work.

C. Parking of Equipment, Vehicles, and Stored Materials.

Do not park equipment and vehicles, or store materials in the median of a divided roadway. Park equipment and vehicles and store material a minimum of 60 feet from the outside edge of the driving lane.

Obtain written permission from the property owner before using private property to park vehicles or equipment, to store materials, or as a work area. Provide the Engineer with a copy of the written permission. Provide the Engineer with a release from the property owner after restoring the property to the property owner's satisfaction.

D. Urban Work.

If the contract requires work within a city's limits, provide written notification to the fire chief and police chief at least 24 hours before blocking any street. Provide the fire department access to fire hydrants at all times. Do not place material or other obstructions within 10 feet of a fire hydrant or as otherwise allowed by ordinances, rules, or regulations.

E. Dust Control.

If the Engineer determines that dust from the performance of the work is creating a hazard to traffic or a nuisance to the public, control the dust on paved surfaces using a vacuum or pickup sweeper and control dust on unpaved surfaces using water. If the Engineer determines the vacuum or pickup sweeper is not adequate, use water in conjunction with the sweeper to control the dust. Do not wash material into storm or sanitary drainage systems. Maintain a safe, clean driving surface on any roadway open to traffic.

The Department will not make direct payment for dust control, except that the Department will pay the Contractor for the cost of water used for dust control in accordance with Section 216, "Water."

F. Crossing Traffic.

Construction vehicles are not allowed to cross lanes of traffic to enter or exit work zones on the interstate. Construction vehicles are required to merge into public traffic.

107.08 HAUL ROADS

A. General.

Before submitting a proposal, contact the appropriate State, County, Township, Tribe, BIA, or City officials to determine if there are any roadways that will be designated as "no haul" routes.

Notify the Engineer of each public road proposed for use as a haul road before hauling over that route. The Engineer will designate the most practical route for transporting materials and designate the route as a "haul road," upon completion of the pre-haul inspection unless deemed unacceptable by a local jurisdiction request.

Change the route of a designated haul road only with the Engineer's written approval. For route change requests made for the Contractor's convenience, the Engineer may require an agreement limiting the Department's liability for the cost of maintenance and restoration of the haul road.

The Engineer will consider the entire haul cycle, loaded and empty, when designating haul routes.

B. Designation of Haul Roads

The Engineer will not designate paved roads off the state system as haul routes.

The Engineer will not designate a road susceptible to severe damage from concentrated heavy hauling as a haul road unless no alternate route is available. Investigate alternate routes before submitting a proposal.

If the Contractor desires to haul on a road that the Engineer determined to be unsuitable for hauling, the Engineer will designate that road as a haul road if the Contractor provides improvements that the Engineer and Contractor agree make the road suitable. Make these improvements at no additional cost to the Department.

If the Engineer determines that pre-haul improvements to a designated haul road will reduce the maintenance or restoration costs, the Department will pay for the materials used to make pre-haul improvements.

A route used to haul material from a commercial pit to the project site is not considered a haul road. A commercial pit is a pit that meets one of the following criteria at the time the project is advertised:

1. The pit has long-term facilities in place and partially derives its annual sales from ongoing operation and sources other than Department or other short-term government contracts;

2. The operator owns the land or has a long-term lease, and did not primarily set up and equip the pit at the location to serve Department contracts; or

3. The operator regularly advertises the availability of material for public sale and has facilities available for effecting public sales at times when there are no government contracted projects utilizing the pit.

C. Pre-Haul Inspection.

Before hauling over a designated haul road, the Engineer, the Contractor, and the agency charged with control and maintenance of the route will make a joint inspection of the haul road. The joint inspection will determine the existing condition of the haul road, including the type, thickness, and width of the surfacing material. The Engineer will record the results in an inspection report. The inspection report will set forth any special conditions for use, maintenance, and restoration of the route. The Contractor, the Engineer, and the agency charged with control and maintenance of the route shall review and sign the report.

D. Use, Maintenance, and Restoration.

Maintain the haul roads used by public traffic in a condition that safely and adequately accommodates public traffic.

If the Contractor damages the haul road by hauling loads in excess of the legal limit, or through negligence or failure to perform maintenance, the Contractor shall repair the damage; the Department will not pay the Contractor for the repairs.

After completing hauling operations over a designated haul road, restore the road to a condition at least equal to the condition existing at the time of the pre-haul inspection. The Engineer will order the type and amount of maintenance and restoration work and the requirements for performing this work.

Maintain and restore the road as required despite the use of the haul road concurrently by other traffic. For haul roads jointly used by multiple contractors on Department contracts, the Engineer will determine the respective obligations for maintenance and restoration.

For haul roads under Department jurisdiction, the Department will only relieve the Contractor of any further obligation for restoration of the road when the Contractor has restored the road to the condition required in the pre-haul inspection report, as accepted in writing by the Engineer. For haul roads under other jurisdiction, obtain a haul road release from the agency charged with control or maintenance of the route and submit a copy of the executed release to the Engineer.

If the Engineer determines that dust from hauling operations on designated haul roads is creating a hazard to traffic or a nuisance to the public, apply water to the haul road as necessary to control the dust.

E. Materials and Construction.

Materials and construction methods used in performing maintenance and restoration work shall meet the requirements of the relevant specifications.

F. Method of Measurement.

The Engineer will measure all approved quantities of material ordered by the Engineer for pre-haul improvements, maintenance, and restoration of designated haul roads as specified in the applicable portions of the contract. The Engineer will measure water used for dust control as specified in Section 216.05, “Method of Measurement”.

G. Basis of Payment.

The Department will pay the Contractor for measured quantities of material ordered by the Engineer for pre-haul improvements, maintenance, and restoration of designated haul roads in accordance with Section 109.03, “Compensation for Contract Revisions.”

The Department will not pay the Contractor for the costs to maintain and restore routes used to haul materials from commercial pits. Include these costs in the contract unit prices of the relevant contract items.

If maintenance and restoration work only requires the use of equipment, the Department will not pay the Contractor for the costs to use the equipment. Include these costs in the contract unit prices of the relevant contract items.

107.09 USE OF EXPLOSIVES

If using explosives to perform the work, do not endanger life or property, and maintain responsibility for all damages resulting from the use of explosives.

Comply with the most restrictive requirements from all local and State laws and ordinances, 27 CFR Part 55, and 29 CFR Part 1926 in the use, handling, loading, transportation, and storage of explosives and blasting agents.

At least 72 hours before using explosives, notify property owners and public utility companies in the vicinity of the proposed detonation.

107.10 PROTECTION AND RESTORATION OF PROPERTY

Protect public and private property while performing the work.

Assume liability for any damage to public or private property resulting from defective work or materials, or non-execution of the contract until project acceptance in accordance with Section 105.15, “Acceptance.”

Restore damaged public and private property to a condition similar or equal to that existing before the damage occurred. Perform restoration in a manner acceptable to the Engineer, the controlling public agency, or private property owners.

Before damaging or disturbing land monuments or property markers, allow the Engineer to witness or otherwise reference their location.

107.11 RESPONSIBILITY FOR DAMAGE CLAIMS

Indemnify and hold harmless the Department, its officers and employees, counties, cities, or other entities or agencies responsible for project supervision, or having jurisdiction over the completed project, and their officers and employees, from suits, actions, or claims brought because of any injuries or damage received or sustained by any person, persons, or property because of the operations of said Contractor; or on account of or in consequence of neglect in safeguarding the work, or through use of unacceptable materials in constructing the work; or because of any act of omission, neglect, or misconduct of the Contractor; or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; or from any claims or amounts arising or recovered under the Workmen’s Compensation Act, or any other law, ordinance, order, or decree.

Money due the Contractor under the Contract may be retained for the use of the Department. In case no money is due, the Surety may be held until such suits, actions, or claims for injuries or damages are settled and evidence to that effect furnished to the Department. Money due the Contractor will not be withheld when evidence shows that the Contractor is adequately protected by public liability and property damage insurance.

It is specifically agreed between the parties executing the contract that it is not intended by any of the provisions of the contract to create in the public or any member thereof a third-party beneficiary, or to authorize anyone to maintain any action for personal injuries, death, or property damage pursuant to or arising out of the terms or provisions of the contract.

107.12 PERSONAL LIABILITY OF PUBLIC OFFICIALS

There shall be no liability upon the Director, Engineer, or their authorized representatives, either personally or as officials of the State in carrying out any contract provisions, or in exercising any power or authority granted to them by or within the contract's scope. It should be understood that in all such matters they act solely as agents and representatives of the State.

107.13 RAILROAD PROVISIONS

A. General Insurance Requirements.

At least 10 business days before starting any work on the railroad right of way, obtain and provide to the Engineer and the railroad company the insurance policy or a certified copy of the Railway Protection Insurance Policy and a certificate of insurance for the Railway Public Liability Insurance policies. Before starting work on the railroad right of way, provide the Engineer with the railroad company's approval of the policies.

Provide insurance policies executed by a corporation qualified and authorized to write the policies in the State and in a form and substance satisfactory to the railroad.

Secure and maintain insurance in full force and effect before starting any work on the railway right of way and until completion of all work required on the railway right of way, as evidenced by acceptance of the portion of the work by the Department. Do not cancel the insurance policies.

B. Indemnification.

Indemnify and hold harmless the railroad company from and against all lawful claims, demands, judgments, losses, costs, and expenses for injury to or death of the person or loss or damage to the property of any person or persons, including the parties hereto, in any manner arising from or growing out of the acts or omissions, negligence, or otherwise of the Contractor, its successors, assigns, licensees, and invitees or agents, in connection with the entry upon, occupation, or use of the said premises described in the contract, including but not limited to that of the location, construction, operation, restoration, repair, renewal, or maintenance of said roadway improvements.

C. Railway Protection Insurance.

1. General Liability.

Assume all liability and provide primary limited coverage as follows:

a. Limited to damage suffered by the railroad because of occurrences arising out of the Contractor's work on or around the railroad right of way, independent of the railroad's general supervision or control, except as included in item b(4).

b. Covering the following:

(1) Death of or bodily injury to passengers of the railway and employees of the railroad not covered by the State Worker's Compensation laws;

(2) Personal property owned by, or in the custody or control of, the railroads;

(3) Death of or bodily injury to the Contractor or any of their agents or employees as the result of acts of the railroad or its agents, regardless of the railroad's negligence;

(4) Negligence of only the following classes of railroad employees:

(a) Any supervisory employee of the railroad at the project site;

(b) Any employee of the railroad while operating, attached to, or engaged on work trains or other railroad equipment at the project site and assigned exclusively to the Contractor; or

(c) Any employee of the railroad not within (a) or (b) specifically loaned or assigned to the Contractor's work for prevention of accidents or protection of property and services paid by the Contractor or the Department.

2. Policy.
Provide a Railroad Protective Liability Insurance policy for all damages arising out of bodily injuries to, or death of, any person or persons, and for all damages arising out of loss or destruction of, or injury or damage to, property in any one occurrence for a combined single limit of not less than $2,000,000 and for a combined total (or aggregate) limit of $6,000,000 during the policy period.

D. Railway Public Liability Insurance.
For work on the railway right of way, protect and hold harmless the railway and any other railroad company occupying or using the railway right of way or line of railroad against all loss, liability, and damage arising from activities of the Contractor, its forces, or any of its subcontractors or agents. Provide the following insurance coverages:

1. Commercial General Liability Insurance, including contractual liability and products completed operations, against claims arising out of bodily injury, illness and death and from damage to or destruction of property of others, including loss of use thereof, and including liability of the railway, with minimum limits for bodily injury and property damage of $2,000,000 for each occurrence and with an aggregate limit of $4,000,000. Provide a policy containing a "Waiver of Transfer Rights" endorsement, waiving any right of recovery by the insurance company against the railway because of payment made for bodily injuries or property damage.

2. Business Automobile Insurance, including owned, non-owned, and hired vehicles with minimum limits for bodily injury and property damage of $1,000,000 per occurrence on all vehicles used while performing any work in this contract.

3. Worker's Compensation Insurance as required by the State of North Dakota. If the Contractor is not covered by the North Dakota Worker's Compensation Act, the Contractor shall provide an employer's liability policy. The policy shall include occupational disease to required statutory limits, employer's liability of $1,000,000 to include FELA (Federal Employees Liability Act), if appropriate, and an "All States" endorsement.

E. Railroad Coordination.
If the contract requires the hauling of materials across railroad tracks other than at existing public crossings, the Department will arrange with the railroad company for the required

crossings. For crossings not required in the contract, arrange to use the crossings with the railroad company.

Provide to the Engineer and the railroad company detailed plans of all falsework, excavation, and cofferdams planned for construction over, below, or adjacent to the railroad's tracks. Before performing this work, obtain the railroad company's approval of the detailed plans.

Perform all work within the railroad right of way in accordance with the requirements and time schedules set by the railroad company. Notify the Engineer and the railroad company at least 10 business days before the proposed date the work within the railroad's right of way will begin and at least 24 hours in advance of the proposed start time for any work that may interfere with the operation of trains.

F. Basis of Payment.

The Department will pay for Railway Protection Insurance by the lump sum contract unit price. The costs of providing Railway Protective Liability Insurance and Railway Public Liability Insurance are included in the contract unit price for Railway Protection Insurance. Upon receiving proof of approval of the policies by the railroad company, the Department will pay the Contractor the lump sum contract unit price.

G. Railroad Flagging.

Coordinate the need for railroad flagging with the affected railroad company.

The Department will pay the railroad company for the cost of providing railroad flagging, and will deduct the amount paid to the railroad company from monies due or to become due the Contractor. The costs of railroad flagging are included in the contract unit price of the contract items.

107.14 PUBLIC LIABILITY AND PROPERTY DAMAGE INSURANCE

A. General Requirements.

Submit to the Department the certificates of insurance effecting the requirements in this section for the Commercial General Liability and Commercial Automobile Liability Insurances with the contract and the contract bond in accordance with Section 103.06, "Execution and Approval of Contract."

Provide insurance policies executed by a corporation qualified and authorized to write the policies in the State of North Dakota. The State reserves the right to obtain complete, certified copies of all required insurance documents, policies, or endorsements at any time.

Secure and maintain insurance in full force and effect before starting the work and until completion of all work required and accepted by the Department or owner. The policies shall provide 30 calendar days notice to the Department or the owner of any intent to cancel or materially alter such insurance.

Failure to maintain the insurance as required constitutes a material breach of contract. The Department or the owner may, after giving 5 business days notice to the Contractor to correct the breach, immediately terminate the Contractor in accordance with Section 108.08, "Termination of the Contract for Default," and procure or renew such insurance and pay all premiums. The Department or the owner may demand repayment of premium costs by the

Contractor, or may offset the premium costs against funds due the Contractor from the Department or the owner.

B. Insurance Requirements.
Secure and maintain in full force and effect during the term of the contract the following insurance coverages:

1. Commercial General Liability for limits not less than $2,000,000 combined single limit per occurrence and aggregate for bodily injury, property damage, personal injury and completed operations/product liability. Provide products and completed operations coverage for a period of one year following final acceptance of the work. Provide coverage with the aggregate limit applied separately to occurrences at the location or project described in this contract. Provide a policy including a "stop-gap" Employers Liability endorsement to cover the employer's liability for injury to employees falling outside the State Worker's Compensation Law.

2. Commercial Automobile Liability for limits not less than $2,000,000 combined single limit per accident for bodily injury and property damage.

3. Workers Compensation coverage as required by the State of North Dakota.

The General Liability and Automobile policies shall provide an additional insured endorsement in favor of the State of North Dakota and the Owner and shall contain a "Waiver of Subrogation" to waive any right of recovery that the Insurance company may have against the State and the Owner. The coverage required under this agreement shall be primary for the State and the Owner, and shall not be affected by any other insurance or coverage obtained by the State or the Owner on their own behalf.

Any right of the State to receive indemnification and insurance shall not give rise to a duty on the part of the State to exercise its rights or status for the benefit of the owner, or any other person or entity.

C. Subcontractor.
If subletting a portion of the contract, the Contractor shall obtain insurance protection in accordance with Section 107.14 B, "Insurance Requirements," to provide liability coverage to protect the Contractor, State, and owner for work undertaken by the subcontractor. Ensure public liability and property damage insurance coverage in accordance with Section 107.14 B, "Insurance Requirements," for all parties performing work under the contract.

107.15 HAZARDOUS MATERIAL

If the Contractor encounters abnormal conditions that indicate the presence of hazardous material or toxic waste anywhere the Contractor performs the work, the Contractor shall immediately suspend the work and notify the Engineer. Continue work in other areas of the project, but do not resume work in the area of the abnormal condition, unless directed to resume by the Engineer.

Abnormal conditions include the presence of barrels, obnoxious odors, excessively hot earth, smoke, or any other conditions indicating the presence of a hazardous material or toxic waste. Treat the conditions with extreme caution.

Dispose of the hazardous material or toxic waste in accordance with the requirements and regulations of the NDDEQ. The Department will pay for work required to dispose of these

materials in accordance with Section 104.02, "Contract Revisions." For waste material disposal requiring special procedures, the Department will arrange with qualified, certified persons to dispose of the material.

107.16 CIVIL RIGHTS

Comply with federal, State, and local laws, rules, and regulations that set forth unlawful employment practices including discrimination because of race, religion, color, sex, or national origin, and defining actions required for Affirmative Action and DBE programs.

Ensure that no person or groups of persons be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under all programs, services, or activities administered by the Department on the grounds of race, color, national origin, sex, age, disability/handicap, or income status.

107.17 REMOVED MATERIAL

Unless otherwise designated in the contract, removed material becomes the property of the Contractor.

If the Contractor determines that the material will be disposed of, the material must be disposed in one of the following ways:

A. Dispose of the material through a beneficial use. Apply for a beneficial use permit from the NDDEQ by completing an *NDDOT Projects-Inert Waste Beneficial Use Application* (SFN 58981). Provide the Engineer with copies of all documents submitted to the NDDEQ.

B. Dispose of the material at an approved permanent waste management facility.

C. If waste cannot be reasonably managed at a permanent waste management facility, obtain approval from the NDDEQ for a variance to dispose of the inert waste at another site. Apply for a variance by completing an *NDDOT Projects-Inert Waste Disposal Variance Application* (SFN 54344). Provide the Engineer with copies of all documents submitted to the NDDEQ.

   Obtain locations of permanent waste facilities, applications, and guidelines from the NDDEQ, Division of Waste Management. View a list of municipal and inert waste landfills and review guidance on the NDDEQ website: https://deq.nd.gov/.

Include the cost of material disposal in the contract unit price of the relevant contract item.

107.18 HIGH VISIBILITY CLOTHING

When not enclosed in a truck or equipment cab, require that all workers within the right of way wear retroreflective clothing in accordance with the MUTCD.

Ensure that retroreflective clothing is the outermost garment, in a clean condition, and closed in both the front and rear. Replace retroreflective clothing as necessary to maintain visibility and reflectivity.

During times of low visibility, require that all workers wear Class 3 retroreflective clothing.

SECTION 108
PROSECUTION AND PROGRESS

108.01 SUBLETTING OF CONTRACT

A minimum of 30 percent of the work, as represented by the original contract amount, must be performed by the Contractor's organization. When calculating the percentage of the work to be performed by the Contractor, the Engineer will deduct from the original contract amount the contract price of contract items identified by the contract as specialty items. The Engineer will include the delivered cost of commercially produced materials and manufactured components purchased by the Contractor in the percentage of the work to be performed by the Contractor.

Sublet, sell, transfer, assign, or dispose of any portion of the contract only with the Engineer's prior written approval. To obtain approval, submit a *Prime Contractor's Request to Sublet* (SFN 5682) for each proposed subcontractor with a copy of the subcontract and associated lower-tier subcontracts. For a partially subcontracted contract item, explain in detail and show the subcontract amount associated with the partially subcontracted contract item.

If a proposed subcontractor is not currently prequalified, certified as a DBE, or registered as a subcontractor with the Department, submit a *Subcontractor Registration Request* (SFN 52243) with the *Prime Contractor's Request to Sublet*.

When the contract specifies a DBE Goal, execute a subcontract with all firms approved through the Department's Good Faith Effort process. If the Department classifies the firm as an oil hauler, supplier, broker, vendor, regular dealer, or manufacturer, no subcontract is required, but the firm must be used to perform the work.

Begin subcontracted work only after the Engineer approves the *Prime Contractor's Request to Sublet*.

A subcontract, transfer of all or a portion of the contract, the Engineer's approval of the *Prime Contractor's Request to Sublet*, or the Department's prequalification, DBE certification, or registration of a subcontractor:

A. Does not relieve the Contractor of responsibility to carry out the contract. Although the Contractor may subcontract a portion of the work to other parties, the Contractor is responsible for the successful performance and completion of all the work as required by the contract.

B. Does not relieve the Contractor of any obligations or liability under the contract and the contract bond.

C. Is not an endorsement of the subcontract, the subcontractor, or the subcontractor's ability to perform the work as required by the contract.

D. Does not create a contractual relationship between the Department and the subcontractor.

E. Does not convey to the subcontractor any rights against the Department.

108.02 CONSTRUCTION MEETINGS

A. Preconstruction Conference.
Before beginning the work, including pit operations specific to the project, and unless waived by the Engineer, coordinate and hold a preconstruction conference with the Engineer at a mutually agreed time and place. Notify subcontractors, utility companies, and other interested parties of the time and place of the preconstruction conference.

Submit the following to the Engineer before or at the preconstruction conference:

1. A company safety plan and the name of the safety officer;
2. An EEO / affirmative action plan and the name of the EEO officer;
3. A list of key project personnel and their phone numbers;
4. The initial or baseline schedule in accordance with Section 108.03, "Progress Schedule";
5. A list of proposed subcontractors requested in accordance with Section 108.01, "Subletting of Contract";
6. A list of material suppliers;
7. A list of pits to be used (owner and legal description);
8. All COAs in accordance with Section 107.05, "Material Source Approval";
9. The applicable storm water permits and the SWPPP in accordance with Section 107.02.C, "Storm Water Permits";
10. The names of Quality Control Personnel and a Quality Control Plan in accordance with Section 430.04 A, "Contractor Quality Control (QC)."

B. Weekly Planning and Reporting Meeting.
The weekly planning and reporting meeting is only required when specified in the plans.

Organize a weekly meeting to coordinate efforts between subcontractors, utilities, local authorities, and others. The Engineer will develop a list of parties to be invited to the meeting and will provide the list to the Contractor at the Preconstruction Meeting. The Engineer may provide an updated list with additional attendees at any time.

Send a knowledgeable representative to conduct the meeting. Prepare minutes for each meeting and make the appropriate distribution of the minutes. Distribute the minutes within 48 hours of the meeting conclusion. Allow the Engineer to review and approve the minutes before distribution.

Include in the meeting agenda a discussion of problems encountered since the last meeting, and information of interest to those invited to the meeting. Provide a written schedule of the next week's work and a tentative schedule for the following week.

108.03 PROGRESS SCHEDULE

A. General.

Prepare and submit to the Engineer a schedule in accordance with Section 108.03 B, "Bar Chart Method," unless the contract requires a Critical Path Method (CPM) schedule. If the contract requires a CPM schedule, prepare and submit to the Engineer a CPM schedule in accordance with Section 108.03 C, "Critical Path Method (CPM)."

Prepare and submit progress schedules in accordance with the AGC's *Construction Planning & Scheduling Manual*. In case of a conflict between the *Construction Planning & Scheduling Manual* and the scheduling requirements in the contract, the contract requirements will take precedence.

Use the schedule to plan, coordinate, and manage the work, whether the Contractor's personnel are performing the work or not. Share copies of the complete baseline schedule, update schedules, and revised schedules with all subcontractors, suppliers, and utility companies affected by the work.

Float is a shared commodity and is not for the exclusive use or benefit of any party. It is available to all parties as needed until it is consumed.

The Engineer will accept or reject a schedule based on the schedule meeting the requirements of Section 108.03, "Progress Schedule," and any other contract requirement. The Engineer's acceptance of a schedule:

1. Does not modify the contract;

2. Does not constitute endorsement or validation by the Engineer of the Contractor's activity logic, activity durations, or assumptions in creating the schedule;

3. Does not guarantee that the project can be performed or completed as depicted in the schedule; and

4. Does not relieve the Contractor of its obligation or responsibility to submit complete and accurate information.

If the Contractor or Engineer discovers an error after the Engineer has accepted a schedule, the Contractor shall correct the error in the next schedule submission.

If the Contractor fails to prepare and submit a progress schedule that is acceptable to the Engineer as required by the contract, the Engineer will withhold progressive estimates until the Contractor submits an acceptable schedule.

B. Bar Chart Method.

1. Submission Requirements.

Provide the following items with the initial, baseline, update, and revised schedule submissions:

a. Narrative Reports.

Narrative reports shall include:

(1) An explanation of the overall plan to complete the project;

(2) The number of crews and the following for each crew:

(a) The number and types of workers;

(b) The number and types of equipment;

(c) The working days per week, the number of shifts per day, the number of hours per shift, and the holidays to be observed; and

(d) The schedule activities being performed;

(3) A description of how the schedule accounts for adverse weather days;

(4) The quantity of work and estimated production rates for each critical activity;

(5) Activities requiring coordination with the Department, other parties, or both;

(6) A description of the critical path;

(7) A description of all changes in the schedule and narrative report that differ from the last accepted schedule submission; and

(8) For a revised schedule, a description of and the reason for all revisions to the schedule.

b. Graphical Depiction of the Bar Chart Schedule.
Submit schedules in color as a paper printout or a .pdf file, with minimum dimensions of 11 inches by 17 inches.

c. Transmittal Letter.
Submit a transmittal letter to the Department that identifies the schedule being submitted for review and states that the schedule being submitted has been developed in accordance with the contract.

2. Initial Schedule.
At least 5 business days before the preconstruction conference, submit an initial schedule. The Contractor may submit the baseline schedule, as specified in Section 108.03 B.3, "Baseline Schedule," as both the initial and baseline schedule. For projects with expected durations of less than 90 calendar days, submit the initial schedule as the baseline schedule.

Define and sequence activities to accurately describe the project and to comply with all contract requirements, including those related to the scope of work, phasing or staging, sequencing, accommodations for traffic, and milestones.

The initial bar chart schedule is a schedule prepared for the first 90 calendar days of work and shall include the following minimum information:

a. The activities needed to perform and complete the work;

b. The planned start and completion dates for each activity, the duration of each activity (stated in working days, and with activities of more than 30 working days in duration broken into two or more activities distinguished by location or some other feature), and the sequencing of all activities;

c. Applicable project milestones, including notice to proceed, the start date of the work, and the completion date associated with the expiration of the contract time;

d. The location of the work;

e. Dates related to the procurement of significant materials, equipment, and articles of special manufacture;

f. Dates related to the submission of work drawings, plans, and other data specified for review by the Department;

g. Dates related to required inspections; and

h. Dates related to work by the Department and other parties.

Submit a summary schedule for the balance of the project work after the first 90 calendar days; activity durations on the summary schedule may exceed 30 working days.

Within 5 business days after the preconstruction conference, the Department will respond in writing accepting the initial schedule, rejecting the initial schedule and identifying the reasons for rejection, or requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the initial schedule or provide the information requested.

3. Baseline Schedule.

Within 30 calendar days after the preconstruction conference, prepare the baseline schedule and submit to the Department for review. For projects with expected duration of less than 90 calendar days, the Department will not require the Contractor to submit a baseline schedule.

The baseline schedule shall include the requirements set forth by Section 108.03 B.2, "Initial Schedule," items "a" through "h", but for the entire project and all work.

Note any differences between the initial schedule and the baseline schedule in the narrative report submitted with the baseline schedule.

Within 10 business days after receipt of the baseline schedule, the Department will respond in writing accepting the baseline schedule, rejecting the baseline schedule and identifying the reasons for rejection, or requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the baseline schedule or provide the information requested.

4. Update Schedule.

After the Department's written acceptance of the baseline schedule, prepare and submit an update schedule every month with a data date of the first business day of the succeeding month. Report the progress of work performed up to, but not including, the data date. Submit the update schedule within 3 business days after the data date.

Schedule and conduct weekly progress meetings with the Engineer to discuss schedule progress. Update the schedule to reflect this actual progress. For activities that have started or finished since the data date of the last accepted schedule, include the actual start or finish dates. For activities started and still ongoing, show the remaining durations and planned finish dates.

Do not make changes between the last accepted schedule and the update schedule, such as adding or deleting activities, increasing or decreasing activity durations, changing the sequence of work, or renaming activities or changing activity descriptions.

Within 5 business days after receipt of the update schedule, the Department will respond in writing by accepting the update schedule, by rejecting the update schedule and identifying the reason for rejection, or by requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the update schedule or provide the information requested.

5. Revised Schedule.

Prepare and submit a revised schedule if a revision to the schedule is necessary.

The Department may request the submission of a revised schedule if any of the following circumstances occur:

a. There is a delay (actual or projected) to the scheduled milestone or project completion dates;

b. There is a difference between the actual sequence or durations of the work and the sequence or durations depicted in the last accepted schedule; or

c. The Department executes a contract revision that adds or deletes work, modifies the planned sequence of work, or modifies the means and methods of its performance.

The requirement to prepare a revised schedule is not a directive by the Department to accelerate the work.

Prepare and submit the revised schedule as soon as the need for a revised schedule is necessary, but no more than 5 business days after the Department's request.

Within 5 business days of receipt of the revised schedule, the Department will respond in writing accepting the revised schedule, rejecting the revised schedule and identifying the reasons for rejection, or requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the revised schedule or provide the information requested.

C. Critical Path Method (CPM).

1. General.
Use CPM scheduling software that is compatible with Microsoft Project.

2. Submission Requirements.
Submit an electronic copy of the CPM schedule in its native format containing the entire schedule. Submit schedules in a format compatible with Microsoft Project.

Calculate the CPM schedule using retained logic. Calculate total float based on finish dates. Calculate schedule durations as contiguous. Calculate start-to-start lags from early dates.

Provide the following items with the initial, baseline, update, and revised schedule submissions:

a. Narrative Report.
Narrative reports shall include:

(1) An explanation of the overall plan to complete the project;

(2) The number of crews and the following for each crew:

(a) The number and types of workers;

(b) The number and types of equipment;

(c) The working days per week, the number of shifts per day, the number of hours per shift, and the holidays to be observed; and

(d) The schedule activities being performed;

(3) A description of how the schedule accounts for adverse weather days;

(4) The quantity and estimated production rates for each critical activity;

(5) Activities requiring coordination with the Department, other parties, or both;

(6) A description of the critical path;

(7) A Claim Digger or equivalent report showing all changes in the schedule and a description of all changes in the narrative report that differ from the last accepted schedule submission; and

(8) For a revised schedule, a description of and the reason for all revisions to the schedule.

b. Logic Diagram.
Logic diagrams shall be in color and on standard D size sheets (24 inches by 36 inches).

c. Tabular Sorts.
Tables shall include sorts of activities listed by the following:

(1) Early start;

(2) Predecessor and successor;

(3) Phase or stage by early start;

(4) Longest path; and

(5) Total float.

d. Graphical Depiction of CPM Schedule.
The graphical depiction shall be a bar chart view of all activities grouped by phase and stage, and sorted by early start date.

e. Look-Ahead Schedule.
The look-ahead schedule shall be a bar chart view of the 60-calendar-day period starting with the data date, and sorted by early start.

f. Transmittal Letter.
Submit a transmittal letter to the Department that identifies the schedule being submitted for review and states that the schedule being submitted has been developed in accordance with the contract.

3. Initial Schedule.
At least 5 business days before the preconstruction conference, submit an initial schedule as specified by Section 108.03 B.2, "Initial Schedule", except that if submitting a baseline schedule as the initial schedule submit the baseline schedule as specified in Section 108.03 C.4, "Baseline Schedule".

4. Baseline Schedule.
Within 30 calendar days after the preconstruction conference, prepare and submit a baseline schedule to the Department for review.

Note any differences made between the initial schedule and the baseline schedule in the narrative report submitted with the baseline schedule.

Provide a baseline schedule that meets the following requirements:

a. Do not use or allow the following:

(1) Negative lags.

(2) Start-to-finish relationships.

(3) Open ends; only the first activity will have no predecessor and only the last activity will have no successor.

(4) Constraints; only constraints associated with phasing, staging, milestones, or project completion dates specified in the contract are allowed, unless the Contractor requests in writing and the Department authorizes in writing.

(5) Manually modified dates; only manually modify dates with written authorization from the Department.

b. Includes the following work activities, as applicable:

(1) Work to be performed by the Contractor, subcontractors, and suppliers.

(2) Work to be performed by the Department and third parties.

(3) The project start date, scheduled completion dates, and other milestones required by the contract, start or finish dates for phases, or site access or availability dates.

(4) Submittal review and approval activities when applicable, including time for the Department's approval as specified in the contract.

(5) Fabrication, delivery, installation, testing, and similar activities for materials, plants, and equipment.

(6) Sampling and testing periods.

(7) Settlement or surcharge periods.

(8) Cure periods.

(9) Utility notification and relocation.

(10) Installation, erection and removal, and similar activities related to temporary systems or structures.

(11) Punch list, final cleanup, and similar activities.

(12) Required acceptance testing, inspections, or similar activities.

(13) Activities representing acquisition of permits or acquisition of right of way.

c. Provide the following attributes for each activity in the baseline schedule:

(1) A unique alphanumeric Activity ID.

(2) A unique activity description that includes a verb, object, and location.

(3) A duration stated in workdays of no more than 15 workdays, unless the Contractor requests a longer duration and the Department approves in writing.

(4) Codes for responsibility, and phasing or staging.

Within 10 business days of receipt of the baseline schedule, the Department will respond in writing accepting the baseline schedule, rejecting the baseline schedule and identifying the reason for rejection, or requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the baseline schedule or provide the information requested.

5. Update Schedule.

After the Department's written acceptance of the baseline schedule, prepare and submit an update schedule every 30 calendar days with a data date of the first business day of the succeeding 30 calendar days. Report the progress of work performed up to, but not including, the data date. Submit the update schedule within 3 business days after the data date.

Schedule and conduct weekly progress meetings with the Engineer to discuss schedule progress. Update the schedule to reflect this progress. For activities that have started or finished since the data date of the last accepted schedule, include the actual start or finish dates. For activities started and still ongoing, show the remaining duration and planned finish dates.

Do not make changes between the last accepted schedule and the update schedule, such as adding or deleting activities, increasing or decreasing original durations, adding or deleting relationships, renaming activities, or changing activity descriptions.

Within 5 business days after receipt of the update schedule, the Department will respond in writing by accepting the update schedule, by rejecting the update schedule and identifying the reason for rejection, or by requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the schedule update or provide the information requested.

6. Revised Schedule.

Prepare and submit a revised schedule if a revision to the schedule is necessary. The Department may request the submission of a revised schedule if any of the following circumstances occur:

a. There is a delay (actual or projected) to the scheduled milestone or contract completion dates;

b. There is a difference between the actual sequence or durations of the work and the sequence or durations depicted in the last accepted schedule; or

c. The Department executes a contract revision that adds or deletes work, modifies the planned sequence of work, or the means and methods of its performance.

The requirement to prepare a revised schedule is not a directive by the Department to accelerate the work.

Prepare and submit the revised schedule as soon as the need for a revised schedule is necessary, but no more than 5 business days after the Department's request.

Within 5 business days of receipt of the revised schedule, the Department will respond in writing accepting the revised schedule, rejecting the revised schedule and identifying the

reasons for rejection, or requesting more information. Within 5 business days after the date of the Department's written response, address the reasons for rejection and resubmit the revised schedule or provide the information requested.

D. Measurement and Payment.

The Department will not pay the Contractor directly for bar chart schedules; the cost of bar chart schedules is included in the contract unit prices of the contract items.

The Department will measure the CPM schedule as a complete unit, and the Department will pay as follows:

Pay Item	Pay Unit
Critical Path Method Schedule	Lump Sum

The Department will pay the Contractor for the CPM schedule as follows:

1. The Department will include 20 percent of the lump sum price in the progressive estimate following the Department's acceptance of the baseline schedule.

2. The Department will pay the remaining 80 percent of the lump sum contract unit price in prorated amounts based on the following formula:

$$\text{Amount paid per update schedule submitted} = 80\% \times \frac{\text{Lump Sum contract unit price}}{\text{number of update schedules anticipated during the life of the contract}}$$

3. If the Contractor fails to submit an update schedule on time, the Engineer will reduce the prorated amount for that update schedule as shown in Table 108-01. Even if the Engineer reduces the prorated amount by 100 percent, the Contractor must submit the update schedule.

Table 108-01
CPM Schedule Price Reductions

Days Late Submitting Update Schedule	Percentage Price Reduction to the Prorated Amount[1]
1	20
2	40
3	60
4	80
5	100

[1] The "prorated amount" is equivalent to the amount calculated for each update schedule submission in Section 108.03 D, Item 2.

Payment will be full compensation for the initial, baseline, update, and revised schedules; all required schedule submittals; and all associated progress meetings as necessary to complete the work.

108.04 NOTICE TO PROCEED

The Department's mailing or delivery of a copy of the executed contract to the Contractor or authorized agent constitutes the notice to proceed.

108.05 LIMITATION OF OPERATIONS

Standard Special Provision (SSP) 5 "Limitation of Operations" has replaced this section.

108.06 DETERMINATION OF AND EXTENSIONS TO THE CONTRACT TIME

A. Determination of the Contract Time.

1. General.

The contract specifies the contract time. Perform the work within the contract time. The contract time may include phased or interim start or finish dates, or minimum or maximum durations for portions of the work.

2. Working Day Contracts.

Working day contracts specify the contract time as the number of working days.

The Department will charge working days from the starting date specified in the contract, or from the date the Contractor starts work at the project site, whichever is earlier. If the notice to proceed is delayed for reasons beyond the Contractor's control and not the Contractor's fault or responsibility, the Engineer will extend the starting date for working-day time charges to no earlier than the seventh calendar day after the notice to proceed or the date the Contractor starts work at the project site, whichever is earlier.

The Engineer will charge a full working day (at least 7 hours) or half working day (more than 3 hours but less than 7 hours) for each calendar day the Contractor can effectively perform work on the critical path as follows:

a. Any day the Contractor could have performed work on critical activities, except Saturday and holidays;

b. Any day the Contractor performs work on critical activities, including Saturdays and holidays; or

c. Any holiday the Contractor receives approval from the Engineer to work, even if the Contractor does not perform work.

The Engineer will not charge a working day under the following conditions:

a. During the period from November 15 to April 15, even if the Contractor performs work on the critical activities during this period;

b. Any day the Contractor is only able to perform work on critical activities for 3 hours or less; or

c. Any day the Contractor performs work on non-critical activities but is unable to perform work on critical activities due to conditions beyond the Contractor's control.

The Engineer will provide a weekly statement showing the number of working days charged for the preceding week and the number of working days remaining in the contract time. Review the weekly statement and, within 5 business days after the last day of the week covered by the statement, notify the Engineer that the weekly statement is correct or protest the weekly statement. To protest, submit to the Engineer a written request to revise the working day charges. Failure to submit a request within 5 business days constitutes the Contractor's agreement with the working day charges in the weekly statement. Once agreed to by the Contractor, whether explicitly or because of the Contractor's failure to submit a timely protest, the working day charges documented by the weekly statement are final and the Contractor waives entitlement to a time extension or compensation for delays not explicitly identified by the weekly statement.

3. Calendar Day Contracts.
Calendar day contracts specify the contract time as the number of calendar days.

The completion date is determined by adding the number of calendar days specified in the contract to the starting date specified in the contract or from the date the Contractor starts work at the project site, whichever is earlier. If the notice to proceed is delayed for reasons beyond the Contractor's control and not the Contractor's fault or responsibility, the Engineer will extend the starting date for calendar day contracts to no earlier than the seventh calendar day after the notice to proceed or the date the Contractor starts work at the project site, whichever is earlier.

4. Completion Date Contracts.
Completion date contracts specify the contract time as a calendar date, or a calendar date with a guaranteed minimum number of working days.

If the completion date contract guarantees a minimum number of working days, the Engineer will charge working days in accordance with Section 108.06 A.2, "Working Day Contracts." If the number of working days charged through the specified completion date is less than the guaranteed number, the Engineer will extend the specified completion date to allow for the guaranteed number of working days.

B. Extensions to the Contract Time.

1. General.
The Contractor shall immediately notify the Engineer of a delay in accordance with Section 104.03, "Contractor Requested Contract Revisions," once the Contractor becomes aware of the delay, not at the conclusion of the delay. The Contractor waives entitlement to a time extension or compensation for delay or costs incurred before the Contractor notified the Engineer of the delay.

After notifying the Engineer of the delay, keep daily records of the labor, material, and equipment affected by the delay as specified in Section 109.03 E, "Force Account." Maintain a daily record of each operation affected by the delay and the station locations of the operations affected. The Department will also maintain daily records of the operations and station locations. Each Monday, compare the previous week's daily records with the records kept by the Department.

Provide written notice to the Engineer within 10 business days of the results of the comparison of the detailed records performed each Monday, and list and describe any disagreements between the records.

The Contractor's failure to meet with the Engineer and review the Department's records or to list and describe disagreements between the Contractor's and Department's records shall establish that the Department's records are accurate, that the Contractor accepts the records as prepared, and that the Contractor agrees that the Department's records will be the basis for determining the delay and any compensation that may be due because of the delay.

In addition to the daily records, prepare and submit written reports to the Engineer containing the following information each Monday:

a. Number of days behind schedule.

b. A summary of all operations that have been delayed, or will be delayed.

c. In the case of a compensable delay, explain how the Department's act or omission delayed each operation.

d. Itemize and document all added costs being incurred due to the delay. Show all calculations related to the determination of costs.

The Contractor's plea that the contract time was insufficient is not a valid reason for an extension of time. For calendar day and completion date contracts, the Department will not extend the contract time for delays encountered on holidays and during the period from November 15 to April 15. When the time as extended by the Department falls on a date that is a holiday, the Engineer will extend the contract time to the next business day.

The Department will evaluate the Contractor's documentation and analysis and determine the time extension due, if any. The Department will not evaluate a request for an extension of the contract time or revise the contract time unless the Contractor notifies the Department as specified in Section 104.03, "Contractor Requested Contract Revisions."

The Engineer will evaluate delays and requests for extensions or revisions to phased or interim start or finish dates, or durations for portions of the project in the same manner as requests for an extension of the contract time for the project as a whole. Comply with the requirements of Section 108.06 B, "Extensions to Contract Time," when seeking a time extension for phased or interim start or finish dates or durations.

In the event that the Department extends the contract time into a period of the year during which the working conditions are less favorable, the Department will consider a further extension of time based on the nature of the work the Contractor scheduled to perform during the less favorable period. Conversely, if the Department extends the contract time into a period of the year during which the working conditions are more favorable, the Department will consider reducing the contract time extension. If the Department reduces the work required to complete the project or relaxes phase or stage requirements, the Department may reduce the contract time.

2. Evaluation of Delays and Calculation of Time Extensions.
The Engineer will evaluate the Contractor's request for a time extension based on the Contractor's compliance with the following requirements:

a. Base all evaluations of delay and all calculations of the appropriate time extensions due on the schedules submitted to and accepted by the Department and current at the time the delay occurred, not schedules created after the delay occurred.

b. The delay is on the critical path when the delay occurred.

c. The delay results in a scheduled milestone, phase or stage, or project completion date that is later than the date required by the contract.

d. If the contract requires a CPM schedule, determine the duration of delays as follows:

(1) Use time impact analysis (TIA) to identify and measure critical delays that have not yet occurred. Do not use this method to evaluate delays that have already occurred. In general terms, perform a TIA as follows:

(a) Develop a "mini" schedule for the changed work. This schedule is known as a fragnet.

(b) Identify the current accepted schedule. and record the scheduled completion date on that schedule.

(c) Insert the fragnet into the current schedule by properly linking the fragnet with the existing activities in the current accepted schedule.

(d) Recalculate the current schedule with the fragnet inserted and record this scheduled completion date.

(e) The difference in the calculated scheduled completion dates between the current schedule and the schedule calculated with a properly inserted and properly composed fragnet is the delay attributable to the changed work. The time extension due, if any, will be based on this delay.

(2) Use a contemporaneous analysis when evaluating delays that have already occurred. In general terms, perform a contemporaneous analysis as follows:

(a) Identify the most recent accepted schedule with a data date before the start of the delay being evaluated.

(b) Identify each accepted schedule in effect during the delay and the schedule with a data date that immediately follows the conclusion of the delay.

(c) Identify the critical path each day from immediately before the start of the delay to the schedule immediately following the delay.

(d) Determine whether the delay falls on the critical path.

(e) If the delay does not fall on the critical path, then no project delay occurred and no time extension is due.

(f) If the delay falls on the critical path, then determine the number of days the critical path is delayed. The time extension due, if any, will be based on this delay.

3. Administration of Time Extensions.
The Department will administer excusable delays on working day, calendar day, and completion date contracts as follows:

a. For working day contracts, the Department will not charge working days for excusable delays, except for delays caused by added work or extra work. For delays caused by added or extra work, the Department will provide a time extension by adding working days to the contract time.

b. For calendar day and completion date contracts, the Department will provide a time extension by adding calendar days to the contract time.

4. Excusable, Non-Compensable Delays.
Excusable, non-compensable delays are unforeseeable and unavoidable delays that are not the Contractor's or the Department's fault or responsibility. The Contractor is entitled to a contract time extension but not entitled to compensation for delay costs associated with an excusable, non-compensable delay. The following are excusable, non-compensable delays:

a. Delays due to floods, tornadoes, earthquakes, or other natural disasters.

b. Extraordinary delays in material deliveries. When the Contractor requests an extension of the contract time for delays due to the late delivery of materials, at the time the delay occurs the Contractor shall provide sufficient documentation to the Department to establish that the delay results from the materials being unavailable because of an unusual market condition. An unusual market condition may be an embargo, government act, nation-wide shortage, industry-wide strike, or natural disaster that arises after the opening of proposals. The Contractor is not entitled to a time extension for delays due to slow delivery when the required material is available from another source.

c. Delays due to civil disturbances or acts of war or terror.

d. Delays due to epidemics or quarantines.

e. Delays due to labor strikes that are beyond the control of the Contractor, subcontractors, or suppliers and are not caused by the improper acts or failures of the Contractor, subcontractor, or supplier.

f. Delays due to utility or railroad work when the Contractor has complied with the requirements of Section 105.03 D, "Scheduling," but the utility or railroad company failed to perform their work within the time agreed to in the utility coordination meeting.

g. Delays due to additional quantities that represent a significant change as defined in Section 104.02 C, "Significant Changes in the Character of Work."

h. All other delays not the Contractor's or Department's fault or responsibility and not reasonably foreseeable or avoidable by the Contractor.

5. Excusable, Compensable Delays.

Excusable, compensable delays are delays that are not the Contractor's fault or responsibility but are the Department's fault or responsibility. The Contractor is entitled to a contract time extension and to compensation for delay costs associated with an excusable, compensable delay. The Department will determine compensation for an excusable, compensable delay in accordance with Section 109.03 F, "Delay Costs." The following are excusable, compensable delays:

a. Delays due to an Engineer-ordered suspension as specified in Section 104.02 D, "Suspensions of Work Ordered by the Engineer."

b. Delays due to differing site conditions as specified in Section 104.02 B, "Differing Site Conditions," extra work as specified in Section 104.02 E, "Extra Work," and significant changes in the character of the work as specified in Section 104.02 C, "Significant Changes in the Character of Work," except significant changes due to increases in quantities.

c. Delays due to the Department's neglect.

d. Delays due to the unavailability of right-of-way.

e. Delays due to utility or railroad work when the Contractor is required to alter operations due to conflicts with utility facilities not shown in the plans or railroads not shown in the plans.

6. Non-Excusable Delays.

Non-excusable delays are delays that are the Contractor's fault or responsibility or delays that the Contractor could have foreseen or avoided, and weather delays not covered by the events listed in Section 108.06 B.4, "Excusable, Non-Compensable Delays." Delays due to the Contractor's, subcontractors', or suppliers' insolvency or performance are neither excusable, nor compensable. The Contractor is not entitled to a time extension or compensation for a non-excusable delay.

7. Concurrent Delays.

Concurrent delays are separate delays to critical activities occurring at the same time. When a non-excusable delay is concurrent with an excusable delay, the Contractor is not entitled to a time extension for the period the non-excusable delay is concurrent with the excusable delay. When a non-compensable delay is concurrent with a compensable delay, the Contractor is entitled to a contract time extension but not entitled to compensation for the period the non-compensable delay is concurrent with the compensable delay.

108.07 UNSATISFACTORY PROGRESS AND FAILURE TO COMPLETE WITHIN THE CONTRACT TIME

A. Unsatisfactory Progress.

If the Contractor fails to satisfactorily progress the work as reflected in the current accepted progress schedule, the Engineer may arrange a meeting between the Contractor, the surety, and other Department representatives to discuss the unsatisfactory progress. The parties will mutually develop a plan for the Contractor to regain satisfactory progress.

B. Failure to Complete within the Contract Time.

1. General.

For each calendar day that the work remains incomplete after the expiration of the contract time, the Department will deduct the sum specified in Table 108-02, "Daily Charges for Liquidated Damages" from any money due the Contractor. If the amount of the deduction exceeds the money due, then the Contractor shall immediately pay the Department the difference.

The sum specified in Table 108-02 is not a penalty but a liquidated damage due the Department because of inconvenience to the public, added cost of engineering and supervision, and other additional expenditures of the public's funds due to the Contractor's failure to complete the work within the contract time.

Permission for the Contractor or surety to continue and finish work after the contract time and approved time extensions have elapsed shall not waive the Department's rights under the contract.

The Department will not assess liquidated damages during a period when the project is in an authorized state of suspension.

The Department will assess liquidated damages in accordance with Table 108-02.

Table 108-02
Daily Charges for Liquidated Damages

Original Contract Amount ($)		Daily Charge ($)	
From more than	To and including	Calendar Day	Working Day
0	100,000	350	400
100,000	250,000	700	1,000
250,000	500,000	900	1,400
500,000	1,000,000	1,300	1,800
1,000,000	3,000,000	1,600	2,300
3,000,000	5,000,000	2,300	3,000
5,000,000	8,000,000	2,800	3,600
8,000,000	12,000,000	3,300	4,100
12,000,000	18,000,000	4,000	4,600
18,000,000	Up	5,000	5,600

For calendar day and completion date contracts, the Department will use the daily charge for calendar days; for working day contracts, the daily charge for working days.

2. **Substantially Complete.**
   If the Department determines the work is substantially complete and is in a condition for safe and convenient use by the traveling public, the Department may terminate the assessment of all or a portion of the liquidated damages that accrue.

   The Department will consider the work substantially complete when the Contractor has installed all necessary signing, striping, guardrail, and other safety appurtenances, and, if the contract requires, when the project is opened to the traveling public. If the contract does not require the project opened to the traveling public, the Department will consider the work substantially complete when it is ready for the subsequent project. The Engineer's suspension of time charges is not a contractual right and its application will be contingent upon the Contractor's diligence in completing the remaining items of work.

3. **Interim Completion.**
   If the project has an iterim completeion date and the included work items are not completed by the interim completion date, the Department will asses liquidated damages in accordance with Table 108-02.

108.08 TERMINATION OF THE CONTRACT FOR DEFAULT

If the Department finds that the Contractor is responsible for any of the following, the Engineer may issue a written notice of default to the Contractor and surety:

A. Failing to begin the work under the contract within the time specified;

B. Failing to perform the work with sufficient resources to ensure the prompt completion of the work;

C. Failing to perform the work satisfactorily;

D. Neglecting or refusing to remove or replace rejected materials or unacceptable work;

E. Discontinuing the prosecution of the work;

F. Failing to resume work, which has been discontinued, within a reasonable time after the Engineer gives the Contractor written notice to do so;

G. Becoming insolvent, being declared bankrupt, or committing any act of bankruptcy or insolvency;

H. Allowing any final judgment to be unsatisfied for 10 business days;

I. Making an assignment for the benefit of creditors without the Engineer's approval;

J. Failing to maintain active insurance policies in accordance with Section 107.14, "Public Liability and Property Damage Insurance"; or

K. Failing to perform the work in an acceptable manner due to any other cause.

If the Contractor or surety does not address the notice of default within 10 calendar days of such notice, the Engineer will provide a written notice of termination for default to the Contractor and surety, and the Department will have the full power and authority, without violating the contract, to terminate the contract and take the prosecution of the work away from the Contractor. The Department may appropriate or use any or all materials and equipment at the project site and may enter an agreement with another party to complete the contract according to its terms and provisions. The Department may use other methods required to perform the remainder of the work or complete the project. If the Department solicits bids for the remainder of the work or completion of the project, the Contractor is not eligible to submit a proposal.

The Department will deduct all costs incurred by the Department, together with the cost of completing the work under contract, from any monies due or that may become due the Contractor. If the Department's costs, including the cost of completing the work under the contract, exceed the amount that would have been payable under the contract, the Contractor and the surety shall be liable and shall pay the Department the amount of such excess.

If the Department issues a notice of termination for default and later determines the Contractor was not in default, the termination for default will become a termination for convenience in accordance with Section 108.09, "Termination of the Contract for Convenience."

108.09 TERMINATION OF THE CONTRACT FOR CONVENIENCE

After determining that, for reasons beyond either the Department's or the Contractor's control, the Contractor is prevented from proceeding with or completing the work as originally contracted for, and that contract termination would be in the public interest, the Department may terminate the contract or any portion of the contract by written order of the Engineer. Reasons for termination include the following:

A. Executive Orders of the President relating to war or national defense;

B. A national emergency that creates a serious shortage of materials, labor, equipment, or funds that will continue for an unreasonable length of time;

C. Orders from duly-constituted authorities relating to energy conservation;

D. Restraining orders or injunctions obtained by third-party citizen action, or where the issuance of such order or injunction is caused by acts or omissions of persons or agencies other than the Contractor;

E. Changes in funding availability at either the State or federal level;

F. Changes in Department priorities from any cause;

G. An act of God; or

H. Any other reason deemed to be in the best interest of the public.

The rights accorded the Department and the Contractor by this section shall not supersede or include other specific rights and responsibilities of each contained in the contract.

After receiving the notice of termination for convenience, submit to the Engineer a request for compensation in accordance with Section 104.02, "Contract Revisions," except, submit the request within 60 calendar days of the effective date of termination for convenience.

The Department will pay the Contractor for costs that the Contractor has incurred before or as a result of the termination for convenience in accordance with Section 109.03, "Compensation for Contract Revisions." In addition, the Department will pay the Contractor for mobilization efforts, guaranteed payments for private land usage as part of the original contract, and any other costs resulting from the termination for convenience, subject to the limitations of Section 109.03 G, "Non-Allowable Charges."

The Department may purchase materials the Contractor has not incorporated into the project at the actual delivered cost to a prescribed location; otherwise, the Contractor shall dispose of the materials in a manner approved by the Engineer. The Department will only purchase material that the Engineer has inspected, tested, and accepted and that the Contactor has properly stored and maintained.

The Department's termination of the contract or a portion thereof shall not relieve the Contractor of any contractual responsibilities for the work completed, or relieve the surety of its obligation for and concerning any just claim arising out of the work performed in accordance with Section 104.06, "Department-Initiated Claims."

SECTION 109
MEASUREMENT AND PAYMENT

109.01 MEASUREMENT OF QUANTITIES

A. General.
The bid item list specifies the unit of measure for each contract item. The Engineer will measure accepted quantities of work for each contract item in accordance with the "Method of Measurement" subsection in the relevant specifications and Section 109.01, "Measurement of Quantities." In the case of a conflict, the method of measurement in the relevant specifications supersedes the method of measurement in Section 109.01, "Measurement of Quantities." Unless the contract specifies payment by plan quantity, the Engineer will measure the actual quantity of accepted work for each contract item.

B. Area.
For area calculations of contract items, the Engineer will measure the longitudinal length horizontally and use the transverse dimension shown on the plans. The Engineer will not make deductions for individual fixtures occupying an area equal to or less than 9 SF.

C. Structures.
For structures, the Engineer will measure structures using the plan quantity based on the dimensions shown on the plans.

D. Linear Units.
For contract items specified for measurement by linear unit, the Engineer will take measurements parallel to the base or foundation.

E. Volume.
For volume calculations of contract items, the Engineer will use the average end-area method, the prismoidal method, truck/vehicle method, or other acceptable methods.

F. Truck/Vehicle Volume.
For materials specified for measurement by volume, the Engineer will measure in vehicles at the point of delivery. Use vehicles that allow easy and accurate measurement of the contents. Load all vehicles to their water level capacity if possible. The Engineer may direct the Contractor to level the loads at the point of delivery to determine the actual volume of the load. Do not exceed the legal load limits for gross weight.

G. Timber.
The Engineer will measure timber by the thousand board feet measure, based on nominal widths and thicknesses and the longest dimension of each piece.

H. Lump Sum.
When a contract item has a "lump sum" unit, the contract unit price is full compensation to the Contractor for that contract item.

I. Standard Manufactured Materials.
The Engineer will accept nominal dimensions for standard manufactured materials unless the contract requires otherwise. The Engineer will accept industry established manufacturing tolerances, unless the contract requires otherwise.

J. Material Weight.

1. General.

Weigh materials on a certified scale. Provide a scale operator to operate the scale, issue weigh tickets, perform scale verifications, and prepare tare weight reports and daily haul summaries.

Do not supply tickets, as specified in Section 109.01 J.6.a "General", to truck drivers if the weight of the load is in excess of the legal load limits in place on the haul route.

Provide scales that are:

a. Certified by a scale service company registered with the North Dakota Public Service Commission. If the certification is more than 9 months old when the scale begins project use, have the scale recertified. Submit a copy of the certification before starting weighing operations.

b. Accurate to within 1.0 percent of the true weight of the applied load throughout the range of use.

2. Scale Applications.

Use either computerized or non-computerized scales to determine weights for material when the quantity of the material included in the bid item list is 2,000 tons or less.

a. Computerized Scales.

Use a computerized scale to determine the weight of material when the quantity included on the bid item list is greater than 2,000 tons.

Use a scale with a digital readout and a computer that produces weigh tickets and daily haul summaries.

b. Computerized Loader Bucket Scales.

Loader bucket scales may be used to weigh materials when the quantity of material included in the bid item list is less than 10,000 tons and for aggregates specified under Sections 420 "Bituminous Seal Coat", 421 "Microsurfacing", and 422 "Slurry Seal" regardless of quantity.

Equip loader bucket scales with an onboard computer that produces weigh tickets.

Load trucks on a level loading area and with the loader scale in dynamic mode. Operate the loader scale in accordance with the manufacturer's guidelines.

3. Types of Scales.

a. Platform Scales.

Provide scales with a platform that is large enough to simultaneously weigh all axles of the longest truck, or truck-trailer combination, used for the project.

Determine the daily tare weight of each truck before it hauls its first load. Ensure trucks are fully fueled at the time the tare weight is determined.

Before the first use of the scale for the project and any time the scale is recertified, perform the:

- zero load test;
- comparison test;
- sensitivity test; and
- shift test.

b. Hopper or Batch Scale.
Provide hopper and batch scales that use one or more load cells.

Before the first use of the scale for the project and any time the scale is recertified, perform the:

- zero load test;
- comparison test; and
- sensitivity test.

c. Computerized Loader Bucket Scale.
Before the first use of loader bucket scales for the project and any time the scale is recertified, perform the comparison test.

4. Verification Tests.
The Engineer will verify the accuracy of scales by observing the Contractor perform the verification tests specified in Section 109.01 J.3 "Types of Scales". The Engineer may request verification tests to be performed randomly.

If the scale is not operating within the required tolerance, have the scale recertified by a scale service company registered with the North Dakota Public Service Commission.

a. Zero Load Test.
Adjust the scale so that it balances or reads "zero" when no load is applied to the scale.

b. Comparison Test.
If the difference between the weight determined by the scale and the comparison test is more than 1.0 percent, repair and recertify the project scale.

(1) Platform Scales.
Perform a comparison test using one of the following methods. Notify the Engineer of the method that will be used before starting weighing operations. Obtain the Engineer's permission if a change in test methods is desired.

(a) Independent Scale Method.
The Engineer will randomly select a loaded truck that has been weighed on the project scale. The Contractor shall weigh this truck on a certified scale owned and operated by an entity other than the Contractor.

(b) Certified Equipment Weight Method.
Weigh a piece of equipment on the project scale. Use a piece of equipment that:

- is fully fueled;

- is free of mud and dirt; and
- has a certified weight of a least 60 percent of the maximum load to be applied to the scale during the life of the contract.

Provide an affidavit affirming the certified weight of the equipment. Provide a new affidavit when any changes are made to the equipment that will affect the certified weight.

If using the certified equipment weight method, perform a secondary check using the independent scale method for the first two days that the scale is in operation and once per month thereafter.

(2) Hopper or Batch Scales.
After the material has been weighed on the project scale and placed in a truck, weigh the loaded truck on a certified scale owned and operated by an entity other than the Contractor. Provide the tare weight of the truck along with the comparison weigh ticket.

(3) Computerized Loader Bucket Scales.
Perform a comparison test using one of the following methods:

(a) Independent Scale Method.
After placing the load in a truck, weigh the loaded truck on a certified scale owned and operated by an entity other than the Contractor. Provide the tare weight of the truck along with the comparison weigh ticket.

(b) Certified Weighted Object Method.
Weigh an object on the project scale and compare its certified weight to the loader bucket scale readout. Use an object that:

- is free of mud and dirt; and
- has a certified weight of at least 60 percent of the capacity of the loader bucket.

Weld a plate onto the object showing its certified weight.

Provide an affidavit affirming the weight of the object, as measured on a certified scale.

Provide a new affidavit when requested by the Engineer or if changes are made to the object that will affect the certified weight.

c. Sensitivity Test.
Weigh a representative load and then add 100 pounds of test weights. If the scale is not sensitive to the added weight, repair and recertify the scale.

d. Shift Test.
Check the performance of the scale with off-center loading by comparing the results of weighing a truck in the following positions:

- Place the rear wheels at the extreme end of the scale platform;

- Position the truck with the rear wheels at the extreme opposite end of the platform; and
- Position the truck in the center of the platform.

Repair and recertify the scale if the results of any two positions differ by more than 0.2 percent.

5. Random Comparison Tests.
If a comparison test reveals that the scale is out of tolerance, repair and recertify the scale.

At any time, the Engineer may require the scale to be checked for accuracy utilizing any test method.

a. Platform Scales.
Perform a comparison test as specified in Section 109.01 J.4.b.(1) "Platform Scales".

Conduct one test for each 5,000 tons of material weighed, except when more than 5,000 tons are weighed in one day. When more than 5,000 tons of material is weighed in one day, conduct one test for that day's production.

b. Batch and Hopper Scales.
Perform a comparison test as specified in Section 109.01 J.4.b.(2) "Hopper and Batch Scales".

Conduct one test for each 5,000 tons of material weighed, except when more than 5,000 tons are weighed in one day. When more than 5,000 tons of material is weighed in one day, conduct one test for that day's production.

c. Computerized Loader Bucket Scales.
Perform a comparison test as specified in Section 109.01 J.4.b.(3) "Computerized Loader Bucket Scales".

Perform a comparison test each day that the loader bucket scale is used. Record the results of the test and submit a signed copy to the Engineer. The Engineer may prohibit the use of loader bucket scales if two consecutive tests fail.

6. Documentation.

a. General.
Place a unique identification number on each truck that is legible and in plain view of the scale operator.

Document the weight of each load on a separate, sequentially numbered weigh ticket that has a maximum size of 5.5 × 8.5 inches. Provide one copy to the driver of the truck. The truck driver shall deliver the weigh ticket to the Engineer at the location where the material is incorporated into the work. The Engineer will reject loads that are not accompanied by a legible weigh ticket.

(1) Computerized Scales.
Produce computer generated weigh tickets. Produce computer generated daily haul summaries using the same computer, software, and data that produced the

individual weigh tickets. Submit paper haul summaries and daily tare weight reports at the beginning of the subsequent work day.

Notify the Engineer if the computer or printer malfunctions. If this occurs, non-computerized weighing and recording will be allowed for a maximum of 2 consecutive work days.

(2) Computerized Loader Bucket Scales.
Generate weigh tickets using the onboard computer and loader bucket scale printer. Produce daily haul summaries by hand or a computer generated spreadsheet.

(3) Non-Computerized Scales.
The scale operator shall generate weigh tickets when non-computerized scales are used. Produce daily haul summaries by hand or a computer generated spreadsheet.

b. Trucks and Weigh Tickets.
Place the following information on each weigh ticket:

(1) Ticket Number
(2) NDDOT project number or NDDOT Project Control Number (PCN)
(3) Delivery date
(4) Contractor and Subcontractor if applicable
(5) Time of weighing
(6) Identification number of truck
(7) Material type identified by pay item name
(8) Unit of measure
(9) Weight delivered:
- Gross weight, tare weight and net weight for platform scales
- Net Weight for batch, hopper, and loader bucket scales

(10) Scale person's signature for manually produced tickets

c. Daily Haul Summaries.
For each material weighed, provide a haul summary containing the following information:

(1) NDDOT project number or NDDOT PCN (whichever is used on the weigh tickets)
(2) Delivery date
(3) Contractor and Subcontractor if applicable
(4) Pit location and owner
(5) Identification number of truck
(6) Each load's net weight and ticket number, with justification for out of sequence numbers
(7) Material type identified by pay item name
(8) Total weight of material delivered to the project
(9) Weight of material voided for the day
(10) Weight of the day's production
(11) A signed statement from the Contractor attesting to the accuracy and completeness of the facts represented. A signed statement from a subcontractor or supplier attesting to the accuracy and completeness of the facts represented is

required if they operate the scales. The statement shall consist of the following language: “I certify the Daily Haul Summary is true, accurate, and complete.”

(12) Blank for the Engineer’s signature. Include the following language: “I certify the Daily Haul Summary has been reviewed, corrected as necessary, and approved.”

(13) Place for comments

7. Basis of Payment.

If a comparison test reveals a scale is overweighing, the Engineer will adjust the payment for all material weighed since the last accepted test under Section 109.01 J.5 “Random Comparison Tests”. The Engineer will calculate the weight of all materials weighed after the last accepted test and reduce the payment for this material by the percentage of scale error exceeding 1.0 percent. The Department will not compensate the Contractor for losses due to a scale under-weighing material.

The Department will pay for materials on the basis of daily haul summaries produced by the Contractor and approved by the Engineer. If daily haul summaries are not generated using the same computer, software and data that produced the individual weigh tickets, the Department will pay based on individual weigh tickets.

Include the cost of operating scales in the contract unit price of the items being weighed.

K. Weight-Volume Conversion.

The Contractor may request to weigh material specified to be measured by volume. If the Engineer approves the request, the Engineer will convert the material weight to a volume quantity for payment. Material will be weighed as specified in Section 109.01 J “Material Weight”.

The Contractor may request to have material specified to be measured by weight, measured by volume. If the Engineer approves the request, the Engineer will convert the material volume to weight for payment.

The Engineer will determine a material’s conversion factors for weight to volume and for volume to weight based on the materials’ specific gravity or density. Before the Engineer uses the conversion factors, the Engineer and Contractor shall agree in writing to the factors.

L. Bituminous Material.

1. General.

The Engineer will measure bitumen by the ton or gallon. The Engineer may convert the weight of bitumen to volume or the volume of bitumen to weight based on conversion factors determined from the specific gravity of the bitumen. If measuring bitumen by volume, the Engineer will adjust the measured volume to the equivalent volume at 60°F, using the tables in ASTM D 4311. The Engineer will measure or verify the quantity of bitumen at the point of delivery. The Engineer will deduct the quantity of bitumen not placed on the road surface from the delivered quantity.

The Engineer may weigh any load of bitumen at the point of delivery to the project site.

2. Weighing of Bituminous Material.

For bitumen weighed at the source, provide a legible shipment manifest with each sealed tank, signed by a supplier representative.

For bitumen transported directly from the source to the project site in a distributor or transport truck and trailer, weigh each vehicle using one of the following methods:

- Before and after loading, on scales provided by the supplier or on public scales near the source; or

- Before and after unloading, on the Contractor's scales or on public scales near the project site.

Use a scale with current certification from the state agency with the appropriate jurisdiction in the state the scale is located.

3. Acceptance of Material.

If the Engineer determines that the bitumen materially affects the quality of the work, to the extent that the contract requires corrective action or removal, the Department will not pay for the bitumen or any affected related items.

If both the original and check samples of bitumen fail to meet the same testing requirement of the relevant specifications and the material remains in the transport vehicles, the Engineer will reject the entire load of bitumen.

If both the original and check samples fail to meet the same testing requirement of the relevant specifications and the material is no longer in the transport vehicle, the Engineer will determine a contract price adjustment as specified in Section 109.01 L.4, "Contract Price Adjustments".

The Department will pay the contract unit price for accepted quantities of bitumen measured, when the Engineer conditionally accepts the material for use and one of the following conditions exists:

- The original sample of the bitumen meets all testing requirements of the relevant specifications; or

- The original sample of the bitumen does not meet all testing requirements of the relevant specifications, but the check sample meets the testing requirements not met by the original.

4. Contract Price Adjustments.

a. Performance Graded (PG) Asphalts.

(1) General.

The Department defines price adjustments for PG Asphalt binders using the Multiply Stress Creep Recovery (MSCR) Test under AASHTO M332.

(2) Sampling.

Obtain one sample of asphalt binder for each 250 tons of binder material supplied to the project. Obtain the sample as prescribed in the NDDOT Field Sampling and Testing Manual, Procedure NDDOT 1. Each 250 tons of material

will represent a sublot and 4 sublots will constitute a lot of material. Partial lots will consist of however many sublot samples were collected for that lot.

(3) Originals and Check Samples.
Each sample consists of two parts, an original and a check. The Engineer will perform tests using the original sample first.

If a test returns a value resulting in a pay factor of less than 1.00, the Engineer will perform that test on the check sample and the check sample results will be used to determine the pay factor for the material.

(4) Testing Parameters.
The Engineer will randomly select one sublot for testing per lot.

If the check sample results in a pay factor of less than 1.00, the Engineer will perform the substandard tests on the remaining sublots within that lot.

b. Non Performance Graded (PG) Asphalts.
For bitumen of types other than PG asphalts, if both the original and check samples of bitumen fail to meet the same testing requirement of the relevant specifications, except penetration and demulsibility, and the Engineer determines that the deviation will not materially affect the quality of the work, the Department will reduce payment for the bitumen by 20 percent of the invoice price (FOB refinery) per unit, for the quantity of bitumen represented by the failing samples. If both the original and check samples fail to meet two or more of the same testing requirements of the relevant specifications, including penetration and demulsibility, and the Engineer determines the deviation will not materially affect the quality of the work, the Engineer will base the price adjustment on the highest unit price reduction.

(1) Penetration.
If the test results of both the original and check samples of the bitumen fail to meet the penetration testing requirements of the relevant specifications, the Engineer will reduce payment for the bitumen by applying a unit price reduction factor to the invoice price (FOB refinery) of the bitumen. The Engineer will average the variation of penetration percentages of both failing samples and determine the unit price reduction factor in accordance with Table 109-01:

Table 109-01
Unit Price Reduction Factor per Variation of Penetration

Variation of Penetration	Adjustment Factor
0.1–5 %	5 %
>5–10 %	10 %
>10–15 %	25 %
>15 %	50 %

The contract price adjustment will be determined by multiplying the Adjustment Factor by the total tons of bitumen represented by the test and the invoice price

for the bitumen. The contract price adjustment will be applied under the appropriate bitumen item.

(2) Demulsibility.
If the test results of both the original and check samples of the emulsified bitumen fail to meet the demulsibility testing requirements of the relevant specifications, the Engineer will reduce payment for the bitumen by applying a unit price reduction factor to the invoice price (FOB refinery) of the bitumen. The Engineer will average the variation of demulsibility percentages of both failing samples and determine the unit price reduction factor in accordance with the following:

$$\text{Adjustment Factor (\%)} = \text{Average Variation from Specified Value} \times 0.67$$

109.02 SCOPE OF PAYMENT

A. General.
The Department will pay the Contractor for accepted quantities of the contract items at the contract unit prices, as required by the contract, except as otherwise specified in Section 104.02, "Contract Revisions."

The Department's payment to the Contractor for the contract items is full compensation for performing all work as required by the contract, including all risk, loss, damage, or expense arising from the nature or performance of the work, subject to Section 105.16, "No Waiver of Legal Rights."

The Department provides either direct or indirect payment for the work, under the contract items shown in the bid item list.

B. Direct Payment.
Direct payment is made under a contract item shown in the bid item list when one of the following applies:

1. The work is measured in the "Method of Measurement" subsection of the relevant specification, and the bid item list contains a contract item for the work with the same three-digit number as the section of the specifications ordering the work.

2. The "Method of Measurement" subsection of the specification ordering the work references another section for measuring the work, and the bid item list contains a contract item for the work from the referenced section.

C. Indirect Payment.
Work required to safely and satisfactorily provide or complete a contract item in accordance with the "Construction Requirements" subsection and Section 100, "General Provisions," but which is not directly measured and paid for, or which is not included in the bid item list, is an incidental obligation of the Contractor. The Department does not directly pay for such work and payment is included under the associated contract items in the bid item list. This includes instances when the "Construction Requirements" subsection references another specification for performing the work and does not reference another specification for direct payment of the work.

109.03 COMPENSATION FOR CONTRACT REVISIONS

A. General.

The Engineer and Contractor shall determine compensation for contract revisions, as provided in Section 104.02, "Contract Revisions," using the sequence specified in Section 109.03 B, "Contract Unit Price," Section 109.03 C, "PS-1 Price," Section 109.03 D, "Negotiated Price," and Section 109.03 E, "Force Account." If a contract revision includes a time extension for compensable delays as determined by the Engineer in accordance with Section 108.06, "Determination of and Extensions to the Contract Time," the Engineer and Contractor will determine compensation for the costs associated with the time extension in accordance with Section 109.03 F, "Delay Costs."

The Department's payment for a contract revision is full compensation for performing the revised work, including any costs allowed by Section 109.03, "Compensation for Contract Revisions," and not expressly precluded by Section 109.03 G, "Non-Allowable Charges."

B. Contract Unit Price.

For contract revisions covered by contract items, the Engineer will determine compensation using the existing contract unit prices.

If the contract does not contain the appropriate contract items, the Department will pay the Contractor in accordance with Section 109.03 C, "PS-1 Price".

C. PS-1 Price.

For contract revisions covered by items listed on the *Price Schedule for Miscellaneous Items* (PS-1), the Engineer will determine compensation using the PS-1 unit prices. If the Contractor uses a subcontractor to exclusively perform the revised work, the Department will pay the Contractor an additional amount for the revised work as a mark-up on the PS-1 unit price in accordance with Section 109.03 E.5, "Subcontracting."

If the contract revision does not include work covered by items listed on the PS-1, the Engineer will proceed with determining compensation in accordance with Section 109.03 D, "Negotiated Price."

D. Negotiated Price.

The Engineer and Contractor will determine compensation based on mutually agreed prices. If the Contractor uses a subcontractor to exclusively perform the revised work, the Department will pay the Contractor an additional amount for the revised work as a mark-up on the negotiated unit price in accordance with Section 109.03 E.5, "Subcontracting."

The Engineer may request that the Contractor provide an estimate of the proposed unit prices or a lump sum price for the contract revision. 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.

Provide the justification within 5 business days after the Engineer's request. The Engineer will respond to the estimate within 5 business days after receipt of the Contractor's justification. The Engineer and the Contractor may mutually agree to extend these time requirements.

If the Engineer and Contractor cannot agree on compensation in accordance with Section 109.03 D, "Negotiated Price," the Engineer will direct the Contractor to track the cost of the revised work in accordance with Section 109.03 E, "Force Account."

E. Force Account.

1. General.

The Engineer may direct the Contractor to perform the revised work on a force account basis. If the Engineer determines that the Department will pay the Contractor for the revised work on a force account basis, the Department will pay the Contractor in accordance with Section 109.03 E.9, "Payment."

Before beginning or continuing with the revised work, submit a written proposal and schedule for the revised work, including labor, materials, equipment, subcontracting work, and specialty work.

The Engineer may direct the Contractor to do any of the following for revised work tracked on a force account basis:

a. Change equipment and labor forces assigned to the revised work;

b. Limit overtime on the revised work to the level previously used by the Contractor on the project for work of a similar nature;

c. Provide overtime for an emergency; and

d. Stop the revised work when adverse conditions limit productivity.

2. Labor.

The Department will pay the Contractor the direct labor costs for each hour a laborer or foreman is engaged in the revised work. Direct labor costs include wage rates and health and welfare benefits. Submit copies of certified payrolls to justify the direct labor rates paid to each laborer and foreman. Before beginning the revised work, the Contractor and Engineer shall mutually agree to wage rates using an *Equipment Rental and Wage Rates Agreement* (SFN 13890) form. The Department will not pay the Contractor for wage rates above those rates in the *Equipment Rental and Wage Rates Agreement*.

The Department will pay the Contractor an additional amount for labor used to perform the revised work as a mark-up on the direct labor costs to cover profit, field and home office overhead, pension fund, fringe benefits, bond, insurance, worker's compensation, unemployment insurance, social security taxes, and any other labor additives. The mark-up is 70 percent of the direct labor costs for all revised work (5 percent for profit and 65 percent for all other mark-ups). The Department will apply the mark-up only to the direct labor costs, not subsistence and travel allowance.

In addition to the direct labor costs and labor mark-up, the Department will pay the Contractor for the actual cost paid to or on behalf of workers for subsistence and travel

allowance. Submit to the Engineer all relevant documentation to justify the subsistence and travel costs.

3. Materials.

For all materials accepted by the Engineer and permanently installed into the work, the Department will pay the Contractor at the invoice price paid by the Contractor, including transportation charges.

Provide the Engineer with paid invoices for materials used in the revised work, including invoices for transportation cost. If the Contractor does not specifically purchase the material for the revised work but takes the material from the Contractor's stock, the Contractor shall provide an affidavit certifying the following:

a. That the material was taken from stock;

b. That the quantity of material claimed was used in the work; and

c. That the Contractor paid the amount on the invoice for the material, including transportation cost.

The Department will pay the Contractor an additional amount for material used in the revised work as a mark-up on the invoice cost to cover administrative costs, field and home office overhead, and profit. The mark-up for material used in the revised work is 15 percent (5 percent for profit and 10 percent for all other mark-ups).

For materials used to perform the revised work but not permanently installed into the work, the Department will not pay the Contractor the full purchase price, but will pay the Contractor a reasonable amount determined by the Engineer for the depreciation in value of the material because of its use to perform the revised work.

4. Equipment.

a. General.

The Department will pay the Contractor for each hour that the Contractor uses an approved piece of equipment to perform the revised work. The Engineer and Contractor shall mutually agree to the Engineer-determined rates using the *Equipment Rental and Wage Rates Agreement*. The Department will not pay the Contractor for the use of small tools not listed in the *Rental Rate Blue Book* published by the Equipment Watch unit of Penton Media, Inc.

The Department will pay the Contractor for subcontractor-owned equipment in accordance with Section 109.03 E.4.b, "Owned Equipment," and for equipment the Contractor has leased, rented, or hired from a subcontractor in accordance with Section 109.03 E.4.c, "Leased, Rented, or Hired Equipment."

b. Owned Equipment.

The Department will pay the Contractor for owned equipment at 70 percent of the hourly ownership cost determined in accordance with the *Rental Rate Blue Book*. The hourly ownership cost equals the regionally adjusted monthly ownership cost divided by 176 hours per month.

The Department will not pay the Contractor more than the purchase price for an owned piece of equipment.

If the owned equipment necessary for the revised work is not available at the project site, the Department will pay the Contractor for the cost of transporting the equipment to the project site ("move-in") and returning the equipment to its original location ("move-out") in accordance with the following:

(1) Obtain the Engineers approval of the original location of the equipment before transporting the equipment to the project site. If the Contractor chooses to keep the equipment at the project site to perform work other than the revised work, the Department will not pay the Contractor for the "move-out" costs. If the Contractor chooses to return the equipment to a location other than the original location, the Department will pay the Contractor for the "move-out" costs, not to exceed the "move-in" costs.

(2) The Engineer will determine the Contractor's cost of transporting the equipment to and from the project site based on the hourly rates for labor and equipment determined in accordance with Section 109.03 E.2, "Labor," and Section 109.03 E.4, "Equipment," not to exceed the cost of transporting the equipment by an established hauler. If the Contractor uses an established hauler to transport the equipment, the Department will pay the Contractor the invoice price paid to the hauler and 50 percent of the hourly ownership costs determined in accordance with the *Rental Rate Blue Book*. Transportation costs include loading and unloading.

(3) If the Contractor moves the equipment operator to the project site with the equipment and the operator only performs the revised work, the Department will pay the Contractor for the operator's labor costs based on the salary paid by the Contractor. Submit to the Engineer proof of the operator's salary.

c. Leased, Rented, or Hired Equipment.
The Department will pay the Contractor for leased, rented, or hired equipment used to perform the revised work at the invoice price, including sales tax, paid by the Contractor. Submit to the Engineer the invoices for the leased, rented, or hired equipment. The Engineer will convert weekly invoice rates to hourly rates by dividing the weekly rate by 40 hours per week, and monthly invoices rates to hourly rates by dividing the monthly rate by 176 hours per month.

The Department will not pay the Contractor more than the invoice price for a leased, rented, or hired piece of equipment.

d. Operating Costs.
The Department will pay the Contractor for the operating costs of owned and leased, rented, or hired equipment based on the operating costs listed in the *Rental Rate Blue Book*.

e. Standby Time.
The Department will not pay for equipment on standby unless the Engineer directs the standby in writing, or the standby is proven to be as the direct result of the Department's actions or inactions. If the Engineer directs standby or standby results

from the Department's actions or inactions, the Department will pay for the standby time as follows:

(1) For owned equipment, at 50 percent of the hourly ownership costs determined in accordance with the *Rental Rate Blue Book*, and

(2) For leased, rented, or hired equipment, at 50 percent of the hourly invoice costs determined in accordance with Section 109.03 E.4.c, "Leased, Rented, or Hired Equipment."

The Department will not pay the Contractor for the operating costs of equipment on standby.

If the equipment operates for more than 8 hours on any day or 40 hours in any week, the Department will not pay the Contractor for standby time for that day or week. If the equipment operates for less than 8 hours on any normal work day or less than 40 hours in any normal work week, the Department will only pay the Contractor for standby time based on the difference between the operating time on a normal work day and 8 hours per day or the difference between the operating time in a normal work week and 40 hours per week. The Department will not pay the Contractor for standby time on any day that is not normally a work day.

5. Subcontracting.

Obtain the Engineer's written approval to use a subcontractor to perform the revised work.

The Department will pay the Contractor for revised work performed by a subcontractor as determined by the Engineer in accordance with Section 109.03 E.2, "Labor," Section 109.03 E.3, "Materials," Section 109.03 E.4, "Equipment," and Section 109.03 E.6, "Specialty Work." Submit itemized daily records for the approved revised work performed by a subcontractor in accordance with Section 109.03 E.7, "Daily Records."

The Department will pay the Contractor an additional amount for approved revised work performed by a subcontractor, as a mark-up on the Engineer-determined costs to cover administrative costs, and field and home office overhead. The mark-up for revised work performed by a subcontractor is 10 percent of the first $15,000 plus 5 percent of any amount over $15,000. The Department will not pay an additional mark-up for revised work performed by a subcontractor under contract to a subcontractor.

6. Specialty Work.

Obtain the Engineer's written approval to use a specialty subcontractor to perform revised work covered by specialty items.

The Department will pay the Contractor for revised work covered by specialty items at the invoice price paid by the Contractor. Submit invoices for the approved specialty work. The Department may adjust the invoice price to match the current market price for the specialty work.

The Department will pay the Contractor an additional amount for approved specialty work as a mark-up on the invoiced price to cover administrative costs and field and home office overhead. The mark-up for specialty work is 10 percent of the first $5,000 plus 3 percent of any amount over $5,000.

7. **Daily Records.**
Compare and reconcile the records of labor, materials, and equipment used in the performance of the revised work at the end of each day or shift with the Engineer on a *Statement of Daily Force Account Work* (SFN 14462).

8. **Statements.**
Submit itemized statements for each week reflecting all costs for the revised work, detailed as follows:

   a. Name, classification, date, daily hours, total hours, wage rate, health and welfare benefits, and extension for each laborer and foreman.

   b. Quantities of materials, prices, extensions, and transportation costs paid by the Contractor. Include invoices for the material, including any transportation charges. Adjust the statements, if applicable, to show any discounts offered by the supplier.

   c. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of equipment. For rented equipment, include invoices and rental agreements.

   d. For revised work performed by a subcontractor, the same information required in items a, b, and c, above.

   e. Invoices for revised work performed by a specialty subcontractor.

9. **Payment.**
After receipt of statements and invoices, the Engineer will prepare a summary statement of the force account work and provide to the Contractor for verification and approval. The Department will pay for revised work within 30 calendar days after receiving all the required information and Contractor-approved summary statements.

F. Delay Costs.

1. **General.**
For a compensable delay as identified in Section 108.06 B.5, "Excusable, Compensable Delays", the Department will pay for the costs incurred by the Contractor because of the delay as specified in Section 109.03 F, "Delay Costs".

   The Department will not pay for delay costs before the Contractor submits an itemized statement of those costs. The Engineer will verify the statements before authorizing payment.

   The Department will not compensate the Contractor for delays caused by work that the Department has paid the Contractor for as specified elsewhere in Section 109.03, "Compensation for Contract Revisions".

2. **Extended Field Office Overhead.**
The Department will pay the Contractor for extended field office overhead costs as follows:

a. For general field supervision, including supervisors, assistants, watchpersons, clerks, and other field support staff, calculate the labor costs as specified in Section 109.03 E.2, "Labor".

b. For field office facilities and supplies, which include field office trailers, tool trailers, office equipment rental, temporary toilets, and other incidental facilities and supplies, calculate the costs as follows:

(1) For field office trailers, tool trailers, and other rented or owned equipment at a daily rate equal to 8 hours per day at the hourly rate determined in accordance with Section 109.03 E.4, "Equipment". Apply the daily rate to the number of days that each trailer or equipment is at the project site longer because of the delay.

(2) For office equipment rental, temporary toilets, and other incidental facilities and supplies, at a daily rate determined by dividing the monthly rental costs by the number of calendar days in each month. Apply the daily rate to the number of days that each facility or supply is at the project site longer because of the delay.

c. For maintenance of field operations costs, which include telephone, electric, water, and other similar costs, calculate a daily rate for these costs by dividing the monthly charges for these services by the number of calendar days each month. Apply the daily rate to the number of days of delay.

3. Idle or Extended Labor.
Calculate these labor costs during delays as specified in Section 109.03 E.2, "Labor", for all non-salaried personnel remaining on the project as approved by the Engineer.

4. Escalated Labor.
To receive payment for escalated labor, demonstrate that the delay forced performance of the work into a period when higher labor costs than the Contractor would have experienced absent the delay. Provide adequate supporting documentation for labor costs, allowances, and benefits.

5. Standby Equipment or Equipment Demobilization.
The Department will pay the Contractor the standby equipment rate determined in Section 109.03 E.4, "Equipment", for equipment, other than small tools, required to remain at the project site during the delay. The Department will pay the Contractor's transportation costs to remove and return equipment not required to remain at the project site during the delay.

6. Materials Escalation or Material Storage.
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.

G. Non-Allowable Charges.
For payments for contract revisions based on contract unit price, PS-1 price, negotiated price, or force account, the Department will not reimburse the Contractor for the following:

1. Home office overhead or profit in excess of that specified in Section 109.03 E, "Force Account";

2. Profit mark-ups, as defined in Section 109.03 E, "Force Account", on costs resulting from Engineer-ordered suspensions in accordance with Section 104.02 D, "Suspension of Work Ordered by the Engineer";

3. Changes in carrier rates or in the costs of any other transportation facilities used in the performance of the work during the project;

4. Loss of anticipated profit;

5. Damages, including special, incidental, consequential, or other damages associated with loss of bonding capacity, loss of bidding opportunities, and insolvency, even if the Contractor notifies the Department of the likelihood of such damages;

6. Indirect costs;

7. Attorney fees, claims preparation expenses, or costs of litigation;

8. Interest; and

9. Any other cost not specifically allowed by the contract.

109.04 PROGRESSIVE PAYMENT

A. General.

The Department's authorization to pay the Contractor in accordance with Section 109.04, "Progressive Payment", does not constitute the Department's final acceptance of any portion of the work or relieve the Contractor of its responsibility to complete the work as required by the contract.

If the Contractor fails to comply with any contract requirement, the Department may withhold progressive payments. If the Department withholds progressive payments, the Department will only make the progressive payments after the Contractor is in full compliance with the contract.

The North Dakota Century Code requires retainage to be withheld on all estimates except the Final Progressive Estimate.

B. Intermediate Progressive Estimate and Payment.

The Department will make progressive payments to the Contractor at least once each month as the work progresses. The Engineer will prepare a progressive estimate of the value of the work completed by the Contractor, including materials in accordance with Section 109.05, "Payment for Materials on Hand".

For each progressive estimate, the Engineer will calculate and retain payment for 2 percent of the estimated total work done to date. Retainage will be capped at 2 percent of the Original Contract Amount or the total work done to date, whichever is less.

C. Semifinal Estimate and Payment.

When the Engineer determines that the Contractor has completed more than 90 percent of the work and the Contractor has met the all of the following conditions, the Engineer may prepare a semifinal estimate:

1. Filed with the Department all pit releases, receipts of payment, and haul road releases;

2. Submitted to the Engineer all up-to-date payrolls;

3. Proven capable of completing the remaining work without being assessed liquidated damages in accordance with Section 108.07 B, "Failure to Complete within Contract Time"; and

4. Is working diligently to complete the remaining work.

For the semifinal estimate, the Engineer will calculate and retain payment for an amount not less than 1 and not more than 2 percent of the estimated total work done to date. Retainage will be capped at 2 percent of the Original Contract Amount or the total work done to date, whichever is less.

When the Engineer determines that the Contractor has completed 100 percent of the original work not including contract revisions, and the Contractor has met all of the conditions listed above in items 1 through 4, the Engineer may prepare additional semifinal estimates.

D. Prompt Payment.

Within 20 calendar days of receiving payment from the Department, pay subcontractors their portion of the payment less applicable retainage, not to exceed 2 percent. If the Contractor does not make prompt payment, the subcontractor may notify the Engineer.

The Contractor may withhold payment to a subcontractor for just cause. If withholding payment from a subcontractor, immediately provide written notification to the subcontractor and the Engineer with the reasons for withholding the payment. If the Engineer determines the Contractor is withholding payment with just cause, interest will not accrue.

If the Engineer determines the Contractor is withholding payment without just cause, beginning on the 21st calendar day after the Contractor's receipt of payment from the Department interest will accrue for the subcontractor at the rate provided by NDCC 13-01.1-02. Additionally, the Department may withhold all payments to the Contractor until the Contractor properly pays the subcontractor and agrees to make all future payments to subcontractors as required by the contract.

The Department will apply these prompt payment procedures to all tiers of subcontracts, in accordance with 49 CFR 26.29.

E. Subcontractor Retainage.

Pay the withheld retainage to a subcontractor within 20 calendar days after the satisfactory completion of the subcontractor's work. The Engineer will determine satisfactory completion of the subcontractor's work. The Department considers satisfactory completion of subcontractor work as the accomplishment of all of the tasks included in the subcontract, documented in accordance with the contract, and paid by the Department.

Obtain from the subcontractor and submit to the Engineer any of the following final documentation that is applicable to the subcontractor's completed work:

1. Certified payrolls;
2. Materials certification;
3. Haul road releases;
4. Pit receipts of payment;
5. Pit releases;
6. Night watchperson reports;
7. Warrantees;
8. Operating manuals;
9. Product literature;
10. Verification of final quantities;
11. *DBE Participation Certification* (SFN 14268);
12. For non-bonded subcontractors, proof of payment for all material bills and wages (only submit copies of these documents upon the Engineer's request); and
13. Any other documents required by the contract for the subcontractor's work.

For retainage not released by the Contractor in accordance with this provision, interest will accrue at the rate provided by NDCC 13-01.1-02 beginning the 21st calendar day after satisfactory completion of the subcontractor's work.

The requirement to release retainage applies to all tiers of subcontracts.

F. No Circumvention.
On federal-aid contracts, do not include any provision in subcontracts that would circumvent 49 CFR Part 26.29.

109.05 PAYMENT FOR MATERIAL ON HAND

The Department may make partial payment for material on hand that meets all of the following conditions:

A. Is intended to be permanently incorporated into the work;

B. Is delivered to or stockpiled at the project site, or other storage facility approved by the Engineer;

C. Has a value over $5,000;

D. Is not living or perishable; and

E. Is not an individual item used to fabricate items off the project site, except for structural steel before fabrication of bridge girders.

Stockpile structural steel at the production plant or fabrication site and store the steel separate from steel for use in other work to qualify for payment as material on hand.

Request payment by submitting a written request to the Engineer with the following information:

A. A statement certifying that the material on hand complies with the contract and will comply at the time of placement;

B. For material not produced or manufactured by the Contractor, a delivery invoice itemizing the material on hand; and

C. For material produced or manufactured by the Contractor, a fully documented statement of production costs, including the type of material, amount of material stockpiled, location of the stockpile, and an itemized breakdown of the cost to produce the material.

The Department will limit payment for material on hand to a portion of the contract unit price as determined by the Engineer. The Department will not pay more than the plan quantity of the contract item that covers payment for the material on hand. As the Contractor incorporates the material on hand into the work, the Department will deduct the amount paid for the material on hand from the payment.

For material not produced or manufactured by the Contractor, within 35 calendar days after the date the Department released payment for the material on hand, the Contractor shall submit to the Engineer paid invoices for the material on hand covered by the payment. With each paid invoice, include a signed statement from the supplier or fabricator acknowledging receipt of payment. If the Contractor fails to submit paid invoices, the Department will deduct the amount paid the Contractor for the material on hand from future payments and will not pay for the material on hand until the Contractor incorporates it into the work.

The Department's payment to the Contractor in accordance with Section 109.05, "Payment for Material on Hand", is not the Department's final acceptance of the material or any portion of the work. None of the following Department actions relieve the Contractor of the responsibility for all materials and work and any damage to the material or work:

A. Payment for material on hand;

B. Acceptance of quantities of material on hand; or

C. Approval of the storage methods or locations.

For lost, stolen, or damaged material, the Department will deduct the amount paid for the material on hand from future payments.

The Department owns material paid for as material on hand, but the risk of loss remains with the Contractor. For material on hand paid by the Department and later determined unacceptable, the Department may deduct the value of the unacceptable material from future payments.

109.06 FINAL PROGRESSIVE ESTIMATE AND PAYMENT

Upon completion of the records reconciliation process discussed in Section 105.15 C, "Project Acceptance", the Engineer will calculate the total amount payable to the Contractor including the amount of the unreleased retainage and will deduct all previous payments and amounts owed to the Department in accordance with the contract. The Engineer will then issue a final progressive estimate and final payment voucher to the Contractor.

The Department may correct previous estimates and payments as necessary in the final estimate and payment.

After the Contractor returns the signed final payment voucher, the Department will pay the balance.

Before making any partial or final payment, the Department may require the Contractor to provide proof of compliance with all laws that directly or indirectly apply to the work.

SECTION 151
ROLLERS

151.01 PNEUMATIC-TIRED ROLLERS

A. General.

Use rollers having at least seven wheels with pneumatic tires of equal size and ply. Arrange wheels to provide complete coverage of the area the roller travels. Do not use petroleum products to moisten the tires.

Submit the data used to determine the contact pressures for the full range of the manufacturer's recommended wheel loads and tire inflation pressures.

Inflate tires so that all tires are within a single 5 psi range.

Use rollers that can be loaded to a gross weight of at least 225 pounds per inch of compaction width.

Provide the empty and ballasted weights using one of the following methods:

- Weigh the roller if it has been modified from its original design or if the ballast weight is unknown; or
- Use the manufacturer's weight ratings if the roller has not been modified and ballast weight is known.

B. Tow-Type Pneumatic-Tired Roller.

Operate rollers with tire inflation pressures and wheel loads as specified by manufacturer.

C. Self-Propelled Pneumatic-Tired Roller.

Equip rollers with:

- positive and accurate steering control;
- skirting large enough to retain heat on the tires;
- smooth-tread tires;
- close-fitting scrapers for each tire; and
- a system for uniformly moistening each tire without excessive use of water and detergent.

Start, stop, and reverse direction smoothly without jerking or backlash.

Wobble wheel rollers are not allowed.

Operate rollers with contact pressure between 40 and 90 psi. Contact pressure is the average ground pressure, expressed in psi, obtained when the wheel load in pounds is divided by the gross contact area in square inches of the tire.

151.02 Vibratory Sheepsfoot/Pad Foot/Extended Pad Foot Roller

Use a vibratory sheepsfoot/pad foot/extended pad foot roller with:

- the capability of developing centrifugal force of 50,000 pounds or more;
- a minimum operating weight of 23,000 pounds; and
- a minimum roller width of 6 feet.

151.03 STEEL-WHEEL ROLLERS

A. Smooth-Faced Steel-Wheel Roller.

1. General.

Use self-propelled rollers equipped with:

- smooth-faced steel-wheels free of defects that mar the surface;
- positive and accurate steering control;
- adjustable spring scrapers for each wheel; and
- a system for each wheel that uniformly moistens the full width without use of excess water. Do not use petroleum products to moisten the roller.

Start, stop, and reverse direction smoothly without jerking or backlash.

Provide the empty and ballasted weights as specified in Section 151.01 A.1, “General”.

2. Smooth-Faced Steel-Wheel Roller: Tandem – Type A.

Use a two-axle or three-axle tandem with a fully ballasted gross weight of 10 tons or more.

3. Smooth-Faced Steel-Wheel Roller: Tandem – Type B.

Use a two-axle or three-axle tandem with a fully ballasted gross weight of 8 tons or more.

B. Vibratory Roller.

Use self-propelled drum-type rollers, capable of static or dynamic mode, equipped with:

- spray bars;
- automatic vibratory shut off;
- accurate and working frequency gauge for each drum or provide an accurate hand-held resonant reed tachometer for each roller;
- 135 pounds per linear inch (PLI) of static force; and
- 300 PLI of total applied force.

Repair damaged or malfunctioning frequency gauges and tachometers within 48 hours.

Provide instructions on the procedures for making amplitude adjustments for each roller.

Do not exceed 4 mph when traveling in static mode, prior to achieving required density.

Use rollers on plant mix base and hot bituminous pavement as specified in Table 151-01. Use rollers with adjustable amplitude and operate at low amplitude with a minimum of 10 impacts per linear foot.

Table 151-01
Impacts per Linear Foot

Roller Speed	Vibrations per Minute (VPM)						
MPH (ft/min)	1800	2000	2200	2400	2600	2800	3000
1.0 (88)	20.4	22.7	25.0	27.2	29.5	31.8	34.1
1.5 (132)	13.6	15.2	16.7	18.2	19.7	21.2	22.7
2.0 (176)	10.2	11.4	12.5	13.6	14.8	15.9	17.0
2.5 (220)	-	-	10.0	10.9	11.8	12.7	13.6
3.0 (264)	-	-	-	-	-	10.9	11.4

151.04 Combination Roller

Use rollers as specified in Section 151.03 B, “Vibratory Roller”, except rollers shall have a single vibrating drum in the front and four smooth pneumatic tires in the rear, with a gross weight of 20 tons or more.

Inflate tires so that all tires are within a single 5 psi range. Ensure tires have contact pressure as specified in Section 151.01 C, “Self-Propelled Pneumatic Tire Roller”.

SECTION 152
TRUCKS

152.01 TRUCKS

A. General.
Use trucks that prevent contents from escaping during transit.

B. Water Trucks.
Use water trucks that have the following features:
- Capability of evenly distributing water;
- Watertight connections and tanks; and
- Control valves operated from the driver's seat.

C. Aggregate Trucks.
Use a truck with a dump box capable of controlled discharge.

D. Bituminous Trucks.
Use trucks equipped with tarpaulins to protect the asphalt from weather. Install tarps free of holes larger than 0.5 inches in diameter and of sufficient size to completely cover the opening above the asphalt.

Use a truck with a dump box capable of controlled discharge.

Use a smooth-lined dump box, free from cracks, holes, and deep dents. Use trucks that are equipped with a hole of sufficient size for a thermometer, on the driver's side in the middle of the box. Discharge material without the dump body or truck frame making direct contact or exerting pressure on the paver. Lubricate dump box when necessary with a thin film of material that does not dissolve the bitumen. Do not use petroleum distillates. Drain excess coating from dump box before use.

E. Bituminous Tank Trucks.
Ensure bituminous tank trucks are sealed at the refinery. Equip tank trucks with a conveniently located bitumen-sampling valve. Ensure the valve is inside the tank and the valve stem and outlet extend outside the tank.

SECTION 153
EARTHWORK AND AGGREGATE EQUIPMENT

153.01 RECLAIMER

Use a self-propelled machine capable of pulverizing and mixing to a depth of 18 inches that also has the following features:

- Capable of incorporating water into the mixture;
- Produces a homogeneous mixture that has a uniform moisture content; and
- Uses a control system that automatically controls the elevation of the cutting head.

153.02 ROADBED PLANERS

Use a track mounted roadbed planer equipped with rotary cutting mechanisms. Equip the planer with an automatic grade control that maintains the elevation at both sides of the planer by controlling the elevation of one side and the crown, or each side independently.

Use an erected string line or other approved grade reference. Use a tightly stretched wire or string as the string line. Offset the string line parallel to the pavement edge on one or both sides and parallel to the established grade of the pavement surface.

SECTION 154
BITUMINOUS EQUIPMENT

154.01 MIXING PLANTS

A. General.
Equip the mixing plant with individual bins, or a bin with individual compartments, for each aggregate component. Construct bins to prevent intermingling of aggregate. Provide uniform production that is uninterrupted under normal operating conditions. Use mixing plants capable of calibrating and checking the proportions of each material.

B. Storage and Heating Equipment.
Use storage tanks that uniformly heat the bitumen to the required temperature without damage or changes to its characteristics. Do not use direct flames against the storage tanks. Equip the tanks with a thermometer that registers the temperature of the bitumen. Provide measuring sticks and outage tables for calibration and determining quantity.

C. Feeders.
Mechanically feed aggregates into the drier.

D. Driers.
Use driers that continuously agitate, heat, and dry the aggregate.

E. Thermometric Equipment.
Use thermometric equipment that automatically records mix temperature as the mix is discharged from the plant. Record and submit each day's production on a chart. Use a graduated with time increments of 15 minutes and temperature increments 10°F. Record temperature variations of 20°F within one minute of the time the variation occurs. Place the equipment where it is unaffected by plant vibration. Place a transparent dust-proof cover over the equipment.

F. Flow Rate Meter.
Measure and record the quantity of bitumen being discharged into the mixer with a flow rate meter with totalizer. Use a totalizer capable of recording up to 1,000,000 gallons with a certified accuracy within 0.20 percent. Use a flow rate meter and totalizer that automatically temperature-corrects to 60°F.

Calibrate the flow meter before the start of the Project and as necessary. Provide the flow rate meter's operations manual.

Submit a chart, generated by the flow meter, showing the asphalt percentage of the total mix on a time-coordinated basis. Use a chart that has maximum increments of 0.10 percent of the total mix. Keep the display and recorder accessible to the Engineer.

Correct the flow if it varies by more than 0.25 percentage points from the set percentage of asphalt. Adjust the plant to meet tolerance within 30 minutes after the first start-up of the day and 5 minutes after any additional start-up.

G. Cold-Feed Control.
Remove plant screens when aggregate is handled by cold-feed control, with the exception of a scalping screen. Use a scalping screen with an opening size that does not exceed the mix's maximum size aggregate plus 1/2 inch. Provide a mechanical feeder with a separate bin for each aggregate. Equip bins with dividers and separate positive feed controls. Calibrate the positive feed controls. Use quick adjusting feed controls that provide constant and uniform flow of aggregate throughout the range of its calibration.

H. Sampling Devices.
The Engineer may obtain representative samples of the aggregate before it enters the mixing unit at any time. Either stop the belt entering the mixing plant or provide an easy to operate sampling device that can be used without interrupting the mixing plant operation. Do not use the mixing plant on the project until the Engineer approves the sampling device.

I. Batch-Type and Continuous-Type Mixing Plants.
Use batch-type and continuous-type mixing plants that conform to AASHTO M 156. The Department will not require a flow rate meter as specified in Section 154.01 F, "Flow Rate Meter" for batch-type and continuous-type mixing plants.

J. Drum-Dryer Mixing Plants.

1. General.
Use a drum-dryer mixing process that provides positive weight control of the cold aggregate feed with a belt scale or other device to automatically regulate the feed gate and permit instant correction of variations in load.

Use a cold-feed flow and bitumen flow that is automatically coupled. Equip the system with automatic burner controls. Use systems that provide for temperature sensing of the bituminous mixture at discharge.

Provide a drum with a pitch no greater than 0.75 inch per foot or as recommended by the manufacturer.

When plant production is changed, maintain mix temperature within 20°F of the average temperature of mix produced during the preceding 30 minutes.

Provide the manufacturer's drum-dryer mixing plant manual.

2. Surge Bins.
Use a plant that has adequate bin storage for the hot mix to ensure continuous production operations. Equip surge bins for hot storage with batchers, baffle plates, or other approved devices to minimize segregation during loading and unloading. Do not allow uninterrupted free fall of material from the loading conveyor into the surge bins.

154.02 SURFACING EQUIPMENT

A. Pavers.
Use self-propelled paver with:

- full-width vibrating screed, heated if necessary, capable of spreading and finishing the mix to specified lane widths and lift thicknesses;

- an auger that extends to within 1 foot from either edge of the vibrating screed;
- receiving hopper with sufficient capacity for a uniform spreading operation and a distribution system that places the mixture uniformly in front of the screed;
- screed or strike-off assembly that produces an undamaged surface;
- control system that automatically controls the elevation and transverse slope of the screed; and
- automatic grade reference device that operates on either side of the paver and maintains the specified transverse slope, with manual override control capabilities.

The Engineer will allow hydraulic extendable screeds for variable width pavements.

Establish the grade reference for control of the screed height using one of the following methods:

- 30 foot minimum length travelling straightedge;
- erected stringline with adequate tension to prevent deflection from the weight of the grade sensor; or
- other approved device.

The Engineer may allow the use of manual controls during breakdown or malfunction of the automatic screed control for the remainder of that working day.

B. Liquid Bitumen Distributors.

Use a truck that maintains a uniform speed equipped with a visible speedometer that displays the truck speed in feet per minute.

Use truck mounted distributors with:

- circulating heating system that evenly controls the heating of the bitumen to the specified temperature;
- thermometer that displays the temperature of the tank contents;
- pressure pump capable of maintaining a uniform and sufficient pressure throughout the full length of the spray bar during operation;
- pressure pump gauge that shows the pump output in gallons per minute;
- adjustable full-circulation spray bars that uniformly distribute bitumen within a tolerance of 0.02 gallon per square yard;
- cutoff valves to start and stop the flow quickly and uniformly over the length of spray bar without dripping; and
- volume gauge that displays the quantity of material in the tank.

Provide data showing the manufacturer’s instructions and recommendations for spray bar height above the road surface, nozzle size, and angle of spray fan with the spray-bar axis.

The Engineer may require that the distributor be calibrated at any time.

Provide for each distributor, charts, tables, or other means for accurate, rapid determination of application rates in gallons per square yard for:

- spray bar widths;
- truck speeds; and
- pump pressures or outputs.

C. Aggregate Spreader.

Use a spreader capable of uniformly placing aggregate over a width of one lane plus one foot, not to exceed 13 feet. Provide cutoff plates to reduce the width of spread when necessary.

Do not allow the equipment wheels to contact bitumen not covered by aggregate.

D. Micro Surfacing and Slurry Seal Equipment.

1. Proportioning Devices.

Use a proportioning device that continuously proportions and delivers aggregate, emulsified asphalt, mineral and field control additives, and water to the mixer. Provide and label individual volume or weight controls for proportioning each material to be added to the mix.

2. Emulsion Pumps.

Use heated positive displacement emulsion pumps.

3. Mixing Equipment.

Use mixing equipment that:

- is self-propelled;
- has sufficient storage for aggregate, emulsified asphalt, mineral and field control additives, and water;
- has a revolving multi-blade twin shafted mixer; and
- discharge the mixed product on a continuous flow basis.

Use a machine equipped with self-loading devices that loads materials while continuing to lay the micro surfacing or slurry seal coat.

4. Spreading Equipment.

Equip the mixer with a mechanical type spreader box that uniformly spreads the surfacing mixture.

Equip the spreader box with:

- paddles that agitate and uniformly spread the materials throughout the box;
- a hinge near the center to compensate for a quarter crown;
- a front seal to prevent material loss at the road contact point;
- an adjustable rear seal for strike off; and
- the capability to side shift to compensate for variations in pavement geometry.

For micro surfacing, attach an additional strike off to the spreader box after the adjustable rear seal that provides a smooth finished surface. Do not use a burlap drag.

5. Rut Box for Micro Surfacing.

Use a rut box to pre-fill wheel ruts. Use a 5 foot wide rut box with hydraulically adjustable strike off screeds. Use a rut box that is capable of an inverted or regular crown.

SECTION 155
CONCRETE EQUIPMENT

155.01 GENERAL
Do not use aluminum in any operation where concrete could come in contact with the aluminum.

155.02 BATCH PLANT

A. General.

Fully load bins that have suspended weighing equipment for a minimum of 2 hours before testing. Construct the weighing mechanism so that it is unaffected by wind and other weather conditions.

Provide a NRMCA Certified plant for concrete used in Sections 550, "Concrete Pavement", 570 "Concrete Pavement Repair", 602 "Concrete Structures", and 622 "Pilings".

1. Bins.

Equip the batch plant with individual bins, or a bin with individual compartments, for each aggregate component. Construct bins to prevent intermingling of aggregate. Use a scalping screen or other device on each bin that is capable of removing deleterious and oversized material from the aggregate.

2. Weighing Hoppers.

a. General.

Use beam or springless dial-type weigh hopper scales. Adjust the balance to read zero before weighing each load.

Do not allow the freely suspended hopper to contact anything that could affect proper functioning of the scale.

Provide one standard 50 pound test weight for every 500 pounds of the scales capacity. Provide a minimum of 10 test weights up to a maximum of 20.

Replace or repair scales that cannot be maintained accurately within the specified tolerances.

Relieve air pressure build up by venting hoppers that are loaded by compressed air.

Charge the weigh hopper to ensure the batched weights are within the tolerances as specified in Section 802.03 B, "Batching of Concrete Materials". Weigh the separate aggregate components for each batch cumulatively in a single hopper or separately in individual hoppers. When weighed cumulatively, weigh the aggregate in the specified sequence.

Use weigh hoppers that discharge material without loss and without manual assistance. If necessary, equip the hoppers with a vibrator to obtain complete discharge. Use hoppers that hold the materials without spillage. Use discharge gates that do not leak when closed.

Use scales that are:

- Certified by a scale service company registered with the North Dakota Public Service Commission. If the certification is more than 9 months old when the scale begins project use, have the scale recertified. Submit a copy of the certification before starting weighing operations.

- Accurate to within 0.5 percent of the true weight of the applied load throughout the range of use.

b. Dial Hopper Scales.
Use dial scales that are marked with the predetermined batch weight of each ingredient by an adjustable pointer on the dial face.

c. Beam Hopper Scales.
Equip beam scales with an "over and under" indicator. Include a separate beam for each ingredient.

3. Bulk Cement and SCM.
Keep bulk cement and SCM separate from the aggregates. Weigh bulk cement and SCM in a weigh hopper attached to a separate scale.

Charge bulk cement and SCM into the weigh hopper from weatherproof bins. Use a bin that is equipped to permit accurate control of the quantity of material withdrawn for each batch within the tolerances specified in Section 802.03 B, "Batching of Concrete Materials".

B. Automatic Batching Equipment.

1. General.
Use automatic batching equipment on projects with over 3,000 CY of concrete.

For each batch the only manual operation allowed is a single actuation of a starting device to proportion the designated quantity of each ingredient into the weigh hopper.

Interlock the automatic batching equipment so that:

- The charging mechanism of any weigh hopper cannot be opened until the scale has returned to zero and the discharge mechanism of the weigh hopper has closed;
- The discharge mechanism of the weigh hopper cannot be opened if the charging mechanism is open;
- The discharge mechanism cannot be opened until all ingredients have been batched to their designated weights; and
- The aggregates are weighed in the specified sequence if separate aggregate components are weighed cumulatively in a single hopper.

Preset the designated batch weight of bulk cement and SCM and each separate aggregate component before the batch cycle starts.

Equip the automatic scales for weighing bulk cement and SCM with an automatic recording device that graphically records or prints the batched and empty weights. Use a

weight recording mechanism that is accurate within one graduation of the chart or tape. Use graphic recording charts graduated for time intervals not exceeding 15 minutes, and with weight graduations not exceeding 0.1 percent of the nominal scale capacity. If using printed tapes, use tapes that record the consecutive batch number and ensure the minimum weight graduation printed on the tape does not exceed 0.1 percent of the scale capacity.

Use automatic batching equipment that is capable of conversion to manual operation. If the automatic equipment breaks down, the Department will allow manual operation for up to 12 hours.

2. Batch Tickets.
Generate a batch ticket for each load and send one copy with the load to the work site.

Include the following information on the batch ticket:
- Ticket Number;
- NDDOT project number or NDDOT Project Control Number (PCN);
- Delivery date;
- Contractor and Subcontractor if applicable;
- Time of weighing;
- Identification number of truck; and
- Quantity of each material in the mix.

155.03 MIXERS

A. Stationary Mixers.

1. General.
Use mechanically operated revolving drum or revolving blade type mixers. Use a mixer that has a manufacturer certified rating plate attached that shows:
- The maximum mixer capacity;
- The recommended speed of rotation of the drum or blade (rpm); and
- The mixer's registration number.

Provide a NRMCA Certified plant for concrete used in Sections 550, "Concrete Pavement", 570, "Concrete Pavement Repair", 602 "Concrete Structures", and 622 "Pilings".

Use mixers with a rated capacity of at least 10 cubic feet. The Department may approve mixers of smaller capacity if the volume of concrete required is less than 10 cubic yards and is not used for concrete pavement or concrete structures.

Use a mixer with a total production capacity that is adequate to furnish concrete at a rate that permits uninterrupted placement and finishing operations.

2. Maintenance and Operations.
Keep deposits of hardened concrete from accumulating in the mixer drum.

Repair or replace the pick up and throw over blades when blade wear exceeds 10 percent of the original blade depth. Provide a copy of the manufacturer's design showing the

original layout and dimensions of the blades or place permanent marks on each blade showing points of 10 percent wear from new conditions.

Interlock the charging, mixing, transfer, and discharge cycles of multiple compartment mixers to prevent intermingling of batches.

Use a revolving drum type stationary mixer that has a manufacturer's guaranteed capacity capable of mixing and holding a volume of concrete equal to its rated capacity plus 10 percent without spillage. Use a revolving blade type stationary mixer that mixes and holds a volume of concrete equal to its rated capacity without spillage. Use a speed of rotation for the mixing drum or blades that is as specified by the manufacturer.

3. Water Measuring.

Equip mixers with a capacity of 10 cubic feet or more with a water measuring system. Mount the water measuring system on the mixer or use a separate unit located at the mixing site.

Use a water measuring system that:

- Delivers the designated quantity of water for each batch within the tolerance specified in Section 802.03 B.4, "Batching Water";
- Automatically stops the water flow when the designated quantity has been delivered; and
- Is adjustable and has a calibrated indicator showing the quantity of water measured for each batch.

Calibrate the water measuring system before use and as necessary to maintain the specified tolerances.

Use approved manual methods for measuring water when the mixer has a rated capacity less than 10 cubic feet.

4. Admixture Measuring.

Use a visual volumetric measuring unit in admixture dispensing systems where the admixture dosage rate does not exceed 32 fluid ounces/100 pounds of cement. Place the measuring unit where the plant operator can read the index points on the measuring unit from the operator's station.

Do not use a measuring unit in a plant when:

- Batching office and batch plant are widely separated; or
- Batch cycle time is insufficient to allow the fill and discharge of a measuring unit.

When a measuring unit is not used, install a flow indicator in the admixture line to indicate to the plant operator the start and completion of each batch. Install a measuring unit in the line to check the dispenser accuracy.

Use a separate dispenser for each admixture.

5. Timing.

When the stationary mixer has rated capacity of 10 cubic feet or more, equip mixers with controls for automatically timing the mixing cycle. Interlock the automatic timing controls

with the discharge mechanism so no part of the batch can be released until the designated mixing time has elapsed. Use an audible or visual signal to indicate the completion of each mixing cycle. Use a lockable timing system.

If the automatic timing controls fail, the Engineer may temporarily allow operation of the mixer by an approved manual timer. Use a manual timer that can maintain a mixing time for each batch of 90 seconds or more. Make repairs to automatic timing controls within 72 hours.

Use a mechanical batch counter on stationary mixers used to mix concrete for pavement.

When the stationary mixer has a rated capacity of less than 10 cubic feet, time the mixing cycle by a method approved by the Engineer.

B. Truck Mixers.

1. General.
Use a truck mixer that has the maximum cubic yard capacities for mixing and agitating as certified by the manufacturer on the attached rating plate.

Provide a NRMCA Certified plant for concrete used in Sections 550, "Concrete Pavement", 570, "Concrete Pavement Repair", 602 "Concrete Structures", and 622 "Pilings".

2. Maintenance and Operations.
Keep deposits of hardened concrete from accumulating in the mixer drum.

Repair or replace the pick up and throw over blades when blade wear exceeds 10 percent of the original blade depth. Provide a copy of the manufacturer's design showing the original layout and dimensions of the blades or place permanent marks on each blade showing points of 10 percent wear from new conditions.

3. Timing.
Equip the truck mixer with a revolution counter that records when the mixer is operated at mixing speed.

Use an agitating speed of 2 to 6 revolutions per minute.

Keep flush water for cleaning is in a separate compartment from the mixing water. Equip each compartment with a calibrated sight gauge.

Use a mixing speed for the revolving drum type mixer between 4 revolutions per minute and a speed that results in a peripheral velocity of 225 feet per minute at the largest diameter of the drum.

Use a mixing speed for the revolving blade type mixer of 4 to 16 revolutions per minute.

C. Mobile Mixers.

1. General.
Use self-propelled mixers.

Use a mixer that has the maximum cubic yard capacities for mixing as certified by the manufacturer on the attached rating plate.

Keep deposits of hardened concrete from accumulating in the mixer.

2. **Measurement.**
   Use a mixer that measures the cement and flow of water introduced into the mix.

   Use a visible cement recording meter equipped with a ticket printout that shows quantity used.

   Use a flow meter to indicate water flow that is adjustable to provide for minor variations in aggregate moisture.

3. **Calibration.**
   The Engineer will calibrate the mixer and each individual component (coarse aggregate, fine aggregate, water, cement, and admixture).

   Furnish:
   - 500 pound capacity platform scale;
   - 300 pounds of test weights;
   - Container that can be placed on the scale; and
   - Deflector to divert the material from the mixer into the container.

155.04 TRANSPORTING

A. General.
Use equipment that delivers the concrete in a thoroughly mixed and uniform mass. Use equipment that has gates or approved means for controlling the discharge rate and vibrators to aid in the discharge.

B. Agitators.
Use revolving-drum or open-top revolving-blade type agitating equipment, or a truck mixer operated at agitating speed. Agitate at a speed between 2 and 6 rpm. Use a drum that has a body or drum that is smooth and watertight. Use a unit that has the maximum cubic yard capacities for mixing as certified by the manufacturer on the attached rating plate.

155.05 SIDE FORMS

Use forms:
- That are clean and oiled;
- Without battered top surfaces; and
- That are not bent, twisted, or broken.

Do not use repaired forms unless approved by Engineer.

Do not use built-up forms.

Use metal straight side forms, at least 7/32 inches thick and at least 10 feet long.

For curves with a radius of 100 feet or less, use flexible forms or curved forms with the specified radius.

Securely set forms to withstand the weight impact and vibration of the consolidating and finishing equipment, without spring or settlement.

Use flange braces that extend outward on the base not less than 2/3 the height of the form.

Use forms with top faces that do not vary from a true plane more than 1/8 inch in 10 feet and with upstanding legs that do not vary from a true plane more than 1/4 inch in 10 feet.

Lock the ends of abutting form sections together.

155.06 SURFACING

A. Spreaders.
Use a self-propelled spreader that is capable of spreading the concrete mix to the desired cross section and is adjustable for different thicknesses.

B. Vibrators.
Vibrators for full width vibration of concrete paving slabs may be either the surface-pan type or the internal-spud type with either immersed tube or multiple spuds. Attach the vibrators to the spreader or the finishing machine, or mount on a separate carriage. Do not allow the vibrators to contact joints, load transfer devices, subgrade, or side forms. Follow the manufacturer's recommendations for vibrator frequency.

Provide equipment for measuring the vibrations per minute.

C. Slip-Form Paving.

1. General.
Use self-propelled equipment that places, consolidates, and finishes the concrete in one complete pass without the use of fixed side forms. Do not apply external tractive force to the equipment.

2. Vibrators.
Use vibrators capable of consolidating the full width and depth of the concrete in a single pass.

Use internal vibrators that operate from 3,500 to 8,000 vpm with an operating position-locking device.

Use surface vibrators that operate from 3,000 to 6,000 vpm.

Do not exceed the manufacturer’s recommendations for horizontal spacing of vibrators and do not exceed a maximum spacing of 16 inches.

Mount the vibrators parallel to the direction of paving with the trailing ends tilted downward 15 degrees.

Use vibrators that meet the following specifications at manufacturer's design frequency of 10,000 vpm:

Amplitude	0.070 inches
Centrifugal Force	1,000 pounds

If two adjacent vibrators fail to operate, stop the paving operation and repair or replace vibrators.

Repair or replace damaged or malfunctioning vibrators before beginning paving operations. The Engineer may allow the use of damaged or malfunctioning vibrators to complete that days paving operation.

3. **Vibrator Monitoring System.**
Use a continuously operating electronic monitoring device equipped with a readout display near the operator's controls. Display the vibrator frequencies with manual or automatic sequencing among all individual vibrators.

Use a monitoring system that produces a record as specified in Section 550.04 D.3.b, "Consolidation Vibrator Operation".

If the electronic monitoring device fails to operate, immediately check the vibrators. Repair or replace damaged or malfunctioning electronic monitoring devices within 72 hours.

155.07 FINISHING

A. Manually Operated Screeds.
The Engineer will allow manually operated screeds on concrete pavement repair of less than 20 feet in length, driveways, concrete tapers, and sidewalks. The Engineer will allow roller screeds if there is no visible deflection or bounce of the tube. Straightedge the tube prior to using.

Use manually operated metal or metal shod screeds that are at least 2 feet longer than the maximum width of the slab. Unless the concrete is satisfactorily consolidated by vibration before screeding, equip the screed with an approved vibratory unit.

B. Transverse Finishing Equipment for Pavement.
Use a self-propelled transverse finishing machine that strikes off, screeds, and consolidates the concrete. Use a machine that is adjustable to the specified crown or surface.

C. Bridge Deck Finishing Equipment.
Use finishing machine that is:

- Self-propelled;
- Mounted on wheels which ride on a track;
- Equipped with one or more power-driven oscillating or rotating screeds;
- Equipped with a mechanical strike off to provide a uniform thickness of concrete; and
- Adjustable to the specified crown and elevation to maintain the required concrete cover over the reinforcing steel.

D. Bridge Deck Overlays Finishing Equipment.
Use a finishing machine that is:

- Equipped with an oscillating screed or screeds with an effective weight of at least 75 pounds for each square foot of bottom face area, and provided with positive control of vertical position, the angle of tilt, and the shape of the crown. At least one oscillating screed shall be capable of consolidating the concrete to the specified density;
- Long enough to uniformly strike off and consolidate the width of lane to be paved
- Capable of forward and reverse motion under positive control;
- Travelling on rails with fully-adjustable and stable supports;
- Supported without the use of shims; and
- Not anchored to the concrete using powder actuated fasteners, unless that concrete will be subsequently overlaid.

155.08 LIQUID CURING COMPOUND SPRAYERS

Use a self-propelled sprayer with a pressure distribution system. Protect the spray nozzles with a hood. Use an approved hand-operated sprayer where necessary.

155.09 SAWING

Use a power saw furnished with suitable blades to cut pavement joints. Maintain each blade of multiple-blade saws in accurate alignment with the other blades. Use a device to guide the saw along the required joint alignment. Provide lighting for night sawing.

155.10 JOINT AND CRACK CLEANING AND SEALING

A. Cleaning.
Use an air compressor that conforms to Section 156.01, “Air Compressor”.

B. Hot Poured Joint Sealant.
Use a thermostatically controlled double-boiler heating kettle equipped with a temperature indicator and a mechanical agitator.

Use a pressure-type applicator.

C. Silicone Sealant.
Use a mechanical device for applying silicone sealant equipped with a nozzle or spout shaped to fit into the joint that completely fills the joint from the bottom up.

D. Preformed Elastomeric Compression Joint.
Install the seals as recommended by the manufacturer.

155.11 GRINDING

Use a self-propelled grinder equipped with diamond blades that is capable of uniformly grinding or removing the surface to the specified depth without damaging the underlying concrete.

155.12 CONCRETE BUGGY

Use a concrete buggy weighing less than 2,000 pounds empty.

SECTION 156
MISCELLANEOUS EQUIPMENT

156.01 AIR COMPRESSOR
Furnish a portable air compressor capable of supplying at least 100 pounds per square inch of air pressure at the nozzle. Equip compressors with traps that maintain the compressed air free of oil and water.

156.02 FOGGER
Produce a fog spray from nozzles that atomize the droplets and a system capable of keeping a large surface area damp without allowing water to drip, flow, or puddle on the surface. Use high pressure equipment that generates a minimum of 1200 psi at 2.2 gpm, or low pressure equipment having nozzles capable of supplying a maximum flow rate of 1.6 gpm.

156.03 MILLING MACHINE
Use a self-propelled milling machine with a control system that automatically adjusts the elevation and transverse slope of the milling head. Provide a 30 foot minimum length skid, rolling traveling straightedge, or other approved device to establish the grade reference for control of the milling head. Use a system that permits the grade reference device to operate on either side of the milling machine and maintains the desired transverse slope regardless of changes in the elevation of the milling head.

Provide conveyors capable of side, rear, or front loading and provide the necessary equipment to transfer the milled material from the roadway to a truck.

SECTION 201
CLEARING AND GRUBBING

201.01 DESCRIPTION
This work consists of clearing, grubbing, removing, and disposal of vegetation and debris.

201.02 EQUIPMENT
Reserved.

201.03 MATERIALS
Reserved.

201.04 CONSTRUCTION REQUIREMENTS
The Engineer will establish the right of way and construction limits and designate the items to remain.

Remove trees and stumps located within the boundaries of the roadbed to a depth of 3 feet below the final dirt grade.

Remove trees and stumps located outside the boundaries of the roadbed and within the construction limits to a depth of 18 inches below the final dirt grade.

Prune branches and remove loose bark on trees or shrubs that were broken, cut, or scarred during construction activities.

Trim tree branches extending over the roadbed to give a clear height of 20 feet, or according to local ordinances, whichever is greater.

The Engineer may allow burning of perishable materials when permitted under applicable laws and ordinances. Provide a watch person on site to monitor the burning of perishable materials.

Backfill and compact all cavities with a suitable material, except in areas to be excavated. Compact backfill material within the boundaries of the roadbed as specified in Section 203.04 G.2, “Compaction Control, Type A”. Compact backfill material outside the boundaries of the roadbed as specified in Section 203.04 G.4, “Compaction Control, Type C”.

201.05 METHOD OF MEASUREMENT
The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will measure stumps by the average diameter of the stump at ground level. Stumps 8 inches in diameter or less will be included in the bid item “Clearing & Grubbing” or “Removal of Trees & Brush”.

The diameter of trees will be measured at a height of 24 inches above the existing ground. Trees will be classified based on Table 201-01:

Table 201-01
Schedule of Sizes

Diameter (Inches)	Pay Item Designation
8 or less	Clearing & Grubbing; Removal of Trees & Brush
Over 8 ≤ 12	Removal of Trees 10 IN
Over 12 ≤ 24	Removal of Trees 18 IN
Over 24	Removal of Trees 30 IN

201.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Clearing & Grubbing	Acre or Lump Sum
Removal of Trees	Acre
Removal of Trees __IN	Each
Removal of Trees & Brush	Lump Sum
Stump Removal	Each

Tree removal bid items include the cost of removing stumps created when cutting trees. The "Stump Removal" bid item applies only to pre-existing stumps.

If no specific bid items for tree and stump removal are included in the contract, include the cost of tree and stump removal in the contract unit price for "Clearing & Grubbing" or "Removal of Trees & Brush".

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 202
REMOVALS

202.01 DESCRIPTION
This work consists of demolishing, removing, salvaging, and disposing of items not designated to remain, salvaging designated materials, and backfilling resulting cavities.

202.02 EQUIPMENT
Reserved.

202.03 MATERIALS
Reserved.

202.04 CONSTRUCTION REQUIREMENTS

A. General.

At the end of each day provide a smooth transition between areas where pavement has been removed and areas from which traffic can enter the removal area.

Replace items designated for salvage that are lost or damaged by work activities with new items, meeting the appropriate specifications, at no additional cost to the Department.

Begin and end removal of existing bituminous and concrete surfaces at a joint or create a smooth, vertical plane along the entire length of the remaining surface.

Backfill and compact material used to fill cavities within the boundaries of the roadbed as specified in Section 203.04 G.2, “Compaction Control, Type A”. Backfill and compact material used to fill cavities outside the boundaries of the roadbed as specified in Section 203.04 G.4, “Compaction Control, Type C” to the same level as the surrounding undisturbed ground.

Before backfilling over concrete slabs that will remain in place, break up the slabs to facilitate drainage.

B. Removal of Structures and Box Culverts.

If bridge elements are designated for salvage, matchmark the elements and transport them to the location specified in the contract.

Remove portions of structures within the limits of a new structure to accommodate the construction of the new structure. In other areas, remove existing substructures to one foot below the existing stream bottom and remove those parts outside the stream to one foot below final ground surface.

When removing a bridge, perform asbestos inspection and testing and submit SFN 17987 “Asbestos Notification of Demolition and Renovation” to NDDEQ at least 10 working days before demolition. If asbestos is discovered, the Engineer will issue a contract revision for work related to the asbestos.

C. Removal of Pipe Conduit.
Dispose of unsuitable or excess excavation at an approved location.

D. Removal of Paving Materials (Bituminous, Concrete, and Aggregate Materials).
If paving materials are designated salvage material, ensure the material is not contaminated with dirt or other deleterious material. Deleterious material includes all steel material within concrete pavement

E. Removal of Manholes and Inlets.
Remove manholes or inlets by removing the casting, rings, barrel, and base; plug or cap the existing lines; and backfill to grade.

202.05 METHOD OF MEASUREMENT

A. General.
The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as described in this section.

B. Removal of Pipes, Culverts and End Sections.
If only the end section is designated to be removed from a pipe location, the Engineer will measure the end section by the each removed.

If pipe, or portions of a pipe, and end sections are to be removed from a location, the Engineer will measure removal of pipe conduit along the top of the pipe. The Engineer will not measure flared end sections. Flared end sections will be considered part of the pipe.

C. Removal of Concrete.
The Engineer will include the reinforcing steel in the total weight when the Department pays for removal of concrete pavement by the ton.

202.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Removal of Structure	Each, Lump Sum
Removal of Structure-Site __	Lump Sum
Removal of Structures and Obstructions	Lump Sum
Removal of Box Culvert	Each, Lump Sum
Removal of Concrete-Site __	Lump Sum
Removal of Concrete	Lump Sum, Square Yard, Cubic Yard, Ton
Removal of Concrete Pavement	Square Yard
Removal of Pavement	Square Yard, Ton
Removal of _____ Surfacing	Square Yard, Cubic Yard, Ton
Remove & Salvage Base & Surfacing	Ton
Removal & Salvage of _____ Surfacing	Square Yard, Cubic Yard, Ton
Removal & Salvage Culverts, All Types & Sizes	Linear Foot
Removal of End Sections All Types & Sizes	Each
Removal of Culvert All types and Sizes	Linear Foot
Removal of Pipe All Types & Sizes	Linear Foot

Pay Item	Pay Unit
Removal of Curb & Gutter	Linear Foot
Removal of Manholes	Each
Removal of Inlets	Each
Removal of Catch Basins	Each
Removal of _____	Each, Lump Sum, Linear Foot, Square Yard, Cubic Yard, Ton

Include the cost for excavation and disposal of excess excavation for removal of pipe conduit in the price bid for “Removal of Pipe All Types & Sizes”.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 203
EXCAVATION AND EMBANKMENT

203.01 DESCRIPTION

A. General.
This work consists of the excavation, haul, placement, disposal, and compaction of embankment material.

B. Common Excavation.
Common excavation consists of excavation within the right of way, not otherwise classified.

C. Rock Excavation.
Notify the Engineer if detached rocks having a volume of 0.5 cubic yard or larger are discovered or if rock excavation methods are required for the excavation of material or boulders.

Rock excavation methods include:
- Blasting, before material can be excavated and removed; or
- Material that requires heavy-duty dozer-mounted rippers or dozer blades to break the material into chunks of more than one cubic foot, before material can be excavated and removed.

D. Shale Excavation.
Notify the Engineer if shale excavation is required before performing the excavation.

Shale excavation includes:
- Excavating material that is laminated, fissile, or sedimentary material that is principally composed of fine-grained particles; or
- Material that requires heavy-duty dozer-mounted rippers or dozer blades to break the material into chunks of one cubic foot or less, before material can be excavated and removed.

E. Muck Excavation.
Notify the Engineer if muck excavation is required before performing the excavation.

The Engineer will classify the excavation as muck when both criteria below are met:
- The material is a saturated mixture of soils and organic matter unsuitable for use as embankment; and
- The material cannot be excavated using the methods the Contractor is using to perform the majority of the surrounding excavation.

F. Borrow Excavation.
Borrow Excavation consists of the use of material obtained from outside the right of way for construction. Borrow may be obtained by either the Contractor or the Department, depending on the specific contract requirements.

G. Haul.

Average haul is the average distance which, in stations, excavation in excess of that deposited within the station must be hauled.

Free haul is the average haul for the project.

Overhaul is authorized hauling in excess of the free haul distance, if the haul is also beyond the designated balance points.

If overhaul is authorized, allow the Engineer 6 hours before and after hauling operations to take measurements to determine the volume of overhaul excavation.

203.02 EQUIPMENT

Equipment	Section
Vibratory Sheepsfoot/Pad Foot/Extended Pad Foot Roller	151.02

Use sheepsfoot rollers with feet that exert a ground pressure of at least 250 psi.

Material used for embankment construction may be hauled in trucks or in scrapers.

If scrapers are used to haul material, construct an earthen ramp across existing roadways. Construct the ramp to a depth that will protect the existing pavement structure from damage and in a manner that will allow traffic to utilize the roadway at all times. Remove the ramp each day when hauling operations cease. Provide flagpersons, as specified in Section 704, "Temporary Traffic Control" for each direction that traffic crosses the ramp. Use of earthen ramps in this manner is dependent upon approval of the Engineer. Construct and remove the ramp at no additional cost to the Department.

203.03 MATERIALS

Material	Section
Subcut Aggregate	Section 816 Class 3 or 5;

203.04 CONSTRUCTION REQUIREMENTS

A. Rock and Shale Excavation.

Excavate rock and shale to a minimum depth of 6 inches and a maximum depth of 12 inches below subgrade.

B. Roadway Obliteration.

Obliterate the roadway by removing the roadway surface material, structures, and appurtenances, filling in the ditches, grading, placing topsoil, and seeding. Restore to match surrounding ground contours.

C. Coal.

Remove coal to a depth:

- 6 feet below the subgrade profile between the graded shoulders; and
- 1 foot below the final surface elevation from the graded shoulders to the top of the backslopes.

D. Topsoil.

1. Topsoil Removal and Stockpiling.

Remove topsoil to its full depth or a depth up to 6 inches, whichever is less, from all excavation and embankment areas. Do not remove the subsoil or other deleterious material with topsoil. Stockpile the removed topsoil.

Place topsoil piles at acceptable locations outside of the grading limits or, if necessary, outside the right of way at no additional cost to the Department. If stockpiling topsoil outside the right of way, submit a copy of the agreement negotiated with the landowner 10 days before constructing topsoil stockpiles.

When stockpiling topsoil within the clear zone, construct topsoil stockpiles with foreslopes of 4:1 or flatter and approach slopes of 10:1 or flatter.

2. Topsoil Placement.

Scarify the surface to a depth of 2 inches before replacing topsoil.

Uniformly spread the stockpiled topsoil over the disturbed areas within the right of way.

3. Topsoil – Imported.

Provide imported topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoil, roots, heavy or stiff clay, stones larger than two inches in greatest dimension, noxious weeds, sticks, brush, litter, and other deleterious matter. Provide the topsoil from a site outside the right of way. Spread the topsoil uniformly to a minimum depth of 6 inches. Use all existing stockpiled topsoil before importing topsoil.

E. Subcut.

1. Excavation.

Use an excavator with a smooth cutting edge to minimize disturbance of underlying soils. Do not scarify the bottom of the subcut. Do not operate construction equipment in the subcut area.

Dispose of material removed from the subcut area as specified in Section 107.17, "Removed Material".

2. Aggregate

Install the first layer of subcut aggregate as specified in Section 709.04, "Construction Requirements" for the type of geosynthetic material installed.

Compact subcut aggregate to at least 90% of the maximum dry density with a moisture content between 2.0 percentage points below and 3.0 percentage points above the optimum moisture content. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T 180.

F. Borrow Excavation.

1. General.

Place all available common excavation before using borrow excavation.

Obtain a borrow source if no Department optioned borrow is provided. The Engineer will allow Contractor furnished borrow unless the Department optioned borrow area is mandatory.

Compact borrow as specified in Section 203.04 G.2, "Compaction Control, Type A" if no other compaction requirements are stated in the contract.

2. Department Optioned Borrow.

a. General.

Identify the legal owners of the borrow area at the time the material is being removed. Use county records for the identification of landowners. Include the names of any other parties having a legal interest in the property. Provide this information to the Engineer.

Notify the landowner in writing if exercising the Department's option, including the removal plan and location of the access route.

Submit a copy of the written notification and any other agreements negotiated with the landowner 10 days before starting operations in borrow area.

Ensure livestock is confined when fencing is removed or altered.

b. Utilites.

The Department will be responsible for utility relocations and costs of relocations.

Schedule work in borrow areas to allow affected utility companies to relocate, adjust, or remove their facilities.

c. Topsoil Removal.

Before excavation, strip a minimum of 6 inches of topsoil. In areas where topsoil depth exceeds 6 inches, strip a maximum of 12 inches of topsoil.

d. Payment of Borrow.

Provide proof of payment to the Engineer within 30 days of issuing the payment to the grantor. The Department will not make progressive payments for borrow material removed from a location until the proof of payment is received.

e. Multi Year Projects.
If the work is performed in more than one calendar year, pay the landowner for the material removed the first calendar year by December 31 of that year. If a payment arrangement different from the Department's option is negotiated with the landowner, submit a copy of the agreement.

f. Material Shortage.
If a material shortage or other issues occur in the Department optioned area and the Engineer directs that borrow be furnished from an alternate site, the Department will pay for:

- Topsoil and seeding on the basis shown for the Department optioned area;
- Costs in excess of what would be incurred in the Department optioned area; and
- Haul will be measured as specified in Section 203.05 G, "Haul".

g. Waste Disposal.
Do not place waste or excess material in a borrow area without obtaining an agreement with the landowner for the placement of the material. Submit a copy of the agreement before placing waste or excess material in a borrow area.

h. Borrow Site Restoration.
Shape the borrow area to drain after excavation is complete. Flatten slopes to a minimum of 8:1, except if blending into steeper slopes and perform the following actions to restore the borrow site after it is no longer needed:

- Remove stockpiles;
- Replace fence to its original condition;
- Spread topsoil over the disturbed area;
- Obliterate and reshape access route; and
- Seed the disturbed area.

Use seed as specified in the Contract, if no seed is specified use Class II seed mixture as specified in Section 251.03, "Materials".

Submit a copy of the landowner's pit release stating that the borrow area has been restored to a satisfactory condition.

i. Remaining Borrow Royalty Payment.
Make a payment for the remaining balance of the royalty payment within 30 days of obtaining a signed pit release from the grantor. Provide proof of payment to the Engineer within 30 days of issuing the payment to the grantor. The Department will not make payment for the final quantity of borrow material removed from the borrow area until proof of payment is received.

3. Contractor Furnished Borrow.
The Engineer will determine if the material is suitable for the specified use.

Before work begins in the pit, furnish the names of the legal owners and the names of other parties having a legal interest in the borrow areas.

Submit a copy of the borrow agreement.

After the borrow area has been restored to satisfactory condition, obtain a release and receipt of payment from the legal owners, and furnish copies to the Engineer.

Utility adjustments shall be the Contractors responsibility.

G. Embankment Construction.

1. General.

If disposing of rocks and boulders, bury them under a minimum of one foot of soil at approved locations.

Do not place rocks, broken concrete, or other solid materials in embankment areas where piling is to be driven. Do not place any rocks larger than 4 inches in its longest dimension in the top one foot of the finished grade.

Do not use frozen material in embankment construction. Do not place material on frozen ground.

Use grading equipment to spread material to a uniform thickness before compacting. Continuously level and manipulate the material to obtain uniform soil distribution. Operate construction equipment uniformly over the entire surface of each lift. Compact each lift to specified density and moisture content before placing the next lift.

Compact private drives, minor road approaches, and other parts of the embankment outside the roadbed as specified in Section 203.04 G.4, “Compaction Control, Type C”.

Construct benches a minimum of 24 inches in width when placing new material against slopes 4:1 or steeper. Begin each horizontal cut at the intersection of the original ground and the vertical sides of the previous cuts. Recompact excavated material along with new embankment material.

If placing and compacting material at structures, place and compact the material in lifts not to exceed 12 inches of loose material. During placement and compaction, ensure that each side is brought up within 12 inches of the other at all times.

Compact without placing excessive pressure against the structure when placing embankment is required only on one side of a structure.

Place fill adjacent to a bridge abutment no higher than the berm elevation in front of the abutment until the superstructure is in place.

2. Compaction Control, Type A.

Construct fills with moisture and density controls. Place embankment in lifts not to exceed 12 inches of loose material.

Manipulate substandard areas by working the soil until the specified density and uniform moisture content are achieved.

Compact material as specified in Section 203.04 G.2.a, “ND T 180” unless the contract specifies otherwise.

a. ND T 180.
Compact material to at least 90 percent of the maximum dry density with a moisture content no less than the optimum moisture and no more than 5.0 percentage points above the optimum moisture. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T 180.

b. ND T 99.
Compact material to at least 95 percent of the maximum dry density with moisture content no less than 4.0 percentage points below the optimum moisture, and no more than 5.0 percentage points above the optimum moisture. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T 99.

3. Compaction Control, Type B.
Construct embankment in lifts not to exceed 12 inches of loose material. If the first layer of fill is over material that will prevent achieving proper compaction, the Engineer may adjust the lift thickness.

Uniformly compact each lift by operating grading equipment and rollers over the entire area. Use a sheepsfoot roller until the roller pads penetrate the surface a maximum of 0.5 inch.

Use separate dumping and compacting areas.

4. Compaction Control, Type C.
Construct embankment in lifts not to exceed 8 inches of loose material over the full width of the proposed embankment section. If the first layer of fill is over material that will prevent achieving proper compaction, the Engineer may adjust the lift thickness.

Uniformly compact each lift by operating grading equipment over the entire area.

H. Approach Foreslope Reconstruction and Flatten Ditch Block Slopes.
Perform topsoil work for excavation and embankment areas as specified in Section 203.04 D, "Topsoil".

Compact embankment material as specified in Section 203.04 G.3, "Compaction Control, Type B".

Place Class II seed mixture as specified in Section 251.02, "Equipment"; 251.03, "Materials"; and 251.04, "Construction Requirements".

Place mulch as specified in Section 253.02, "Equipment"; 253.03, "Materials"; and 253.04, "Construction Requirements".

I. Guardrail Embankment.
Perform topsoil work as specified in Section 203.04 D, "Topsoil".

Compact embankment material as specified in Section 203.04 G.3, "Compaction Control, Type B".

Place Class II seed mixture as specified in Section 251.02, “Equipment”; 251.03, “Materials”; and 251.04, “Construction Requirements”.

Place mulch as specified in Section 253.02, “Equipment”; 253.03, “Materials”; and 253.04, “Construction Requirements”.

Maintain existing drainage during construction of the embankment.

J. Finishing.
When traffic is maintained on the existing roadbed, conduct operations so the distance does not exceed 3 miles between the point where the existing road surface is disturbed and to where the roadbed is finished to grade and aggregate is placed.

Place and shape topsoil on foreslopes, backslopes, and ditches as construction progresses.

203.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

A. Excavation.
When measuring excavation, the Engineer will obtain an initial measurement of the original ground after the topsoil has been removed and a second measurement after the completion of grading activities, but before the placement of topsoil.

Conduct operations to allow the Engineer to measure rock, shale, and muck excavation. If the Engineer was not allowed to measure rock, shale, and muck excavation, it will be measured as “Common Excavation”.

The Engineer will measure excavation of rock and shale up to 12 inches below grade as necessary to provide the designed thickness of backfill.

The Engineer will deduct the quantity measure over-breakage of wasted rock excavation from the volume. A maximum of 10 percent of the authorized quantity of rock excavation will be measured for the over-breakage quantity.

The Engineer will measure the authorized excavation of muck.

The Engineer will include coal in the measurement for “Common Excavation”.

Where ramps are constructed to allow scrapers to cross a roadway, the Engineer will measure flagging hours as specified in Section 704, “Temporary Traffic Control”.

B. Borrow Excavation.
The Engineer will measure borrow excavation by taking an initial measurement of the original ground after removal of topsoil and then a second measurement after removing the material but before placing topsoil.

If borrow excavation is placed before using all available common excavation, the Engineer will deduct the quantity of unused common excavation from the measured quantity of borrow excavation. The Engineer will include the deducted quantity of borrow excavation in the common excavation quantity.

If the borrow source is a Department option, the Engineer will measure the topsoil stripped from the borrow area. Provide a minimum of two working days' notice to allow the Engineer to complete the preliminary cross sectioning before removing topsoil. Provide notice and allow one working day for the Engineer to complete the topsoil measurement before beginning borrow excavation.

C. Topsoil.
The plan quantity for topsoil may be used as the measurement for payment if the Engineer and Contractor form a written agreement.

D. Topsoil – Imported.
The Engineer will measure imported topsoil as specified in Section 109.01 E, "Volume".

E. Embankment.
The Engineer will measure embankment by taking an initial measurement of the original ground and then a second measurement after placement of the material.

F. Slope Reconstruction.
The Engineer will measure each side of approach foreslope and ditch block slopes.

G. Haul.
The Engineer will measure haul distance as follows:

- Along the centerline of the roadway, when material is obtained from the right of way and deposited inside the right of way; or
- Along the shortest route when material is obtained from outside the right of way.

1. Authorized Haul.
The Engineer will determine the authorized haul by multiplying the number of cubic yards of material moved from its original position and the distance, in stations, that the material was hauled. This will be expressed in the unit Cubic Yard Stations.

2. Free Haul.
The Engineer will determine the free haul distance by dividing the number of cubic yard stations between balance points by the ordinate of the mass diagram which is the yardage hauled. This will be expressed in stations.

3. Overhaul.
The Engineer will fix 2 points on the volume curve, one on each side of the neutral grade point such that the distance between the points equals the free haul distance. Material located between these points will not be considered when determining the overhaul distance.

The Engineer will determine the overhaul distance by subtracting the free haul distance from the distance between the center of gravity of remaining mass of excavation and the remaining mass of embankment.

The Engineer will determine overhaul by multiplying the number of cubic yards of material hauled by the overhaul distance. This number will be expressed in Cubic Yard Miles.

203.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Common Excavation-Type__	Cubic Yard, Lump Sum
Common Excavation-Subcut	Cubic Yard
Rock Excavation	Cubic Yard
Shale Excavation	Cubic Yard
Muck Excavation	Cubic Yard
Borrow Excavation	Cubic Yard, Ton
Topsoil	Cubic Yard
Topsoil – Imported	Cubic Yard
Topsoil-Dept Option Borrow Area	Cubic Yard
Remove & Salvage Topsoil	Mile, Acre, Cubic Yard, Square Yard
Roadway Obliteration	Linear Foot
Embankment-Type__	Cubic Yard, Each, Lump Sum
Guardrail Embankment	Each
Flatten Ditch Block Slopes	Each
Approach Foreslope Reconstruction	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

A. Excavation.
Include disposal of excess excavation from the trenches of storm drains, water lines, water mains, sanitary sewers, and related items in the contract unit price for the item that required the excavation.

B. Borrow Excavation.
Include the costs for haul in the contract unit price for “Borrow Excavation”.

C. Department Optioned Borrow.
Include the costs for obliterating, scarifying, reshaping, and reseeding of the access route in the contract unit price for “Borrow Excavation”.

Include the removal and replacement of topsoil in Department optioned borrow areas in the contract unit price for “Topsoil – Dept Option Borrow Area”.

D. Contractor Furnished Borrow.
Include all costs associated with contractor furnished borrow in the contract unit price for “Borrow Excavation”.

E. Overhaul.
Overhaul will be paid for at the price listed in the PS-1.

SECTION 210
STRUCTURAL AND CHANNEL EXCAVATION, FOUNDATION FILL AND PREPARATION

210.01 DESCRIPTION

A. Structural Excavation.

1. **Class 1:** Class 1 excavation will be defined in the plans.

2. **Class 2:** Class 2 excavation will be defined in the plans.

3. **Box Culvert Excavation:** Excavation and ordinary backfill required for installation of box culverts.

B. Channel Excavation.
Channel excavation will be designated on the plans and includes excavation necessary to place riprap or aggregate cushions and to flatten and shape slopes around abutment locations.

C. Foundation Preparation.
Foundation preparation will be designated for installation of a box culvert or bridge.

210.02 EQUIPMENT
Reserved.

210.03 MATERIALS

A. Ordinary Backfill.
Use approved material from the excavation. Use borrow material as specified in Section 203.04 D, “Borrow Excavation” if additional material is required.

B. Foundation Fill.
Use CL 3 or CL 5 aggregate as specified in Section 816, “Aggregates”.

210.04 CONSTRUCTION REQUIREMENTS

A. Excavation.

1. **General.**
Perform excavation so that concrete can be placed in a dry area free of water.

If excavation has been performed to the specified elevation and unsuitable material is encountered, remove the unsuitable material and place foundation fill to the specified elevation.

Dispose of unsuitable excavated material as specified in Section 107.17, “Removed Material”.

2. Class 1 and 2 Excavation.
If footings are to be placed on an excavated surface and the excavated surface is disturbed, scarify the area and compact the material using a mechanical tamper. Perform final preparations of the foundation bed just before placing concrete.

When foundation piles are specified the bottom of the excavation may be extended below the footing to allow for heaving. Perform the extended excavation and place additional required backfill at no additional expense to the Department.

Use all suitable excavated material for backfilling in areas where ordinary backfill is specified. Dispose of remaining suitable excavation as specified in Section 107.17, "Removed Material".

B. Backfill.

1. General.
Place backfill material in an area free of water using tamping equipment that will not cause a wedging action of the material against the structure.

Place backfill material after the concrete has reached 70 percent of its design strength. Place backfill material around box culverts after the roof has reached 70 percent of its design strength.

If a wall depends on a superstructure for support, release the falsework before placing backfill material.

When placing of backfill material is required on only one side of a structure, compact backfill material without placing excessive pressure on the structure.

Place fill adjacent to a bridge abutment no higher than the berm elevation in front of the abutment until the superstructure is in place.

If foundation fill is not specified, backfill using ordinary backfill.

2. Ordinary Backfill.
Place ordinary backfill in layers not exceeding 6 inches of compacted material.

3. Foundation Fill.
Place foundation fill in layers not exceeding 6 inches. Compact material to at least 90 percent of the maximum dry density with a moisture content not less than 2.0 percentage points below optimum moisture and no more than 3.0 percentage points above the optimum moisture. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T 180.

C. Foundation Preparation.

Perform all work necessary to properly stage and maintain a site for construction of a structure. Construct and remove temporary features necessary to facilitate construction of the structure. Backfill the site as specified in the plans and Section 210.04 B, "Backfill". Dispose of excess and waste materials as specified in Section 107.17, "Removed Material".

210.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

A. Foundation Fill.
The Engineer will measure foundation fill completed and in place. The Engineer will not measure beyond the excavation limits for payment.

B. Channel Excavation.
The Engineer will not measure beyond the excavation limits for payment.

210.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Channel Excavation	Lump Sum, Cubic Yard
Class __ Excavation	Lump Sum, Cubic Yard
Foundation Preparation	Lump Sum
Foundation Fill	Ton, Cubic Yard

Include dewatering of the construction site in the contract unit price for “Foundation Preparation”.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 216
WATER

216.01 DESCRIPTION
This work consists of using water for dust control and to obtain proper moisture content and compaction.

216.02 EQUIPMENT

Equipment	Section
Water Trucks	152.01 B

216.03 MATERIALS
Reserved.

216.04 CONSTRUCTION REQUIREMENTS
Apply water in sufficient quantity to secure and maintain proper moisture content or dust control.

216.05 METHOD OF MEASUREMENT
The Engineer will measure water:

- In calibrated tanks;
- By weighing and converting to gallons at the rate of 8.33 pounds per gallon; or
- By an approved metering device placed in the supply line.

Before using a water metering device, furnish a certified statement that the device conforms to AWWA requirements. The statement must show that the device has been calibrated within the past year. Should subsequent measurements prove unreliable, furnish another certified device producing satisfactory measurements.

216.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Water	M Gal

An “M Gal” is equivalent to 1,000 gallons.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 220
STOCKPILE SITE

220.01 DESCRIPTION
This work consists of preparing or restoring a stockpile site for materials other than topsoil.

220.02 EQUIPMENT
Reserved.

220.03 MATERIAL
Use granular material with less than 30 percent passing the No. 200 sieve.

220.04 CONSTRUCTION REQUIREMENTS

A. Prepare Stockpile Site.
Strip all existing topsoil from stockpile area, up to a maximum of 1 foot. Shape and compact the site so water drains away from the stockpiled material. Place and compact 6 inches of granular material on the stockpile site.

B. Erosion Control.

1. **General.**
Install erosion control items as specified in the appropriate section of the specifications.

2. **Department Designated Stockpile Site.**
If the Department designates a stockpile site, include the erosion control measures in the SWPPP submitted to the Engineer as specified in Section 107.02 C, "Storm Water Permits".

3. **Contractor Obtained Stockpile Site.**
If using a Contractor obtained stockpile site, obtain the applicable permits as specified in Section 107.02, "Permits, Licenses, and Taxes". These permits will be separate from the permits obtained for Department designated areas.

Before work begins on the site, furnish the names of the legal owners and the names of other parties having a legal interest in the borrow areas.

Submit a copy of the site agreement.

After the site has been restored to satisfactory condition, obtain a release and receipt of payment from the legal owners, and furnish copies to the Engineer.

C. Restore Stockpile Site.

1. **Department Designated Stockpile Site.**
Restore the stockpile site upon completion of the project. Dispose of the unused or waste material and granular material at locations acceptable to the Engineer.

Restore the site to its original condition replacing topsoil and seeding. Use seed as specified in the plans, if no seed is specified use Class II seed mixture as specified in Section 251.02, "Equipment", 251.03, "Materials", and 251.04, "Construction Requirements".

Place mulch as specified in Section 253.02, "Equipment"; 253.03, "Materials"; and 253.04, "Construction Requirements".

Submit a copy of the landowner's release, receipt of payment, and a statement that the stockpile site has been restored to a satisfactory condition.

2. **Contractor Obtained Stockpile Site.**
   Restore the stockpile site as required within the site agreement upon completion of the project.

220.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities" and as follows:

Erosion control items for Department designated stockpile sites will be measured as specified in the "Method of Measurement" portion of the appropriate section of the specification. Seeding and mulching will not be measured.

Erosion control items for Contractor obtained stockpile sites will not be measured.

220.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Prepare Stockpile Site	Lump Sum
Restore Stockpile Site	Lump Sum

Erosion control items for Department designated stockpile sites will be paid as specified in the "Basis of Payment" portion of the appropriate section of the specification.

Include the costs for all removing and stockpiling topsoil, shaping and compacting subgrade, furnishing, placing, shaping, and compacting granular material in the contract unit price "Prepare Stockpile Site".

Include the costs for all disposal of wastes, spreading topsoil, compaction, blading, water, seed, fertilizer, and mulching in the contract unit price "Restore Stockpile Site".

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 230
RESHAPING ROADWAY AND SUBGRADE PREPARATION

230.01 DESCRIPTION
This work consists of scarifying, shaping, compacting, and maintaining the subgrade, or reshaping an existing roadway before constructing a base, or surface course.

230.02 EQUIPMENT

Equipment	Section
Roadbed Planer	153.02

Provide a general purpose moldboard plow capable of plowing to a depth of 12 inches or more that will completely lift, invert, and throw the soil to the side.

Provide a heavy duty disk capable of breaking up and evening out the plowed surface.

230.03 MATERIALS
Reserved.

230.04 CONSTRUCTION REQUIREMENTS

A. Reshaping Roadway.
Reshape roadway, ditches, and slopes.

Remove and dispose of the following:
- Rocks larger than 4 inches in their longest dimension;
- Roots; and
- Deleterious material.

Fill and compact holes and depressions with approved material.

Compact the soil as specified in Section 203.04 G.2, “Compaction Control, Type A.”

B. Shoulder Preparation.
Spray herbicide to kill all vegetation and roots on the pavement slough and within 2 feet of the outside edge of the slough. Mix and apply the herbicide according to the manufacture's recommendations. Spray the herbicide in two applications that are three weeks apart. Complete spraying no more than 30 days before starting paving operations. Take precautionary measures to prevent any damage to adjacent vegetation caused by the spraying operation.

Till or disk the area beginning at the bottom of the existing pavement slough to a distance between 2 and 4 feet down the foreslope. Move the disturbed material away from the pavement slough before placing the overlay.

Replace the disturbed material within 14 days of initial.

Provide a smooth transition between the top of the pavement slough and the existing inslope. Remove all materials that will interfere with a smooth transition.

Remove all weeds, grass, dirt, and deleterious material from the shoulders. Do not remove more than one inch depth of shoulder material.

Remove sod chunks larger than 36 square inches on any surface.

C. Reshaping Foreslopes.
Use existing material to provide a smooth transition between the finished shoulder and the existing foreslope.

D. Subgrade Preparation – Type A.
Scarify, shape, and compact the subgrade to the specified depth.

Scarify the subgrade with a moldboard plow and heavy duty disk.

Manipulate the subgrade in 6 inch lifts and compact the subgrade as specified in Section 203.04 E.2, "Compaction Control, Type A". Shape the subgrade to drain at the end of each day.

Shape and compact private drives, minor road approaches, and areas of irregular dimension or restricted access according to Section 203.04 E.4, "Compaction Control, Type C".

Remove deleterious materials and rocks from the subgrade.

Construct the final subgrade elevation to within 0.08 feet of the proposed subgrade elevation.

Obtain approval of the final subgrade surface before placing base or surface material.

E. Subgrade Preparation – Type B.
Construct as specified in Section 230.04 D, "Subgrade Preparation – Type A" and trim the subgrade with a roadbed planer.

The Engineer may permit a base or surface course to be used as a grade reference for trimming the shoulders.

F. Subgrade Preparation – Type C.
Construct as specified in Section 230.04 D, "Subgrade Preparation – Type A". Trim the subgrade with equipment using automatic grade control of the cutting edge.

230.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01,"Measurement of Quantities" and as follows:

A. Shoulder Preparation.
The Engineer will measure each shoulder separately.

B. Reshaping Foreslopes.
The Engineer will measure each foreslope on each side of the roadway separately.

C. Subgrade Preparation.
The Engineer will not measure areas outside the roadbed, such as private drives, road approaches, road tapers, and ramps.

D. Subgrade Preparation-Type A - Shoulders.
The Engineer will measure each shoulder separately.

230.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Reshaping Roadway	Station, Mile
Reshaping Foreslope	Station, Mile
Shoulder Preparation	Station, Mile
Subgrade Preparation-Type__	Station, Mile
Subgrade Preparation-Type A Shoulders	Station, Mile

Include the cost of removing, and stockpiling, along the reshaped foreslopes in the price bid for the reshaping or subgrade preparation items.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 251
SEEDING

251.01 DESCRIPTION
This work consists of seeding disturbed areas.

251.02 EQUIPMENT

A. Class I, II, III, and Wetland Seed Mixture Equipment.
Use a grass drill equipped with double disk furrow openers that are:
- Spaced no greater than 8 inches apart;
- Individually mounted;
- Adjustable;
- Spring loaded;
- Capable of planting seeds at depths between 1/4 and 3/4 inches; and
- Packer wheels meeting one of the following requirements:
  - Mounted individually to each furrow opener and have an adjustable spring tension; or
  - Mounted independently with a press wheel positioned to follow directly behind each furrow opener.

Equip the seed box with:
- A positive feed mechanism that meters seed in a uniform manner with agitators that prevent seed bridging; and
- Baffles or partitions that keep all seeds uniformly mixed during drilling.

If chaffy native grasses (sideoats grama, big bluestem, or Indiangrass) are part of the seed mixture, equip the seed box with a positive picker-wheel mechanism with oversize teeth and auger style agitators that meters the chaffy native grasses either in a mixture or separately in a uniform manner.

B. Temporary Cover Crop Seed Mixture Equipment.
Use a seed drill that provides a uniform flow of seed at the required rate and a planting depth between 1/2 and 1 1/2 inches.

251.03 MATERIALS

A. General.
Furnish seed that meets or exceeds Pure Live Seed requirements for the specified seed.

Use seed that contains no prohibited noxious weed seeds and contains less than 25 seeds per pound of restricted noxious weed seeds. North Dakota Department of Agriculture classifies noxious weeds at www.nd.gov/ndda.

The Engineer will not accept seed that is wet, moldy, or damaged.

B. Seed Testing.
Provide seed that has been tested for purity and germination within 12 months of the planting date by one of the following methods:

- North Dakota Seed Department, Seed Lab;
- Commercial seed testing lab; or
- A registered member of the Society of Commercial Seed Analysts.

Provide the certified lab test report with copies of testing results for each seed species. Submit the report and results before beginning seeding operations.

C. Labeling.

Provide a label for each bag of seed that meets the requirements of the North Dakota State Seed Department. The labeling requirements can be found at the following location: http://www.nd.gov/seed/index.aspx

D. Seed Class.

Provide the minimum amount of seed per acre shown in Table 251-01. The mix requirements for Class III seed will be specified in the plans.

TABLE 251-01
Seed Class Mix Requirements

Grass Species	Variety	Pounds Pure Live Seed Per Acre
Class I		
Kentucky Blue Grass	Park	4.0
Perennial Rye Grass	--	5.4
Blue Grama	Bad River	2.4
Sideoats Grama	Killdeer, Pierre, Butte	7.2
	TOTAL	**19.0**
	Class II – Early Season	
Western Wheatgrass	Rodan, Rosana, Walsh, Flintlock, W.R. Poole, Recovery	9.6
Switchgrass	Dacotah, Forestburg, or Sunburst, Summer	3.2
Green Needlegrass	Lodorm, AC Mallard, Fowler	2.4
Sideoats Grama	Killdeer, Pierre, Butte	3.6
Slender Wheatgrass	Revenue, Primar, Adanac, Pryor, Firstrike	5.0
Oats	--	10.0
	TOTAL	**33.8**
Class II – Late Season		
Western Wheatgrass	Rodan, Rosana, Walsh, Flintlock, W.R. Poole, Recovery	9.6
Switchgrass	Dacotah, Forestburg, or Sunburst, Summer	1.6
Green Needlegrass	Lodorm, AC Mallard, Fowler	3.6
Canada Wild-rye	Mandan	5.2
Slender Wheatgrass	Revenue, Primar, Adanac, Pryor, Firstrike	5.0
Oats	--	10.0
	TOTAL	**35.0**

E. Temporary Cover Crop.
Provide a temporary cover crop that consists of oats. Spread at a rate of 64 pounds pure live seed per acre.

F. Wetland Seed.
Provide the minimum amount of seed per acre shown in Table 251-02.

TABLE 251-02
Wetland Seed Mix

Grass			Pounds Pure Live Seed Per Acre	
Common Name	**Scientific Name**	**Variety**	**East of HWY 83**	**West of HWY 83**
Prairie Cord Grass	Spartina pectinata	Red River	1.1	1.1
American Slough Grass	Beckmannia syzigachne	Common	0.2	0.2
Fowl Blue Grass	Poa palustris	Common	0.2	0.2
Fox Sedge	Carex vulpinoidea	Common	0.2	0.2
American Manna Grass[1]	Glyceria grandis	Common	0.2	0.2
Fowl Manna Grass[1]	Glyceria striata	Common	0.1	0.1
Bluejoint Grass[2]	Calamagrostis canadensis	Common	0.1	0.1
Virginia Wild-rye	Elymus virginicus	Omaha	2.0	---
Canada Wild-rye	Elymus canadensis	Mandan	---	1.3
		Total	4.1	3.4

[1] American, Fowl, or both may be used. If only one is used the seeding rate of other species does not need to be increased.
[2] Seed may not be available and can be removed without increasing the seeding rate of other species.

G. Fertilizer.
Use a fertilizer mixture that contains a minimum of 20 pounds of nitrogen (N) and 20 pounds of phosphorous (P_2O_5) per acre.

251.04 CONSTRUCTION REQUIREMENTS

A. General.
Clear seeding areas of all deleterious materials. Shape the cleared areas before seeding.

Do not place seed in frozen ground or in standing water.

Operate equipment parallel to the contours of the ground.

B. Seedbed Preparation.
Cultivate or disk topsoil to a depth of approximately 3 inches. Break up lumps and clods exposed by the initial pass of tillage equipment into pieces less than 1 inch in diameter. Remove materials greater than 1 inch in diameter that cannot be broken up. Construct a

smooth and firm seedbed that allows seeds to be placed at a depth between 1/4 and 3/4 inches.

Do not cultivate or disk topsoil if temporary cover crop has achieved greater than 25 percent vegetative coverage determined by the Engineer.

Round the tops of backslopes before seeding.

Cover the exposed backslope with existing topsoil during the finish grading work without loading and transporting the topsoil.

Leave seedbeds that are to be hydraulic mulched with seed in loose condition.

Mow temporary cover crop to a height between 8 and 10 inches before placing final seed mixture.

C. Seasonal Limitations.

If seeding is required before April 20 or between July 16 and August 9, plant a temporary cover crop as specified in Section 251.03 E, "Temporary Cover Crop". Re-seed the area with the specified seed mixture between April 20 and July 15 or after August 10 and before the ground freezes.

If planting Class II seed between April 20 and July 15, use the Class II – Early Season seed mixture specified in Table 251-01.

If planting Class II seed after August 10 and before the ground freezes, use the Class II – Late Season mixture specified in Table 251-01.

D. Seeding Requirements.

1. Class I, II, III, and Wetland Seeding Requirements.

Plant seeds to a depth between 1/4 and 3/4 inches.

2. Other Equipment Seeding Requirements.

Employ other methods in areas that are inaccessible to a grass drill.

Use a drag harrow to cover the seed. Use a light-weight packer over the seeded area.

Seed only when wind is less than 15 mph when not using a grass drill.

E. Fertilizer.

Only apply fertilizer to sites where less than 2 inches of topsoil is available. Apply fertilizer before placing topsoil.

251.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities".

251.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Seeding Class __	Acre or Mile
Wetland Seed	Acre or Mile
Temporary Cover Crop	Acre or Mile
Fertilizer	Acre

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 252
SODDING

252.01 DESCRIPTION
This work consists of placing sod in designated areas.

252.02 EQUIPMENT
Reserved.

252.03 MATERIALS

A. General.
Provide sod with the following characteristics:
- Dense and well-rooted;
- Desirable grass, such as a variety of Kentucky Blue Grass;
- Adapted to the general locality;
- Free from weeds;
- Grass shorter than 2 inches; and
- Uniform thickness.

B. Sampling, Testing, and Certification.
Submit a Certificate of Compliance from an independent testing laboratory with each shipment of sod to the project.

In addition to the requirements specified in Section 106.01 C, "Certificate of Compliance" include the following:
- Date;
- Location and size of sod field;
- Type of grass contained in the sod;
- Statement that the soil, upon which the sod was grown, contains less than 20 percent organic material as determined by AASHTO T 267;
- Sampling and testing dates;
- Statement that the testing laboratory tested 2 samples per 2.5 acres or fraction thereof, taken at least 50 feet apart in the sod field;
- Statement that each sod field location has been tested and certified within the last 5 years;
- Statement that the sod was grown in the sod field tested; and
- Name of independent testing laboratory.

252.04 CONSTRUCTION REQUIREMENTS

A. Sod Bed Preparation.
Cultivate or disk topsoil to a depth of approximately 3 inches. Remove stones and deleterious material larger than 1 inch in diameter. Roll the surface of the sodbed to a smooth and uniform consistency.

B. Placement.
Keep sod rolls moist and protected from the sun and wind by tarpaulins or shade cloth. Do not install sod that has dried, has a soil layer that breaks, tears and or crumbles.

Place sod:

- In strips transverse to the predominate flow of water beginning at the bottom of the slope and work upward;
- With staggered joints at the end of strips; and
- With outside edges turned into the earth bed and a layer of earth placed over edge.

Clear surface of loose sod, excess soil, or other deleterious material after placement is complete.

C. Anchors.

Use six inch or longer stakes or staples. Anchor the sod on slopes that are 4:1 or steeper. Space the anchors 18 to 36 inches apart along the longitudinal axis of the sod strip. Drive anchors to within one inch above the sod surface.

D. Maintenance.

Keep the sodded area moist a minimum of 3 inches deep for a minimum of 4 weeks after placement and until the acceptance requirements are met. The maintenance period for sod placed after September 15 will not begin until April 15 of the following year.

E. Acceptance.

The Engineer will accept sod after the maintenance period that is live, growing, well rooted and the sod cannot be separated or lifted from the soil.

252.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, “Measurement of Quantities”.

252.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Sod	Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 253
MULCHING

253.01 DESCRIPTION

This work consists of grass hay or straw mulching, and hydraulic mulching.

253.02 EQUIPMENT

A. Hydraulic Mulch.

When applying hydraulic mulch and seed together use hydraulic spraying equipment that mixes the seed and mulch in water.

B. Straw Mulch.

Use equipment that uniformly distributes the mulch over the seedbed.

Use a puncher that consists of a series of dull, flat disks:

- With notched or cutout edges;
- Approximately 20 inches in diameter;
- 0.25 inches thick;
- Spaced approximately 8 inches apart; and
- Fitted with scrapers.

253.03 MATERIALS

A. Seed.

Use the seed classification shown in the bid item that meets the requirements of Section 251.03 D, "Seed Class".

B. Hydraulic Mulch.

Use hydraulic mulch free of germination or growth inhibiting factors. Provide hydraulic mulch free of recycled paper and toxins.

Provide hydraulic mulch with fibers that are capable of absorbing water and allowing infiltration to the underlying soil without restricting emergence of seedlings.

C. Straw Mulch.

Use mulch material consisting of straw from cereal grain or native hay. The mulch shall be free of seed bearing stalks of noxious weeds as defined by the North Dakota Department of Agriculture.

The Engineer will not accept mulch that:

- Is wet, musty, moldy, or rotted;
- Is chopped or ground; or
- Contains deleterious material.

D. Tackifier.

Use a tackifier consisting of one of the following:

1. Water soluble natural proteins, vegetable gums, or guar gums blended with gelling and hardening agents. Guar gum based tackifier shall consist of a minimum of 95

percent guar gum by weight with the remainder consisting of dispersing and cross-link additives.

2. Water soluble blend of hydrophilic polymers, viscosifiers, sticking aids and other gums.

E. Bonded Fiber Matrix.
Use a bonded fiber matrix consisting of a continuous layer of elongated fiber strands held together by a water resistant bonding agent. The matrix shall be 100 percent biodegradable and composed of, by weight, 90 percent wood fiber, 9 percent natural binder and 1 percent organic and mineral activators.

253.04 CONSTRUCTION REQUIREMENTS

A. General.
Uniformly cover seeded areas with mulch within 24 hours of initiating seeding.

Protect traffic, signs, structures, and other objects from being marked or splattered by the material.

B. Hydraulic Mulch.

1. General.
Use mulch that is evenly dispersed and suspended in agitated water. Apply at a rate of one ton per acre with a minimum of 95 percent coverage of the seedbed.

When hydraulic mulch is required, the specified seed mixture may be combined with the hydraulic mulch and applied in a single application.

2. Temporary Care Maintenance.
Keep the soil in the mulch area moist a minimum of 3 inches deep for the first 21 days.

The Engineer will not require watering between October 1 and May 15 in areas with hydraulic seeding.

3. Seasonal Limitations.
If applying seed mixture and hydraulic mulch in a single application, the timeframes specified in Section 251.04 C, “Seasonal Limitations” will apply.

C. Straw Mulch.

1. Application.
Place mulch at a rate of 2 tons per acre.

Do not perform mulching operations when the sustained wind velocity is greater than 25 miles per hour.

Avoid placing excessive cover that smothers seedlings.

2. Anchoring.
Anchor mulch using one of the following methods to:

a. Punching.
Immediately following application, punch mulch into the soil using a puncher.

Operate the tiller parallel to the contours of the ground.

Push the mulch into the soil 3 inches, with the ends of the mulch exposed above the soil surface.

b. Tackifier.
Use tackifier on areas where slopes are steeper than 3:1. Apply the tackifier at the rate recommended by the manufacturer. If no manufacturer recommendations are available, apply at a rate between 175 and 275 pound per acre by spraying with the mulch or immediately following the mulching application.

3. Maintenance.
Repair or re-mulch damaged areas.

D. Bonded Fiber Matrix.
Apply at the manufactures recommended rate or 3,900 pounds per acre and use a mix consisting of 1 pound bonded fiber matrix to 12.5 gallons water.

Install the matrix with hydraulic seeding equipment.

253.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, “Measurement of Quantities”.

253.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Straw Mulch	Acre, Square Yard
Hydraulic Mulch	Acre, Square Yard
Bonded Fiber Matrix	Acre, Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 255
EROSION CONTROL BLANKET AND TURF REINFORCEMENT MAT

255.01 DESCRIPTION
This work consists of placing an Erosion Control Blanket (ECB) or Turf Reinforcement Mat (TRM) on a prepared slope or channel.

255.02 EQUIPMENT
Reserved.

255.03 MATERIALS

Item	Section
Erosion Control Blanket and Turf Reinforcement Mat	856

255.04 CONSTRUCTION REQUIREMENTS

A. General.
Remove all rocks or clods greater than 1 inch in diameter, and all sticks and deleterious material from the area to be covered.

B. ECB and TRM Type 1.
Complete seeding before placing ECB and TRM.

C. TRM Type 2.
If the TRM requires soil filling, fill the TRM with topsoil, compost, or a blend of topsoil and compost. Place seed and fertilizer on the soil filled TRM. Apply hydraulic mulch or place ECB on the seeded TRM.

Place the ECB with the netting on top and the fibers in contact with the soil.

In ditches, unroll the ECB and TRM starting from the top of the slope and perpendicular to contours.

On embankments shorter than 10 feet, unroll the ECB horizontally or vertically to the slope.

D. Repair of ECB and TRM.
Restore the damaged area to the proper contour. Seed as specified in Section 251 “Seeding”. Replace the ECB and TRM with the required type.

255.05 METHOD OF MEASUREMENT
The Engineer will measure, completed and in place, as specified in Section 109.01 “Measurement of Quantities”.

The Engineer will not measure overlaps or buried portions of the ECB or TRM.

255.06 BASIS OF PAYMENT

Pay Item	Pay Unit
ECB Type 1	Square Yard
ECB Type 2	Square Yard
ECB Type 3	Square Yard
ECB Type 4	Square Yard
TRM Type 1	Square Yard
TRM Type 2	Square Yard

Such payment is full compensation for furnishing all materials, staples, equipment, labor, and incidentals to complete the work as specified.

SECTION 256
RIPRAP

256.01 DESCRIPTION
This work consists of furnishing or salvaging, and placing stones on slopes, channel ways, or other areas.

256.02 EQUIPMENT
Reserved.

256.03 MATERIALS

A. General.
Use stone that is clean and free of deleterious material.

B. Grout.
Proportion grout using one part Portland Cement and two parts sand by volume.

C. Riprap.
Use field stone or quarry stone as riprap.

1. Gradation.

Table 256-01
Riprap Gradation

Grade I Size (Inches)	Grade I Percent Smaller	Grade II Size (Inches)	Grade II Percent Smaller	Grade III Size (Inches)	Grade III Percent Smaller
20	100	28	100	36	100
18	70-90	22	30-80	29	55-85
15	40-60	16	20-50	24	35-50
10	0-10	10	0-5	10	10-15
6	0-2	6	0-2	6	0-2

2. Field Stone.
Do not use field stone that:
- Consists of sandstone, shale, or soft limestone;
- Contains cracks or flaws that would cause splitting or breakup; or
- Is easily abraded or crushed.

3. Quarry Stone.
Do not use quarry stone that consists of sandstone, limestone, or stone of sedimentary origin.

Provide quarry stone that would meet the requirements of Table 256-02, if the stone was properly processed.

Table 256-02
Quarry Stone Properties

Test	Method	Max. Percent by Weight of the Plus No. 4 fraction
L.A. Abrasion	AASHTO T 96	40.0
Soundness (Sodium Sulfate)	AASHTO T 104	12

256.04 CONSTRUCTION REQUIREMENTS

A. General.
Place the stones on sloped areas beginning at the toe of the slope. Set stones to obtain an even outer surface and a uniform appearance.

B. Riprap.
Dig a trench at least one foot deep and place the largest stones in the trench, filling gaps with smaller stones.

Place stones by mechanical means or by hand.

Distribute stones evenly over the riprap area without:
- Material segregation
- Deviating from designed slope and grade by greater than 6 inches

Do not drop riprap stones from a height greater than 3 feet. Place stones greater than 250 pounds with no free-fall. Achieve contouring of the stones during initial placement. Do not roll the stones along the surface. Begin placement of the stone cover at the base of the slope and at the center of the fabric covered zone.

C. Grout.
Dampen riprap before applying grout. Recess the grout 1 to 3 inches below the top of the riprap.

256.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will measure the actual surface dimension of grouted riprap to determine the amount of grout placed.

256.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Riprap Grade __	Cubic Yard or Ton
Grout for Riprap	Square Yard

Include excavation and shaping necessary to place the riprap or bedding stone in the price bid for these items.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 258
CONCRETE SLOPE PROTECTION

258.01 DESCRIPTION
This work consists of placing cast-in-place concrete slope protection.

258.02 EQUIPMENT
Reserved.

258.03 MATERIALS

Material	Section
AE-3 Concrete	802
Preformed Expansion Joint Filler	826.02
Joint Sealant	826.02 A.2
Reinforcing Steel	836.02
Steel Welded Reinforcement, Plain, for Concrete	836.03 B

258.04 CONSTRUCTION REQUIREMENTS

A. Preparation of Subgrade.
Remove vegetation and deleterious material. Compact all loose material.

Wet surfaces before placing concrete. Do not place concrete on soft subgrade or in standing water.

B. Placing Concrete.
Place and consolidate concrete using methods that prevent segregation and sagging.

Place a construction joint at the end of the panel if placement of concrete is stopped for more than 30 minutes.

C. Transverse Grooved Joints.
Construct transverse grooved joints in the surface of the plastic concrete. Maintain the transverse grooved joints during finishing operations until the concrete has hardened.

Seal the joints after the concrete becomes stiff enough to prevent distortion to the groove or damage to the concrete. Clear the joints of foreign material and water before sealing. Apply the sealer with a caulking gun or other approved device.

D. Finishing Concrete.
Finish the surface so there are no irregularities greater than 0.75 inch in 10 feet.

E. Curing Concrete.
Cure concrete as specified in Section 550.04 I, “Curing Concrete”, with the following exception:

Cure the concrete for a minimum of 5 days.

258.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, “Measurement of Quantities”.

258.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Concrete Slope Protection	Square Yard
Remove & Replace Concrete Slope Protection	Square Yard

Such payment is full compensation for furnishing all materials, earthwork, equipment, labor, and incidentals to complete the work as specified.

SECTION 260
SILT FENCE

260.01 DESCRIPTION
This work consists of furnishing, installing, maintaining, and removing silt fence.

260.02 EQUIPMENT
Reserved.

260.03 MATERIALS

A. Posts.
Do not use silt fence with posts pre-attached. Use posts that have a minimum length of 4 feet.

1. Wood Posts.
Use one of the following wood posts with the minimum dimensions:
- 2 inch diameter round wood posts; or
- 1.5 × 1.5 inches rectangular wood posts.

2. Steel Posts.
Use steel posts that are a minimum of 0.95 pounds per foot and have projections for fastening wire or fabric.

B. Filter Fabric.
Provide filter fabric as specified in AASHTO M 288. Use fabric with a minimum width of 36 inches. Protect the filter fabric from moisture and ultraviolet exposure before placement.

C. Silt Fence Supported.
Use wire backing or monofilament silt fence when installing supported silt fence.

If backing for a silt fence is required, use a steel wire fence fabric meeting the following:
- A minimum of 32 inches wide;
- Has a maximum opening size of 6 × 6 inches; and
- Is a minimum of 14 gauge, grade 60.

260.04 CONSTRUCTION REQUIREMENTS

A. Installation.
Install continuous silt fences transverse to the flow and follow the contours of the site. Place the fence so water cannot flow around the end of the fence.

If joining two sections of filter fabric, overlap at support posts a minimum of 18 inches in such a manner that prevents silt from passing through the fence.

B. Maintenance.
Remove sediment when it reaches 1/3 of the exposed height of any section of the silt fence, or as directed by the Engineer. The Engineer may direct the installation of additional silt fence if removing the sediment deposit is not feasible.

Inspect the silt fence within 24 hours of each rainfall greater than 0.25 inches and at least daily during prolonged rainfall. Submit a silt fence inspection report within 24 hours of each inspection.

Perform a daily review of the location of silt fences and check for effectiveness. In addition, the Contractor shall make daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness.

Immediately repair or remove and replace ineffective silt fence.

C. Removal.
Do not remove the silt fence without the Engineers approval.

Level, smooth, seed, and mulch the removal area to match existing conditions.

260.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

Material used for overlaps and seams will not be measured.

260.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Silt Fence Supported	Linear Foot
Silt Fence Unsupported	Linear Foot

The Department will pay for the cleaning of sediment deposits as specified in Section 109.03 C, “PS-1 Price”.

The Department will pay for the removal of pre-existing silt fence as specified in Section 109.03, “Compensation for Contract Revisions”.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 261
FIBER ROLLS

261.01 DESCRIPTION
This work consists of furnishing, installing, maintaining and removing fiber rolls.

261.02 EQUIPMENT
Reserved.

261.03 MATERIALS.

A. General.

Provide fiber rolls that are composed of degradable netting that contains compressed:

- Straw from cereal grain or native hay that is free of seed-bearing stalks of noxious weeds, as defined by the North Dakota Department of Agriculture; or
- Wood excelsior.

The Engineer will not accept fiber rolls containing material that is rotted at the time of installation.

At the time of manufacture fiber rolls must be not less than 1 inch of the specified diameter. At the time of installation refer to table 261-01 for minimum fiber roll diameters.

B. Permanent Fiber Rolls.

When fiber rolls are permanently incorporated into the project, use fiber rolls that are composed of netting that meets either of the following:

- Bio- or photo-degradable plastic netting that has a life expectancy between 6 and 24 months; or
- 100 percent biodegradable natural netting that has a life expectancy between 6 and 24 months.

261.04 CONSTRUCTION REQUIREMENTS

A. Installation.

1. General.

Install fiber rolls that are within the tolerances shown in Table 261-01 at the time of installation.

Table 261-01

Specified Diameter	Acceptable Diameter
12 inches	10 inches
20 inches	17 inches

2. Substandard Fiber Roll Diameter.

If the Engineer's visual observation within 48 hours of installation notes the appearance of fibers rolls that are deficient in diameter the fiber roll size will be verified in the field.

The Engineer will determine the diameter of the fiber roll at the apparently deficient location. If the diameter of the roll is less than that shown in Table 261-01, the Engineer will determine the extent of the deficient length. If the Engineer determines the deficiency is weather related, Section 261.04 B, "Maintenance" will apply. If the deficiency is not weather related, correct the deficiency at no additional cost to the Department.

If the deficiency is not determined to be weather related, place additional fiber roll upstream of the deficient area creating 12-inch overlaps on each end. Document the placement of additional roll in the SWPPP. If manual manipulation of the fiber roll returns it to a shape within tolerance, the Engineer will accept it with no further remediation.

B. Maintenance.

Remove sediment when it reaches 1/3 of the exposed height of any section of the fiber roll, or as directed by the Engineer. The Engineer may direct the installation of a second fiber roll if removing the sediment deposit is not possible.

Inspect the fiber rolls within 24 hours of each rainfall greater than 0.25 inches and at least daily during prolonged rainfall. Submit a fiber rolls inspection report within 24 hours of each inspection.

Perform and submit a daily review of the location of fiber rolls and check for effectiveness.

Remove and replace fiber rolls when necessary.

C. Removal.

Do not remove the fiber roll without the Engineers approval.

Level, smooth, seed, and mulch the removal area to match surrounding conditions.

261.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities" and as follows:

The Engineer will measure fiber roll added or replaced due to maintenance activities.

The Engineer will not measure overlaps.

The Engineer will not measure fiber roll placed to supplement deficient areas.

261.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Fiber Roll __IN	Linear Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

The Department will pay for the cleaning of sediment deposits as specified in Section 109.03 C, "PS-1 Price".

The Department will pay for the removal of pre-existing fiber rolls as specified in Section 109.03, "Compensation for Contract Revision".

SECTION 262
FLOTATION SILT CURTAIN

262.01 DESCRIPTION
This work consists of furnishing, installing, maintaining, and removing flotation silt curtain.

262.02 EQUIPMENT
Reserved.

262.03 MATERIALS

Material Property	Requirement
Curtain Fabric	Impermeable vinyl-coated nylon
Grab Tensile Strength	500 lb
Floatation	8 inch diameter Marine quality expanded polystyrene
Net Buoyancy per Foot	20 lb
Top Load Carrying Components	Fabric plus 5⁄16 inch galvanized steel cable 9,800 lb min break strength
Ballast (min)	5⁄16 inch galvanized chain
Connections Between Sections	Aluminum collar reinforced quick disconnects

262.04 CONSTRUCTION REQUIREMENTS

A. Installation.
Attach anchor lines to the flotation device.

1. Still Water.
Secure both ends of the curtain on land using the anchor points. Use anchor buoys if bottom anchors are used.

Tow out the curtain in the furled condition and attach to the anchor points. Set additional anchor points as necessary and attach them firmly to the curtain to maintain the desired location of the curtain.

Release the furling lines to let the curtain skirt drop.

2. Moving Water.
Set all anchor points. Ensure the anchor points keep the curtain in the desired location. Use anchor buoys on all anchor points.

Start securing the furled curtain to the anchor points on the upstream side and work downstream. Make any necessary adjustments.

Release the furling lines to let the curtain skirt drop.

Do not install the curtain across the entire width of a flowing channel.

B. Maintenance.
Discontinue work if the silt curtain sinks below the surface or detaches from the anchor points or buoys. Repair or replace the silt curtain before continuing work.

Remove silt curtain before the water freezes for winter. Replace silt curtain in the spring once ice is out.

C. Removal.
Place bank protection before removing the silt curtain.

If bank protection is not specified, complete final grading of the adjacent slopes and install sediment control devices at the toe of the slope before removing the silt curtain.

262.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities”.

262.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Flotation Silt Curtain	Linear Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 265
STABILIZED CONSTRUCTION ACCESS

265.01 DESCRIPTION
This work consists of installing, maintaining, and removing a stabilized construction access where equipment enters a public roadway.

265.02 EQUIPMENT
Reserved.

265.03 MATERIALS

A. Aggregate.
Provide aggregate that has 90 percent fractured faces and meets the following gradation:

Sieve Size	Percent Passing
4 Inch	100
2 Inch	0

B. Geosynthetic Fabric.

Material	Section
R1 Fabric	858

265.04 CONSTRUCTION REQUIREMENTS

A. General.
Remove topsoil before construction of stabilized construction access. If the access restricts water flow, provide temporary drainage through the stabilized construction access.

B. Maintenance.
Maintain the stabilized construction access so that it retains its effectiveness.

Add material as specified in Section 265.03 A, “Aggregate” as needed.

C. Removal.
After removal, restore the disturbed area to its original condition.

Perform topsoil work as specified in Section 203.04 B, “Topsoil”.

Place the type of seed specified in the plans. If no seed is specified use Class II seed mixture. Place seed mixture as specified in Section 251.02, “Equipment”; 251.03, “Materials”; and 251.04, “Construction Requirements”.

Place mulch as specified in Section 253.02, “Equipment”; 253.03, “Materials”; and 253.04, “Construction Requirements”.

265.05 METHOD OF MEASUREMENT
The Engineer will measure as specified in Section 109.01, “Measurement of Quantities”.

265.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Stabilized Construction Access	Each

Include the cost for pipe, geosynthetic material, topsoil, and seed in the price bid for “Stabilized Construction Access”.

The Engineer will pay 50% of each access upon initial installation and the remaining 50% upon removal and restoration of the area to its original condition.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 302
AGGREGATE BASE AND SURFACE COURSE

302.01 DESCRIPTION
This work consists of furnishing and placing aggregate or salvaged material on a prepared foundation.

302.02 EQUIPMENT

Equipment	Section
Pneumatic-Tired Rollers	151.01
Vibratory Sheeps Foot/Pad Foot/Extended Pad Foot Rollers	151.02
Water Trucks	152.01 B
Aggregate Trucks	152.01 C
Roadbed Planers	153.02

302.03 MATERIALS

Material	Section
Aggregates	816
Salvaged Base Course	817
Traffic Service Aggregate	816 Class 5; or 817

When the plans specify a class of aggregate for the base, the Contractor may substitute Salvaged Base Course that meets Section 817, "Salvaged Base Course."

302.04 CONSTRUCTION REQUIREMENTS

A. Acceptance of Aggregate.

1. General.
The requirements of Section 302.04 A.3, "Miscellaneous Properties", will not apply to salvaged base course.

2. Gradation.
The Engineer will collect three samples for each 1,000 tons of material placed with a maximum of three samples collected in one day. The three samples constitute one lot of material. If the aggregate fails to meet the specified gradation, the Engineer will apply a price reduction as specified in Section 302.06 B, "Contract Price Adjustments".

Halt aggregate placement operations if two consecutive lots deviate from the specified gradation. Restart placement operations after taking corrective actions and passing a gradation test.

3. **Miscellaneous Properties.**
   The Engineer will collect three samples for each 10,000 tons lot of material produced to determine shale content, plasticity index, and the number of fractured faces. The Engineer will include fraction lots of less than 2,500 tons in the previous lot.

   If the material fails to meet the requirement for plasticity index or fractured faces, make corrections to the stockpile before incorporating additional material into the work.

   If the material exceeds the maximum shale content by less than 3 percentage points, the Engineer will apply a price reduction as specified in Section 302.06 B, "Contract Price Adjustments". The Engineer will reject the material if the maximum shale content is exceeded by 3 or more percentage points.

B. Placement and Compaction.
Place aggregate on a damp surface in lifts not exceeding 6 inches of compacted material.

Uniformly mix aggregate placed in windrows before spreading.

Compact aggregate, utilizing pneumatic-tired rollers, until the surface is tightly bound, shows no rutting, and no displacement occurs under the roller operation. The Engineer may allow other compaction methods when placing aggregate under sidewalks, driveways, or medians.

Compact material over geosynthetic geogrid as specified in Section 709.04 C, "Geosynthetic Geogrid (Type G)".

Compact material over geotextile reinforcement fabric as specified in Section 709.04 D, "Geosynthetic Reinforcement (Type R)".

C. Surface Tolerance.

1. **General.**
   Unless one of the following surface tolerances is specified, construct the surface to within 0.08 feet of the proposed elevation.

2. **Surface Tolerance Type B.**
   Use trimming equipment, including motor graders, equipped with automatic grade control to adjust for the cross slope and longitudinal profile. Construct the finished surface to within 0.04 feet of the proposed elevation.

   Reincorporate material removed from high points during trimming into other portions of the base.

3. **Surface Tolerance Type C.**
   Use roadbed planers to construct the finished surface. The Engineer will allow the base or surface course to be used as the grade reference when trimming shoulders. Construct the finished surface to within 0.04 feet of the proposed elevation.

   Reincorporate material removed from high points during trimming into other portions of the base.

D. Limitations.
Do not place material on frozen subgrade.

When the roadway is open to traffic, the following limitations apply:
- The maximum windrow length is three miles; and
- Spread material within 48 hours of placing the material in a windrow.

E. Maintenance of Completed Courses.
Maintain a smooth and compacted surface on completed courses.

F. Traffic Service Aggregate.
Before removing pavement, place a stockpile of traffic service aggregate within the project limits. Place a quantity of material in the stockpile equal to 10 percent of the amount shown in the plans and maintain that quantity in the stockpile until the Engineer deems the stockpile is no longer necessary, or until base operations are complete.

Place a 4 inch thick mat of traffic service aggregate in locations directed by the Engineer.

Salvage and reuse placed traffic service aggregate to the extent feasible. Incorporate material that cannot be picked up into the subgrade.

If material remains in the stockpile at the time of release, incorporate it into other aggregates of the same class to be used on the project. If no aggregates of the same class are part of the project, incorporate the remaining stockpile into the subgrade in areas determined by the Engineer.

Section 302.04 A, "Acceptance of Aggregate" applies to traffic service aggregate when it is incorporated into other aggregates of the same class that require acceptance testing.

302.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and the following:

The Engineer will measure traffic service aggregate when it is placed in the stockpile. No measurement will be made for traffic service aggregate that is picked-up and reused on the roadway.

302.06 BASIS OF PAYMENT

A. General.

Pay Item	Pay Unit
Salvaged Base Course	Ton or Cubic Yard
Traffic Service Aggregate	Ton
Aggregate Base Course Cl__	Ton or Cubic Yard
Aggregate Surface Course Cl__	Ton or Cubic Yard

Include all costs for time, material, and labor required to supply traffic service aggregate and to place, maintain, salvage, and reuse the material in the contract price for "Traffic Service Aggregate".

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Contract Price Adjustments.

1. General.
The Engineer will determine contract price adjustments by multiplying the applicable adjustment factor by the contract unit price for the aggregate and the amount of material in the lot represented by the test.

If contract price adjustments are warranted in more than one category, a contract price reduction will be applied for each area of deficiency.

2. Aggregate Gradation Adjustment Factor.
The Engineer will determine the aggregate gradation adjustment factor if aggregate base does not meet the specified gradations for all required samples, as calculated:

$$\text{Aggregate Gradation Adjustment Factor} = 5 \times \text{Sum of deviations from range limits on all sieves}$$

3. Shale Content Adjustment Factor.
The Engineer will determine the shale content adjustment factor if the limits for shale are exceeded, as calculated:

$$\text{Shale Content Adjustment Factor} = 5 \times (\text{Average of 3 Samples} - \text{Allowable Percentage})$$

SECTION 401
PRIME, TACK, OR FOG COAT

401.01 DESCRIPTION
This work consists of preparing and treating a surface with bitumen.

401.02 EQUIPMENT

Equipment	Section
Bituminous Tank Trucks	152.01 E
Storage and Heating Equipment	154.01 B
Liquid Bitumen Distributors	154.02 B
Aggregate Spreader	154.02 C

401.03 MATERIALS

A. General.

Material	Section
Water	812
Blotter Sand, Class 44	816

Emulsified asphalt may be diluted with water. When diluting emulsified asphalt, the amount of water added to the dilution shall not exceed the amount of emulsified asphalt.

Obtain samples of the bitumen under the observation of the Engineer. The Engineer will take immediate possession of the samples.

B. Prime Coat.
Use MC 70 or MC 250 that meets the requirements of Section 818.02 C, "Medium-Curing Cutback Asphalt".

C. Tack Coat.
Use a material from Table 401-01.

Table 401-01

Material	Section
SS-1h	818.02 F
MS-1	818.02 F
CSS-1h	818.02 E.1

When MS-1 is used it may be diluted by the supplier or the Contractor.

D. Fog Seal.
Use a material from Table 401-02.

Table 401-02

Material	Section
SS-1h	818.02 F
CSS-1h	818.02 E.1

401.04 CONSTRUCTION REQUIREMENTS

A. Application of Bitumen.

1. General.
Prepare the surface by removing loose dirt and deleterious material.

Provide the Engineer with the manufacturer recommended application temperature ranges. During application, maintain the temperature of bitumen within the ranges recommended by the manufacturer.

Apply bitumen with a distributor on a compacted and stable surface. Use hand sprayers to cover irregular areas. Completely cover the area receiving the bitumen application.

If applying bitumen in multiple passes, overlap the bitumen along adjoining edges of the passes.

Protect the surfaces of structures and other roadway appurtenances against tracking and splattering.

2. Prime Coat.
Apply prime coat when the ambient air temperature is at least 40°F.

Allow the prime coat to cure a minimum of 48 hours before placing pavement.

3. Tack Coat.
Apply tack coat when the air temperature and existing mat temperature are at least 35°F.

Apply tack coat to a dry surface.

Allow tack coat to cure before applying surfacing material.

4. Fog Coat.
Apply fog coat when the ambient air temperature is at least 40°F.

Apply fog coat to a dry surface.

B. Application of Blotter Material.
Obtain the Engineer's approval before applying blotter material. The Engineer may order an adjustment to the rate of application for blotter material.

If it is impractical to prohibit traffic from use of the primed surface for 48 hours, the Engineer may order the spreading of blotter material after the application of prime coat.

C. Opening to Traffic.
Only allow traffic on a bitumen treated surface after the bitumen has penetrated and dried or after application of blotter material.

401.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities”.

The Engineer will measure undiluted emulsified asphalt to determine the quantity for payment.

401.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Tack Coat	Gallon
Prime Coat	Gallon
Fog Seal	Gallon
Blotter Material CL 44	Ton or Cubic Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 411
MILLING PAVEMENT SURFACE

411.01 DESCRIPTION
This work consists of milling pavement surface.

411.02 EQUIPMENT

Equipment	Section
Milling Machine	156.03

411.03 MATERIALS
Reserved.

411.04 CONSTRUCTION REQUIREMENTS
Remove deleterious material from the pavement before milling.

Mill the surface parallel to the centerline, beginning at the centerline and progressing outward to the edge of pavement. If using the adjacent lane for traffic, do not leave a longitudinal drop off in place for greater than one day. Provide a smooth transition to the original pavement surface when stopping.

Mill the surface to prevent water from ponding on surface.

Provide a milled surface free of irregularities exceeding 1/4 inches when measured with a 10 foot straightedge.

Remove loose material from the milled surface before opening to traffic.

Coordinate milling and paving operations so that no section of milled roadway has public or construction traffic operating on it for more than 5 days. If public or construction traffic operates on the milled surface for more than 5 days, repair the roadway as directed by the Engineer at no additional cost to the Department.

411.05 METHOD OF MEASUREMENT
The Engineer will measure, as specified in Section 109.01, “Measurement of Quantities”.

411.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Milling Pavement Surface	Ton or Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 420
BITUMINOUS SEAL COAT

420.01 DESCRIPTION
This work consists of an application of bitumen followed by an application of cover coat material on a prepared surface.

420.02 EQUIPMENT

Equipment	Section
Self-Propelled Pneumatic-Tired Rollers	151.01 A.3
Aggregate Trucks	152.01 C
Bituminous Tank Truck	152.01 E
Bituminous Equipment	154
Liquid Bitumen Distributors	154.02 B
Aggregate Spreader	154.02 C

Use a broom with a positive means of controlling the vertical pressure on the broom head.

420.03 MATERIALS

Item	Section
Aggregate	816
Bitumen	818.02 E

420.04 CONSTRUCTION REQUIREMENTS

A. General.
Begin seal work after May 15 and on or before September 1.

Allow material to cure as shown in Table 420-01 before applying seal coat materials.

Table 420-01
Curing Period

Material Type	Curing Period
Prime Coat	4 days
Asphalt Cement Pavements	7 days
Emulsion Pavements	15 days

Schedule the work so that the last bitumen application of the day is sufficiently cured to allow installation of the short-term pavement marking before sunset.

B. Preparation of Surface.

1. General.
Prepare the surface by removing loose dirt and deleterious material.

2. Spotting Tabs.
Before applying bitumen, install spotting tabs every 200 feet along the centerline and at the beginning and end of the no-passing zones. After installation of permanent pavement markings, remove spotting tabs by cutting the tabs flush with the roadway surface.

C. Application of Bitumen.
The Engineer will direct the application rate of bitumen.

Apply bitumen with a liquid bitumen distributor in a uniform and continuous spread. Correct skipped areas and deficiencies. Apply bitumen to a dry surface with a minimum pavement surface temperature of 60°F.

Protect the surface of structures and other roadway appurtenances against tracking and splattering.

If applying bitumen in multiple passes, overlap the bitumen along adjoining edges of the passes.

Maintain traffic without pickup or tracking of bitumen.

Promptly shut off the bitumen spray at the end of the application to prevent lapping at transverse junctions.

Before continuing the application, spread building paper or metal sheets to cover the previously treated surface a sufficient distance back from the joint to allow the sprayers to operate at the established application rate upon reaching the untreated surface.

D. Cover Coat Material Application.
The Engineer will direct the application rates of the cover coat material.

Flush the cover coat material with clear water and ensure it is well drained before applying it to the roadway.

Within one minute following the application of the bitumen, spread the cover coat material uniformly over the bituminous material with an aggregate spreader. Apply cover material by hand to areas that are inaccessible to the aggregate spreader.

Cover deficient areas with additional cover coat material or blotter material as directed by the Engineer.

Use a self-propelled pneumatic-tired roller immediately behind the spreader and continue for a minimum of four complete passes. Ensure the roller speed does not exceed 7 MPH on the initial pass.

Sweep loose cover coat material from the roadway after the material has set and within 24 hours of application. Do not dislodge embedded aggregate.

Use a vacuum or pickup sweeper to remove excess material accumulated in curb and gutter sections.

E. Blotter Material Application.
Apply blotter material in the quantity and manner directed by the Engineer if necessary to correct bleeding. Apply the blotter material with a mechanical spreader.

F. Traffic Control.
Furnish flagging and pilot cars as specified in Section 704, "Temporary Traffic Control". Include the cost of flagging and pilot cars in the price bid for other items.

On two-lane, two-way traffic highways place flaggers and signs at each end of the seal operation and at major intersections within the seal operation area. On divided highways, place flaggers and signs at major intersections within the seal operation area.

Keep the following signs covered until the seal operation is within 3 miles of the nearest sign:
- No Centerline Stripe;
- Do Not Pass;
- Fresh Oil Loose Rock; and
- Speed Limit.

G. Maintenance.
Maintain the seal coat during the seal coat operation and continue maintenance for 5 calendar days after completion of the seal coat operation.

Maintenance of the seal coat may include additional:
- application of bitumen;
- application of cover coat material;
- rolling; and
- sweeping.

Do not place loose cover coat material from the shoulder onto the new sealed surface.

Perform a final sweeping at the end of the maintenance period. Remove excess material from roadway and shoulders.

H. Acceptance.

1. Bitumen.
Obtain samples of this material under the observation of the Engineer. The Engineer will take immediate possession of the samples.

2. Cover Coat Material.
The Engineer will collect and test three samples for each lot of material. A lot is defined as 1,200 tons. If the final lot is less than 600 tons, the Engineer will include it in the previous lot. If the final lot is 600 tons or greater, the Engineer will sample it as a separate lot.

If the average of the three samples does not meet the gradation specified, the Engineer will either reduce the contract unit price, as specified in Section 420.06, "Basis of Payment", or reject the material.

Do not incorporate additional material if two consecutive lots deviate from the gradation. Restart placement operations after taking corrective actions and passing a gradation test.

3. **Blotter Material.**
   The Engineer will collect and test one sample of blotter material for every 5 roadway miles, or fraction thereof. Samples will be collected from material stockpiled on the project or delivered to the project.

420.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place as specified in Section 109.01, "Measurement of Quantities".

420.06 BASIS OF PAYMENT

A. General.

Pay Item	Pay Unit
__Liquid Asphalt	Gallon
__Emulsified Asphalt	Gallon
Cover Coat Material Class__	Ton or Square Yard
Blotter Material	Ton

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Spotting Tabs.
Include the cost of the spotting tabs in the price bid for "Cover Coat Material Class__."

C. Contract Price Reductions.

1. **General.**
   The Engineer will determine contract price adjustments by multiplying the applicable adjustment factor by the contract unit price for the aggregate and the amount of material in the lot represented by the test.

   If contract price adjustments are warranted in more than one category, a contract price reduction will be applied for each area of deficiency.

2. **Aggregate Gradation All Sieves Except No. 200 Sieve.**

$$\text{Price Adjustment Factor (except No. 200)} = 5 \times \text{Sum of deviation from range limits on all sieves}$$

   If the aggregate fails to meet the specified gradation on one or more sieves, the Engineer will reduce the contract price by the sum of the deductions.

3. **Aggregate Gradation No. 200 Sieve.**

$$\text{Price Adjustment Factor (No. 200)} = 10 \times \text{Deviation from range limit}$$

SECTION 421
MICRO SURFACING

421.01 DESCRIPTION
This work consists of applying a thin overlay material composed of modified emulsified asphalt, aggregate, water, and additives over a prepared surface.

421.02 EQUIPMENT

Equipment	Section
Aggregate Trucks	152.01 C
Bituminous Tank Trucks	152.01 E
Micro Surfacing and Slurry Seal Equipment	154.02 D

Calibrate each mixing unit in the presence of the Engineer before starting work. Perform calibration according to ISSA-MA 1. Include the individual calibration of each material at various settings in the documentation.

421.03 MATERIALS

A. General.
Obtain samples of the bitumen under the observation of the Engineer. The Engineer will take immediate possession of the samples.

Item	Section
Water	812
Aggregate for Micro Surfacing	816.04
Bituminous Material for Micro Surfacing	818.03

B. Aggregates.
Screen the stockpile before delivery to the paving machine to prevent having oversize material in the mix.

C. Mineral Fillers.
Use mineral filler to improve mixture consistency and to adjust mixture breaking and curing properties. Use material that meets the requirements of ASTM D 242. Use levels of mineral filler between 0.0 and 3.0 percent. Submit a certificate of compliance for the mineral filler.

D. Field Control Additives.
Use additives to accelerate or retard the break/set of the micro surfacing.

Submit a certificate of compliance stating that the liquid field control additive is compatible with the mix design.

421.04 CONSTRUCTION REQUIREMENTS

A. Mix Design.

Submit a mix design prepared by a qualified testing laboratory. Submit the certified test reports with the mix design. Use the same materials in the mix design as on the project.

The laboratory must approve the appropriate field control additives and their application use range as part of the mix design.

Obtain a new mix design from a testing laboratory before changing any materials in the mix design.

Submit a mix design conforming to Table 421-01.

Table 421-01
Micro Surfacing Mix Design

Test	ISSA Test No.	Specification
Mix Time @ 77°F	TB-113	Controllable to 120 Seconds Minimum
Wet Cohesion @ 30 Minutes Minimum (Set) @ 60 Minutes Minimum (Traffic)	TB-139	 12 kg-cm Minimum 20 kg-cm or Near Spin Minimum
Wet Stripping	TB-114	Pass (90% Minimum)
Wet-Track Abrasion Loss One-hour Soak Six-day Soak	TB-100	 50 g/ft^2 Maximum 75 g/ft^2 Maximum
Lateral Displacement Specific Gravity after 1,000 Cycles of 125 lb	TB-147	5% Maximum 2.10 Maximum
Excess Asphalt by LWT Sand Adhesion	TB-109	50 g/ft^2 Maximum
Classification Compatibility	TB-144	11 Grade Points Minimum (AAA, BAA)

Use component materials that meet requirements in Table 421-02.

Table 421-02
Micro Surfacing Component Material Requirements

Component	Quantity
Residual Asphalt	5.5% to 10.5% by dry weight of aggregate
Mineral Filler	0.0% to 3.0% by dry weight of aggregate
Polymer Content	Minimum 3.0% solids based on bitumen weight content
Additives	As required to provide specified properties
Water	As required to produce consistency

B. Test Strip.

Construct a one lane, 1,000 foot test strip for each machine used on the project at an approved location within the project limits. Construct the test strip between 6:00 am and 9:00 am. Construct the test when the emulsion temperature is below 122°F.

Open the test strip to traffic within 90 minutes. The Engineer will inspect the test strip for damage immediately after it begins carrying traffic. Begin full production only after the Engineer accepts the test strip. If the test strip is unable to carry traffic after 90 minutes, modify the material and placement and construct another test strip.

In place of construction of a test strip, submit evidence of successful construction of a test strip on another Department project using the same mix designs. The project must have been constructed in the same construction season. The material, material source, and equipment used for the test strip must be identical to all parts of the proposed material, material source, and equipment.

The Engineer may direct the construction of a new test strip during production application. Construct a new test strip if the material or equipment changes.

C. Weather Limitations.

Place material when the surface and ambient temperatures are at least 45°F and the forecast is greater than 32°F for 24 hours after placement. Do not place the material if the pavement or ambient temperatures is below 50°F and falling.

Do not place the material if it is raining.

D. Traffic Control.

Furnish flagging and pilot cars as specified in Section 704, "Temporary Traffic Control". Include the cost of flagging and pilot cars in the price bid for other items.

On two-lane, two-way traffic highways, place flaggers and signs at each end of the surfacing operation and at major intersections within the operation area. On divided highways, place flaggers and signs at major intersections within the micro surfacing area.

E. Surface Preparation.

Remove deleterious material.

Protect manholes, valve boxes and other service entrances from the surfacing material.

F. Application.

Fog the surface with water if necessary. Adjust the rate of application of the fog spray to suit the pavement surface and atmospheric conditions. Do not allow water to pond on the surface.

Begin placement at the lowest point of the roadway cross section and place subsequent passes upslope from the previous pass.

Uniformly spread the material using the spreader. Mix and spread a homogeneous material. If material prematurely breaks before application, remove the material that broke prematurely from the roadway and the spreader box.

Use hand methods to spread the mixture in areas inaccessible by mechanical spreaders. Complete handwork at the time of the machine applied application. Finish hand-worked areas to resemble the mechanical spreader finish.

If excessive streaking develops, stop production and fix the cause of the streaking. Streaking is excessive if in any 30 square yard area there are more than four drag marks greater than:

- 0.5 inches wide and 4.0 inches long; or
- 1.0 inches wide and 3.0 inches long.

Construct joints with no excessive buildup or uncovered areas. Place longitudinal joints on lane lines. Construct straight edges along curbs and shoulders and through intersections, with no runoff.

Clean the spreader box to be free of material buildup at the start of each work day. Stop operations and clean the spreader box if material buildup begins to affect performance.

421.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place as specified in Section 109.01, “Measurement of Quantities” and as follows.

The Engineer will measure the dry aggregate weight. The Engineer will subtract the weight of moisture determined from moisture tests. The Engineer will determine the moisture content by collecting 3 samples each day material is placed and averaging the moisture contents.

The Engineer will measure traffic control as specified in Section 704.05, “Method of Measurement”.

421.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Aggregate for Microsurfacing Type_	Ton
Asphalt Emulsion for Microsurfacing	Gallon

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 422
SLURRY SEAL

422.01 DESCRIPTION
This work consists of applying a material composed of emulsified asphalt, aggregate, water, and additives over a prepared surface.

422.02 EQUIPMENT

Equipment	Section
Aggregate Trucks	152.01 C
Bituminous Tank Trucks	152.01 E
Micro Surfacing and Slurry Seal Equipment	154.02 D

Calibrate each mixing unit in the presence of the Engineer before starting work. Perform calibration according to ISSA-MA 1. The Engineer may accept previous calibration documentation if the calibration was done within the calendar year. Include the individual calibration of each material at various settings in the documentation.

422.03 MATERIALS

A. General.
Obtain samples of the bitumen under the observation of the Engineer. The Engineer will take immediate possession of the samples.

Item	Section
Water	812
Aggregate for Slurry Seal	816.05
Bituminous Materials for Slurry Seal	818.04

B. Aggregates.
Screen the stockpile before delivery to the paving machine to prevent having oversize material in the mix.

C. Mineral Fillers.
Use mineral filler to improve mixture consistency and to adjust mixture breaking and curing properties. Use material that meets the requirements of ASTM D 242. Use levels of mineral filler between 0.0 and 3.0 percent. Submit a certificate of compliance for the mineral filler.

D. Field Control Additives.
If necessary, use additives to accelerate or retard the break/set of the slurry seal.

Submit a certificate of compliance stating that the liquid field control additive is compatible with the mix design.

E. Emulsion.
Obtain and submit a certificate of compliance from the emulsion manufacturer stating that the aggregate and emulsion are compatible.

422.04 CONSTRUCTION REQUIREMENTS

A. Mix Design.

Submit a mix design prepared by a qualified testing laboratory. Submit the certified test reports with the mix design. Use the same materials in the mix design as on the project.

The laboratory must approve the appropriate field control additives and their application use range as part of the mix design.

Obtain a new mix design from a testing laboratory before changing any materials in the mix design.

Submit a mix design conforming to Table 422-01.

Table 422-01
Slurry Seal Mix Design

Test	ISSA Test No.	Specification
Mix Time @77° F	TB-113	Controllable to 180 Seconds Minimum
Slurry Seal Consistency	TB-106	2.0 - 3.0 cm
Wet Cohesion @30 Minutes (Set) @60Minutes (traffic)	TB-139	12 kg-cm Minimum 20 kg-cm or Near Spin Minimum
Wet Stripping	TB-114	Pass (90% Minimum)
Wet-Track Abrasion Loss One-hour Soak	TB-100	75 g/ft^2 Maximum
Excess Asphalt by LWT Sand Adhesion	TB-109	50g/ft^2 maximum

Before use, allow the Engineer to review the design mix, all slurry sealing materials and methods.

Use component materials that meet requirements in Table 422-02.

Table 422-02
Slurry Seal Component Material Requirements

Component	Quantity
Residual Asphalt	Type II: 7.5 - 13.5% Type III: 6.5 - 12% (Based on dry weight of aggregate)
Mineral Filler	0.0 - 3.0% (Based on dry weight of aggregate)
Additives	As needed
Water	As required to produce proper mix consistency

B. Test Strip.

Construct a one lane, 1,000 foot test strip for each machine used on the project at an approved location within the project limits. Construct the test strip between 6:00 am and 9:00 am. Construct the test when the emulsion temperature is below 122°F.

Open the test strip to traffic within 90 minutes. The Engineer will inspect the test strip for damage immediately after it begins carrying traffic. Begin full production only after the Engineer accepts the test strip. If the test strip is unable to carry traffic after 90 minutes, modify the material and placement and construct another test strip.

In place of construction of a test strip, submit evidence of successful construction of a test strip on another Department project using the same mix designs. The project must have been constructed in the same construction season. The material, material source, and equipment used for the test strip must be identical to all parts of the proposed material, material source, and equipment.

The Engineer may direct the construction of a new test strip during production application. Construct a new test strip if the material or equipment changes.

C. Weather Limitations.

Place material when the surface and ambient temperatures are at least 45°F and rising and the forecast is greater than 32°F for 24 hours after placement. Do not place the material if the pavement or ambient temperatures is below 50°F and falling.

Do not place the material if it is raining.

D. Traffic Control.

Furnish flagging and pilot cars as specified in Section 704, “Temporary Traffic Control”. Include the cost of flagging and pilot cars in the price bid for other items.

On two-lane, two-way traffic highways, place flaggers and signs at each end of the surfacing operation and at major intersections within the operation area. On divided highways, place flaggers and signs at major intersections within the micro surfacing area.

E. Surface Preparation.

1. General.
Remove deleterious material.

Protect manholes, valve boxes and other service entrances from the surfacing material.

2. Tack Coat.
If a tack coat is required, allow tack coat to cure before the applying the slurry seal.

F. Application.
Fog the surface with water if necessary. Adjust the rate of application of the fog spray to suit the pavement surface and atmospheric conditions.

Uniformly spread the material using the spreader. Ensure the material does not prematurely break in the spreader box and is homogeneous during mixing and spreading.

Use hand methods to spread the mixture in areas inaccessible by mechanical spreaders. Complete handwork at the time of the machine applied application. Finish hand-worked areas to resemble the mechanical spreader finish.

Construct joints with no excessive buildup or uncovered areas. Place longitudinal joints on lane lines. Construct straight edges along curbs and shoulders and through intersections, with no runoff.

Clean the spreader box to be free of material buildup at the start of each work day. Stop operations and clean the spreader box if material buildup begins to affect performance.

422.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will measure the dry aggregate weight. The Engineer will subtract the weight of moisture determined from moisture tests. The Engineer will determine the moisture content by collecting 3 samples each day material is placed and averaging the moisture contents.

The Engineer will measure traffic control as specified in Section 704.05, “Method of Measurement”.

422.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Aggregate for Slurry Seal - Type_	Ton
Asphalt Emulsion for Slurry Seal	Gallon

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 430
HOT MIX ASPHALT (HMA)

430.01 DESCRIPTION
This work consists of constructing bituminous pavement.

Sample and test as outlined in the Field Sampling and Testing Manual.

430.02 EQUIPMENT

Equipment	Section
Self-Propelled Pneumatic-Tired Roller	151.01 C
Smooth-Faced Steel-Wheel Roller: Tandem – Type A	151.03 A.2
Smooth-Faced Steel-Wheel Roller: Tandem – Type B	151.03 A.3
Vibratory Roller	151.03 B
Combination Roller	151.04
Bituminous Trucks	152.01 D
Bituminous Tank Trucks	152.01 E
Bituminous Equipment	154

When air temperatures fall below 50˚ F at any place along the haul route of the mix, deploy the tarps installed on the bituminous trucks.

430.03 MATERIALS

Item	Section
Bituminous Materials	818

A. Asphalt Cement.
The Engineer will accept asphalt cement as outlined in the Combined State Binder Group agreement for North Dakota. The Contractor shall obtain samples of this material under the observation of the Engineer. The Engineer will take immediate possession of the samples.

B. Aggregate.
Develop a mix design that contains an aggregate gradation that conforms to the requirements in Table 430-01.

Table 430-01
Aggregate Gradations for Mix Design

Sieve Size	1/2 Inch Nominal Maximum Aggregate Size[1] Percent Passing	
	Min	Max
⅝ Inch	100	100
½ Inch	90	100
#4	40	70
#30	15	35
#200	2.0	7.0

[1] Nominal maximum aggregate size is defined as 1 sieve size larger than the first sieve to retain more than 10 percent.

Provide aggregate that meets the requirements in Table 430-02.

Table 430-02

Test Designation	Test Name	Criteria
ND T 176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test	40% minimum
ND D 4791	Test Method for Flat Particles, Elongated Particles, or Flat Elongated Particles in Coarse Aggregate	10% maximum
AASHTO T 96	Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	40% maximum
ND T 113	Lightweight Pieces in Virgin Aggregate	5.0% maximum

C. Superpave Mix Properties.

Provide mix that meets the requirements of Table 430-03. Base the fine aggregate angularity (FAA) on the designation of the bid item.

Table 430-03
Superpave Mix Properties

Property	FAA 40	FAA 42	FAA 43	FAA 45
Fractured Particles in Coarse Aggregate (minimum)	75%	75%	75%	85%
Fine Aggregate Angularity (minimum)	40%	42%	43%	45%
Gyratory Effort, # of Gyrations	N_{ini} = 7, N_{des} = 75, N_{max} = 115	Nini = 7, Ndes = 75, Nmax = 115	Nini = 7, Ndes = 75, Nmax = 115	Nini = 7, Ndes = 75, Nmax = 115
Voids filled with Bitumen	65-78%	65-78%	65-78%	65-75%
$\%G_{mm}$ @ N_{ini} (maximum)	90.5%	89%	89%	89%

The superpave mix properties shown in Table 430-03 will be determined according to the methods shown in Table 430-04.

Table 430-04

Methods for Determining Superpave Mix Properties

Fractured Particles in Coarse Aggregate	NDDOT 4
Fine Aggregate Angularity	ND T 304
Gyratory Effort, # of Gyrations	AASHTO R 35
Voids filled with Bitumen	AASHTO M 323, ND T 166
$\%G_{mm}$ @ N_{ini}	AASHTO M 323, ND T 166

D. Preparation of Aggregates.

When using a drum-dryer mixer, prepare aggregate so that the moisture content of the bituminous mixture is less than 1 percent.

Screen aggregates used in a cold-feed control into two or more fractions consisting of at least 1 fine and 1 coarse aggregate stockpile. Feed aggregate from the stockpile into separate compartments for accurate proportioning into the mixer.

E. Recycled Asphalt Pavement (RAP).

When a mix contains RAP, obtain the recycled material from the project or from a source specified for the project by the Department. The Engineer will approve recycled material from a different source only if that source is another Department project.

RAP may be incorporated into mix used for mainline pavement at a rate between 10 and 25 percent of the mix, by weight.

RAP may be incorporated into mix used for shoulder pavement at a rate between 10 and 35 percent of the mix, by weight.

Provide recycle material with a maximum particle size of 1.5 inch.

Introduce recycled material so that it does not come into direct contact with the burner flame. Add binder to the combined virgin aggregate and recycled material.

If using a mix with RAP and a mix without RAP, submit mix designs for both mixes.

When obtaining material from the roadway to determine the RAP mix design, the Engineer will designate the location used to obtain material.

430.04 CONSTRUCTION REQUIREMENTS

A. Contractor Quality Control (QC).

1. Quality Control Personnel.

Provide the following personnel:

- Certified Aggregate Field Lab Tester to be on the project during aggregate production;
- Certified Aggregate Field Lab and Asphalt Mix Tester to be on the project during asphalt mix production;
- Certified Asphalt Pavement Inspector to be on the project during paving operations; and
- Certified Asphalt Mix Controller to be on the project during paving operations.

Ensure that all personnel performing tests on materials used in the paving operation are certified as outlined in the Department's Technical Certification Program (TCP). The requirements of the TCP can be found on the Department's website, www.dot.nd.gov.

2. Quality Control Plan.

Before beginning work, submit a copy of the QC plan to the Engineer. Provide and maintain copies of the plan at the Quality Assurance (QA) and QC laboratories. Provide the following minimum information in the plan:

a. The names and phone numbers of the individuals responsible for the QC program.
b. A listing of the personnel responsible for the QC testing and their Technician ID and qualifications.
c. An organizational chart indicating lines of authority, including names and phone numbers.
d. Details of the QC plan addressing the following items:
   - Pit operations and methods used to control uniformity, limiting segregation, and efficiently utilizing the aggregate resources of the pit;
   - Plant operations listing proposed equipment and method of operations;
   - Site plan drawing of plant;
   - Testing frequency for both aggregate production and mix production; and
   - Discussion of how the QC program responds to the need for corrective action.

An example quality control plan is available on the Department's website.

B. Engineer's Quality Assurance Plan.

The Engineer will provide a quality assurance plan to the Contractor at the time the Contractor submits the quality control plan specified in Section 430.04 A.2, "Quality Control Plan." The quality assurance plan will contain:

- The names and phone numbers of the individuals responsible for the QA program.
- A listing of the personnel responsible for the QA testing and their Technician ID and qualifications.
- An organizational chart indicating lines of authority, including names and phone numbers.

C. Pit Operations and Stockpiling of Aggregate.

1. General.

Perform the tests required in Section 430.02 A.2, "Contractor Testing" in the *Field Sampling and Testing Manual.* Provide copies of test results for each stockpile of aggregate by noon the day following the tests.

Before the start of bituminous mix production, stockpile sufficient aggregate at the plant to produce the lesser of:

- 25,000 tons of bituminous mixture; or
- 50 percent of the required quantity of bituminous mixture.

During bituminous mix production, maintain sufficient aggregate in the stockpiles to produce the lesser of:

- 5,000 tons of bituminous mixture; or
- 25 percent of the required quantity of bituminous mixture to finish production.

2. Determination of Specific Gravity.

If the mix will contain RAP, obtain an 80-pound sample of milled material for determination of RAP specific gravity, split the sample, and submit half of the material to the Engineer.

If the specific gravity values determined by the Contractor and Engineer as required by Section 430.02, "Quality Control Testing" of the *Field Sampling and Testing Manual* correlate within 0.040, proceed with developing a mix design using the Contractor's averaged specific gravity values.

If the specific gravity values determined by the Contractor and Engineer as required by Section 430.02, "Quality Control Testing" of the *Field Sampling and Testing Manual* do not correlate within 0.040, choose one of the following options:

- Perform the tests together with the Engineer at an agreed upon location; or
- Resolve the testing differences according to the dispute resolution procedures in Section 430.04, "Dispute Resolution" of the *Field Sampling and Testing Manual*.

Once resolved, proceed with the development of a mix design using the determined number for the tests performed with the Engineer or the number determined by the dispute resolution procedure.

D. Mix Design.

1. General.

Develop a mix design in accordance with NDDOT 2, “Gyratory Mix Design Procedure”, which can be found in the FSTM. Do not begin production of hot bituminous pavement before the Department approves the mix design.

If the project will contain both recycled and non-recycled pavements, submit one mix design containing recycled material and one without recycyled material.

Submit the mix design a minimum of 10 calendar days before beginning paving operations. The Engineer will review the mix design. If the Engineer does not approve the mix design, revise the mix design and submit the revised mix design. Allow 10 calendar days for the Engineer to review a revised mix design before beginning paving operations.

When making the blend determinations for the mix design, use the average of the production samples value for each sieve from each stockpile.

Base the mix design on the criteria specified in Table 430-05 and develop the mix design according to the standards outlined in Table 430-06.

TABLE 430-05
Hot Mix Asphalt Testing Criteria

Procedure/Property/Test	Criteria	Reference
Voids in Mineral Aggregate	14.0 Minimum for ½ Inch Nominal Maximum Aggregate	AASHTO M 323 ND T 166
% G_{mm} @ N_{max}	98.0 Maximum	AASHTO M 323 ND T 166
Dust/Effective Asphalt Ratio	0.6 - 1.3 (top Lift) 0.6 - 1.4 (Bottom Lifts)	AASHTO M 323 ND T 166
Desired Moisture Sensitivity, Min. % Strength Retention [1,2]	70 @ 7.0 ± 1% Air Voids	AASHTO T 283 AASHTO R 30
Asphalt Film Thickness [1] (Microns)	7.5 - 13	Determined by Department’s mix design program.

[1] Desired value, the Department will make a final determination based on the mix design.
[2] Only required when specified on the plans

TABLE 430-06
AASHTO SUPERPAVE MIX DESIGN STANDARDS

Designation	Title
ND T 312	Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
AASHTO R 35	Practice for Superpave Volumetric Design for Hot Mix Asphalt
AASHTO R 30	Mix Conditioning of Hot Mix Asphalt (HMA)
AASHTO M 323	Specification for Superpave Volumetric Mix Design
ND T 166	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

Submit a revised mix design if:

- utilizing aggregate from sources not initially submitted;
- processing the aggregate using a different crusher; or
- using a different type or grade of bitumen.

Allow 10 calender days for the Department to review the revised mix design before incorporating the material into the work.

If the source of bitumen changes from the approved mix design, immediately notify the Engineer of the change and provide the relevant information related to the new source. The Engineer may request a new mix design. If the Engineer requests a new mix design, submit the necessary materials and allow 10 days for the Department to review the revised mix design before incorporating the material into the work.

2. Items to be Submitted.

Submit the following items with each mix design:

a. An aggregate sample representing each stockpile used for the mix design. The total weight of material shall be approximately 150 lbs.

b. Eight one-quart cans of PG asphalt. The PG asphalt shall be the same grade specified on the plans and from the supplier that will be used on the project.

When multiple grades of PG asphalt are specified, one grade may be supplied, but it must be the same grade used to develop the mix design.

c. Approximately 30 lbs of loose asphaltic concrete mix prepared at the optimum asphalt content recommended by the mix design.

d. The Contractor shall submit a mix design that contains the following elements:

1. The percentage of aggregate passing each of the specified sieves.
2. The percent asphalt cement to be added to the mixture.
3. The target air voids will be 3.0%.
4. The maximum specific gravity of the mixture obtained in the laboratory.
5. The bulk specific gravity of the mixture obtained in the laboratory.
6. The percent VMA of the mixture obtained in the laboratory.
7. Calculated film thickness (microns).
8. Calculated dust/asphalt ratio.
9. %Gmm @ N_{ini}.
10. %Gmm @ N_{max}.
11. RAP asphalt cement content
12. RAP specific gravity
13. RAP FAA
14. RAP gradation

e. If the mix contains RAP, submit a 50 pound sample of the milled material.

E. QC Testing.

1. General.

During production of the bituminous mix, perform sampling and testing on the aggregate and bituminous mix as the mix is being produced and placed on the roadway.

Perform the tests specified in Section 430.02, "Quality Control Testing" of the *Field Sampling and Testing Manual* at the designated frequencies. During aggregate production, test results must be made available by noon the day following the test. During mix production, furnish copies of test results upon completion of the test.

If the QC test results for ND T 176 or ND T 113 indicate uniform results, the Engineer may issue a written notice reducing the frequency of these tests.

2. Determination of Asphalt Content.

Under the observation of the Engineer, determine the asphalt content each time a gradation test is taken. Base the asphalt content on readings from the totalizers for the aggregate and the asphalt as outlined in SFN 18674, "Asphalt Content & Virgin Aggregate Determination".

3. Sample Splitting.

The Engineer will take possession of one half of the split QC sample and will perform testing on a portion of the material, as necessary.

The portion of the sample submitted to the Engineer will be retained for 24 hours after the QA test representing the lot of material has been performed. Either the Engineer or Contractor may request to have the remaining portion of the sample tested within the 24 hour timeframe. If a request is made, the Engineer will test the remaining portion of the QC sample and the Engineer's results will be used as the basis for acceptance of the aggregate.

4. Documentation.

Maintain complete records of all process quality control tests. Record all test results and calculations and document results on Department provided forms. The required forms are available on the Department's website www.dot.nd.gov. The proper forms for individual tests are listed in the Field Sampling and Testing Manual.

Maintain control charts at the QC laboratory. Record test results on the control charts immediately upon completion of the test. Record the following parameters on the control charts:

- Gradation of the control sieves (1/2 Inch, #4, #30, and #200), (ND T 27 and ND T 11);
- Asphalt Content;
- Theoretical Maximum Specific Gravity, (ND T 209);
- Bulk Specific Gravity, (ND T 166);
- Percent Air Voids of field Gyratory samples;
- Daily average Air Voids percentage of the cores;
- Average Daily Density;
- Fines/Asphalt Ratio;
- Asphalt Film Thickness (microns); and

- Fine Aggregate Angularity.

Control charts must display:

- Single test control limits for each test parameter;
- Individual test results;
- Moving average control limits; and
- Moving average of the last four tests.

Color code the moving average results and control limits, and the single tests and control limits.

Make the control charts available at the QC laboratory and accessible for review by the Engineer during the paving operations. Submit complete control charts upon completion of the paving operations.

5. Control Limits.

The field test results may vary from the mix design target values as shown in Table 430-07.

The Engineer will allow 2.0 percent of the material to be retained on the 5/8 inch sieve providing all material passes the 3/4 inch sieve.

TABLE 430-07
ALLOWABLE WORKING RANGES

Test/Assessment		Single Test Target Value Control Limit	Moving Average Target Value Control Limit
Asphalt Content (based on totalizer reading)		±0.30	±0.24
ND T 11 and ND T 27 and	Sieve Analysis of Fine and Coarse Aggregates (Control Sieves)		
	1/2"	±6	±5
	#4 sieve	±6	±5
	#30 Sieve	±5	±4
	#200 Sieve[1]	±2.0	±1.5
SFN 50289	Percent Air Voids	1.5% to 5.0%	2.0% to 4.5%
ND T 113	Lightweight Pieces in Aggregate	Not more than the maximum specified	
NDDOT 4	Percentage of Fracture Particles in Coarse Aggregate	Not less than the minimum specified	
ND T 304	Fine Aggregate Angularity	Not less than the minimum specified	
ND T 176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test	Not less than the minimum specified	

[1] Not to exceed the maximum specified in Table 430-01.

a. Single Test Target Values.

If an individual test falls outside the single test target value control limits, take immediate corrective action. After implementation of the corrective action, collect a sample and conduct the test that fell outside the control limits. If the test following the corrective action falls outside of the control limits discontinue paving operations until the cause is found and corrected. Resume paving operations only after obtaining approval from the Engineer.

The test following the corrective action is used to determine the effectiveness of the corrective action. It is not used for acceptance of material and will not be factored into the moving average.

If, in an individual gradation test a single control sieve falls outside the single test target value control limits, continued production is allowed only if the air voids are within the control limits and the material passing the #200 sieve does not exceed the maximum specified in Table 430-01.

Discontinue paving operations if 2 consecutive tests exceed the single test target value control limit for any of the following:

- ND T 113, Lightweight Pieces in Aggregate;
- ND T 304, Fine Aggregate Angularity;
- NDDOT 4, Percentage of Fracture Particles in Coarse Aggregate; or
- ND T 176, Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test.

Resume paving operations only after taking corrective action and obtaining approval from the Engineer.

b. Moving Average Target Values.

The moving average for each test is determined using the 4 most recent test results.

If the moving average for a test trends toward the moving average target value control limits, take corrective action. After implementation of the corrective action collect a sample and conduct the test that is trending towards the moving average control limits. The test following the corrective action is used to determine the effectiveness of the corrective action. It is not used for acceptance of material and will not be factored into the moving average. Document the corrective action.

If the moving average for a test exceeds the moving average target value control limits, continued production is allowed only if the air voids are within the control limits and the material passing the #200 sieve does not exceed the maximum specified in Table 430-01.

If the air voids are outside the control limits or the material passing the #200 sieve exceeds the maximum specified in Table 430-01, perform one of the following actions:

- Implement corrective measures to produce mix that is based on the mix design; or
- Request that new target values be set if the test results indicate that adjustments to the target values are necessary. Implement the adjusted target values only after receiving the Engineer's written approval.

If the moving average for air voids exceeds the moving average control limit, discontinue paving operations and implement corrective measures. The Engineer may allow continued paving if satisfied with the corrective measures. Resume quality control testing when the plant has started and operations are equalized.

F. Surface Preparation.

Remove deleterious material from the surface.

Correct local irregularities in the existing surface before placing the first lift of bituminous material. If milling is specified, correct local irregularities after milling. Apply a tack coat to the surface before correcting the irregularities. Use the same type of mix that is required for the subsequent lift. Use self-propelled pneumatic-tired rollers to roll and compact the mix.

The mix required for correcting local irregularities will be deducted from the total mix used for the project, meaning that the subsequent lift of pavement will be thinner than originally planned.

Apply a tack coat to the surface and to the exposed edges of longitudinal and transverse joints before placing bituminous pavement. Apply a double application of tack coat to longitudinal joints and a minimum of one inch on either side of the joint. Apply a tack coat on a previously placed layer or surface of pavement before placing the next lift.

G. Patching.

Remove existing broken or unstable surface material and replace that material with the same mixture specified for the next course.

Place the bituminous material in lifts not to exceed 3 inches and compact the material. Allow the patch material to cool to 130°F before placing additional material. If patching is required during the paving operation, allow the patch material to cool to 185°F before placing additional material.

H. Spreading and Finishing.

1. General.

Do not place bituminous mixture on a damp pavement surface, on a frozen roadbed, or when weather conditions prevent the proper handling and finishing of the bituminous mixtures.

Use bituminous pavers to spread and finish mixtures to the required section leaving the mixture uniformly dense, smooth, and free from irregularities. In locations where it is impractical to use normal laydown equipment the Engineer will allow other methods.

Control paver speed below the manufacturer’s recommended maximum speed. Coordinate plant output and paver speed so paver operation is smooth and continuous.

The surface thickness shown on the plans is for estimating purposes only. Place pavement to use the estimated tonnage uniformly throughout the roadway.

Supply mix that is uniform and homogeneous. The Engineer will reject loads of mix or sections of pavement containing uncoated batches of aggregate or segregated materials.

Remove and replace material that is visibly segregated. If a paver placed the material, remove the segregated material to the full width of the paver. If the material was placed by hand, remove the full area of segregated material, plus an additional 6 inches around the entire segregated area.

Place material in lifts between 1.5 and 3.0 inches of compacted bituminous material. Leveling courses may be placed with thickness less than 1.5 inches.

Place bituminous mixture so a single lane is not more than one day's run in advance of any adjacent lane. Leveling courses are excluded from this requirement.

Do not place bituminous pavement on bridge decks.

2. Air and Surface Temperature Requirements.
Place a subsequent lift after the previous lift has cooled to 130°F.

Place bituminous mix without supplementary admixture when the temperatures are at or above the requirements in Table 430-08. Include a supplementary admixture such as Evotherm, AD-here LOF 65-00 EU, or an approved equal in the bituminous mixture when placing bituminous mix when temperatures are within the ranges shown in Table 430-09. Do not place bituminous mix when temperatures are below those shown in Table 430-09.

Table 430-08
Standard Paving Temperatures

Compacted Thickness	Air Temp for Surface Course	Air Temp for Subsurface Course and Approaches	Existing Mat
1-1/2 inches or less	45°F	40°F	40°F
More than 1-1/2" inches	40°F	35°F	40°F

If placing bituminous mix according to Table 430-09, submit the supplementary admixture manufacturer's dosage rate and any changes to the mix design. The supplementary admixture may be added to the asphalt binder by the supplier or refiner, or by the Contractor at the asphalt plant. Add the admixture to the binder according to the supplementary admixture manufacturer's recommendations. If the admixture is added at the plant, equip the plant with a metering device that records the rate of admixture. Tie the metering device into the same system that measures the other components of the mix.

Table 430-09
Paving Temperatures Using Supplementary Admixtures

Compacted Thickness	Air Temp for Surface Course	Air Temp for Subsurface Course and Approaches	Existing Mat
1-1/2 inches or less	40°F - 45°F	35°F - 40°F	35°F - 40°F
More than 1-1/2 inches	35°F - 40°F	35°F or above	35°F - 40°F

Measure the existing mat temperature using one of the following methods:

- Using an infrared sensing thermometer; or
- Insert a conventional thermometer into a 1 inch deep hole in the pavement. Fill the hole with water, oil, or grease.

3. Mix Temperature Requirements.

Discharge mix from the mixer with a temperature no higher than the bituminous material manufacturer's recommendation. If there are no recommendations on maximum mix temperature, discharge mix with a maximum temperature of 300°F.

When the ambient temperature is 60°F or higher, place mix with a minimum laydown temperature of 230°F. When the temperature is below 60°F, place mix with a minimum laydown temperature of 250°F.

I. Compaction.

1. General.

Remove all surface irregularities before beginning compaction.

Sequence rolling operations and select the type and the number of rollers to match production and to attain the required density before the mat temperatures fall below 185°F.

In areas not accessible to rollers, compact the pavement mat with hand or mechanical tampers.

2. Calculated Density.

a. General.

Use calculated density on mainline pavement, interstate crossroads, ramps, turn lanes, rest area approaches, and parking lots.

b. Coring.

(1) General.

Obtain pavement cores at locations designated by the Engineer under the observation of the Engineer.

Use a machine that cuts a cylindrical core sample without disturbing the density of the sample. Complete coring on or before the working day following the placement of the lift. Obtain a core with a smooth outer surface, no distortion of the cylindrical shape, and no displacement of the aggregate particles. Obtain a core that is 4 to 6 inches in diameter and the full depth of the in place asphalt.

Fill core holes before placing the subsequent lift of pavement. If there is no subsequent lift of pavement, fill the core hole within 24 hours of obtaining the core. Remove free standing water before filling core holes. Fill core holes in 2 inch lifts using material from the same mix design used on the roadway. Compact each lift using a hand tamper.

(2) Pavement Density Cores.

Use a masonry saw to cut the core so that only the layer to be tested is removed.

Label each core, using a system approved by the Engineer, to identify the location from which the core was obtained.

(3) Pavement Thickness Determination Cores.
Obtain pavement thickness determination cores after the final lift of pavement has been placed. Label the cores. The Engineer will take possession of these cores immediately upon extraction. Do not cut these cores.

3. Ordinary Compaction.

a. General.
Use ordinary compaction on shoulders, driveways, section line approaches, bike paths, leveling courses, and patches.

Ordinary compaction consists of breakdown rolling, intermediate rolling, and finish rolling. Compact the bituminous material until the surface is tightly bound and shows no displacement under operation of the roller.

For patching, immediately after spreading perform initial rolling with pneumatic-tired rollers or combination rollers.

b. Breakdown Rolling.
Pass a roller over the placement area one or more times. Use a roller from the following list:

- Self-Propelled Pneumatic-Tired Roller;
- Smooth-Faced Steel-Wheel Roller: Tandem – Type A;
- Vibratory Roller; or
- Combination Rollers.

c. Intermediate Rolling.
Perform intermediate rolling following breakdown rolling using a self-propelled pneumatic-tired roller or a combination roller until the surface is tightly bound and shows no displacement under the roller.

If roller tires pick up the bituminous material or there are excessive roller marks in the mat, the Engineer may allow the removal of the intermediate rolling operation if it appears to the Engineer that compaction is being achieved.

d. Finish Rolling.
Perform finish rolling with a tandem Type B smooth-faced steel-wheel roller or a vibratory roller in the static mode. Continue finish rolling until roller marks are eliminated.

J. Joints.

1. General.
Place pavement against the surface of curbing, gutters, manholes, and similar structures uniformly near the contact surfaces so the pavement is slightly higher than the edge of the structure after compaction.

Do not construct a joint on top of a joint from a previous lift or in a wheel path.

2. **Longitudinal Joints.**
Construct longitudinal joints on successive lifts between 6 and 12 inches from the previous longitudinal joint.

Place and follow markings to guide the paver. Construct joints in a uniform line. Correct pavement edges that deviate from the uniform line and correct areas of the joint that vary from the intended location of the joint by more than 2 inches. Construct joints with tight seams and no visible segregation.

3. **Transverse Joints.**
Construct transverse joints on successive lifts a minimum of 12 feet from the previous transverse joint.

K. Tolerances.
Correct surface irregularities that exceed 3/16 inch measured with a 16 foot straightedge.

When making corrections, use equipment that does not cause strain or damage to the underlying surface of the pavement. Do not cause excessive ravels, aggregate fractures, or disturbance of the joints.

L. Pavement Sloughs.
Compact pavement sloughs with rollers capable of providing a smooth finished compacted slough that is free of tire marks and unevenness and drop-offs. The Engineer will not require density tests.

M. Acceptance.

1. **General.**
The Engineer will accept bituminous mix based on the criteria in this section.

The Engineer will include material used in shoulder placement when calculating the total quantity of material affected by the Aggregate and Asphalt Content pay factors. The Engineer will exclude materials used in shoulder placement when calculating the Field Density and will not designate core locations within shoulder areas.

2. **Aggregate.**
The Engineer will accept aggregate used in the mix based on QC tests that are verified by QA testing, and the control limits specified in Section 430.04 E.5, “Control Limits”.

If the results for two consecutive aggregate gradation tests in a single day fall outside the single test target value control limits, the Engineer will apply a contract price adjustment as specified in Section 430.06 C, “Contract Price Adjustments”.

3. **Asphalt Content.**
The Engineer will base the acceptance of the asphalt content of bituminous mix on the totalizer readings obtained as specified in Section 430.04 E, “QC Testing” and SFN 9988, “Mix Bitumen Cut-Off Report” and will apply a contract price adjustment as specified in Section 430.06 C, “Contract Price Adjustments”.

If the average asphalt content, as determined by the Engineer according to SFN 9988, "Mix Bitumen Cut-off Report" deviates from the target value by 0.40 percentage points or more, the Engineer may reject the material. If the material is accepted, the Engineer will apply a contract price adjustment as specified in Section 430.06 C, "Contract Price Adjustments".

4. **Field Density.**
This section will apply when the pavement is constructed as specified in Section 430.04 I.2, "Calculated Density".

The Engineer will base acceptance of the density of hot mix asphalt on the average density of the pavement compared to the daily average maximum theoretical density. The comparison will be made using SFN 59132, "Density Pay Factor".

The Engineer will determine the density of pavement based on lots. A lot is equal to the amount of material, in tons, placed each production day.

A sublot is defined as a single lift, one paver width wide, and 1,000 feet long. If a partial sublot is less than 500 feet, it will be included in the previous sublot. A partial sublot 500 feet or greater will be considered a separate sublot.

The individual sublot densities will be averaged to determine the density of the pavement lot.

If the average pavement density compared to the daily average maximum theoretical density is below 90.0%, remove and replace the pavement. If the average pavement density compared to the average maximum theoretical density is equal to or greater than 90.0%, the Engineer will apply the adjustment factors specified in Section 430.06 C, "Contract Price Adjustments". If the lift of pavement is placed on aggregate base or reclaimed material, the numbers listed in this paragraph are adjusted to 89.0%.

430.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and the following:

A. Bituminous Pavement.
The Engineer will pay for the tonnage of bituminous mix used in the accepted pavement and will make no deduction for the weight of asphalt cement used in the mixture.

B. Asphalt Cement.
The Engineer will determine the quantity of asphalt cement used each day by completing SFN 9988, "Mix Bitumen Cutoff Report".

C. Cored Sample.
The Engineer will measure each individual cored sample that is removed in the required condition.

D. Tack.
Tack will be measured as specified in Section 401.05, "Method of Measurement".

430.06 BASIS OF PAYMENT

A. General.

Pay Item	Pay Unit
__Asphalt Cement	Ton or Gallon
Superpave, FAA __	Ton
RAP Superpave, FAA __	Ton
Patching	Ton
Cored Sample	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Tack.
Tack will be paid for as specified in Section 401.06, "Basis of Payment".

C. Contract Price Adjustments.

1. General
The Engineer will calculate the Combined Adjustment Factor by multiplying the individual adjustment factors for:

- Aggregate gradation;
- Asphalt content; and
- Compaction.

1.0 will be subtracted from the Combined Adjustment Factor to determine the Contract Price Adjustment.

The contract price adjustment will be determined by multiplying the Contract Price Adjustment Factor by the total tons of hot mix asphalt placed during a single day and the contract unit price for "Superpave, FAA __".

2. Aggregate Gradation Adjustment Factor.
The aggregate gradation adjustment factor will only be applied if two consecutive aggregate gradation tests in a single day contain a sieve that is outside the Single Test Target Value Control limits specified in Table 430-07. If different sieves fall outside the limits on consecutive tests, the adjustment factor will be applied.

If more than one sieve exceeds the Single Test Value Control Limits, the Engineer will use the largest uniformity deviation (U) when determining the adjustment factor.

When the aggregate gradation factor is applied, the Engineer will calculate the adjustment factor using the largest deviation (U) to calculate the adjustment factor.

$$Adjustment\ Factor = \frac{100 - U}{100}$$

3. Asphalt Content Adjustment Factor.
For each day's production, the Engineer will apply the lowest adjustment factor determined from the average or uniformity methods.

a. Average.
The Engineer will determine average asphalt content using SFN 9988, "Mix Bitumen Cut-off Report" and apply the appropriate adjustment factor specified in Table 430-11.

If the average asphalt content deviates from the mix design by 0.40 percentage points or more, the Engineer will determine the adjustment factor in accordance with Section 105.07, "Conformance with the Contract Requirements", or may reject the material.

Table 430-10
Average Asphalt Content

Deviation from Target (percentage points)	Adjustment Factor
0.00-0.24	1.00
0.25-0.29	0.98
0.30-0.34	0.95
0.35-0.39	0.92
≥ 0.40	Section 105.07

b. Uniformity.
The Engineer will determine the average asphalt cement content based on the totalizer readings specified in Section 430.04 E, "QC Testing" and SFN 18674, "Asphalt Content & Virgin Aggregate Determination Report".

If the asphalt content from any random reading varies from the daily average of the readings by more than 0.24 percentage points, the Engineer will calculate the adjustment factor according to SFN 18552 "Daily Report – Hot Bituminous Pavement – Quality Control".

$$Adjustment\ Factor = \frac{100 - [20(Deviation - 0.24)]}{100}$$

4. Compaction Adjustment Factor.
The adjustment factor for compaction will not be used for areas constructed according to Section 430.04 I.3, "Ordinary Compaction".

The Engineer will apply the adjustment factor specified in Table 430-11.

Table 430-11
Density Adjustment Factors

Adjustment Factor	Average Pavement Density *
1.04	≥ 94.0 %
1.02	93.0 to 93.9 %
1.0	92.0 to 92.9 %
0.95	91.0 to 91.9 %
0.90	90.0 to 90.9 %
Remove & replace	< 90.0 %

* All Average Pavement Density numbers are adjusted down by 1.0% when pavement is placed on aggregate base or reclaimed material

D. Bitumen Testing Price Adjustment.

The Engineer will apply Bitumen Testing Price Adjustment to each individual sublot of material. If more than one test parameter in a sublot results in a pay factor of less than 1.00, the Engineer will apply the pay factor that results in the largest monetary deduction to that sublot.

The pay factor determined by the Engineer will be applied to the "PG _____ Asphalt Cement" contract item. The pay factor will be multiplied by the unit cost of the item and the quantity of oil represented by the sample.

Table 430-12
Requirements on Original Binder

Specification	Test Result	Pay Factor (Percent)
Dynamic Shear AASHTO T 315 G*/sin δ Min. 1.00 kPa	≥ 1.00	1.00
	0.97 – 0.99	0.95
	0.94 – 0.96	0.90
	0.91 – 0.93	0.85
	< 0.91	0.70

Table 430-13
Requirements on Rolling Thin Film Oven (RTFO) Residue

Specification	Test Result	Pay Factor (Percent)	Specification	Test Result	Pay Factor (Percent)
	≤ 4.5	1.00			
Standard Traffic “S”	4.6	0.95			
AASHTO T 350	4.7	0.90			
$J_{nr@3.2}$	4.8	0.85			
Max. 4.5 kPa^{-1}	> 4.8	0.70			
	≤ 2.0	1.00		> 30	1.00
Heavy Traffic “H”	2.1	0.95	Heavy Traffic “H”	29	0.95
AASHTO T 350	2.2	0.90	AASHTO R 92	28	0.90
$J_{nr@3.2}$	2.3	0.85	Percent Recovery @	27	0.85
Max. 2.0 kPa^{-1}	> 2.3	0.70	3.2 kPa Min. 30%	< 27	0.70
	≤ 1.0	1.00		> 55	1.00
Very Heavy Traffic “V”	1.1	0.95	Very Heavy Traffic “V”	54	0.95
AASHTO T 350	1.2	0.90	AASHTO R 92	53	0.90
$J_{nr@3.2}$	1.3	0.85	Percent Recovery @	52	0.85
Max. 1.0 kPa^{-1}	> 1.3	0.70	3.2 kPa Min. 55%	< 52	0.70
	≤ 0.5	1.00		> 75	1.00
Extreme Traffic “E”	0.6	0.95	Extreme Traffic “E”	74	0.95
AASHTO T 350	0.7	0.90	AASHTO R 92	73	0.90
$J_{nr@3.2}$	0.8	0.85	Percent Recovery @	72	0.85
Max. 0.5 kPa^{-1}	> 0.8	0.70	3.2 kPa Min. 75%	< 72	0.70

Table 430-14
Requirements for Pressure Aging Vessel (PAV) Residue

Specification	Test Result	Pay Factor (Percent)
Standard Traffic “S” AASHTO T 315 DSR, G*(sin δ) Max. 5000 kPa	≤ 5000	1.00
	5001 - 5200	0.95
	5201 - 5400	0.90
	5401 - 5600	0.85
	> 5600	0.70
Traffic “H”, “V”, “E” AASHTO T 315 DSR, G*(sin δ) Max. 6000 kPa	≤ 6000	1.00
	6001 - 6050	0.95
	6051 - 6100	0.90
	6101 - 6150	0.85
	> 6150	0.70
Creep Stiffness AASHTO T 313 Max. 300 mPa	≤ 300	1.00
	301 - 310	0.95
	311 - 320	0.90
	321 - 330	0.85
	> 330	0.70
m-value AASHTO T 313 Min. 0.300	≥ 0.300	1.00
	0.295 – 0.299	0.95
	0.290 – 0.294	0.90
	0.285 – 0.289	0.85
	< 0.285	0.70

SECTION 550
CONCRETE PAVEMENT

550.01 DESCRIPTION
This work consists of constructing concrete pavement.

550.02 EQUIPMENT

Item	Section
Concrete Equipment	155
Air Compressor	156.01
Fogger	156.02

550.03 MATERIALS

Item	Section
Portland Cement Concrete	802
Grouts and Epoxy	806
Epoxy for Spall Repairs	806.02
Hot Applied Joint Sealant Type IV	826.02 A.2
Preformed Elastomeric Compression Joint Seal	826.02 E
Reinforcing Steel, Dowel Bars, and Tie Bars	836
Dowel Bars for Pavement Joints	836.04

Provide aggregate that meets the requirements of Section 802.01 C.4, “Well Graded Aggregate”.

Develop a mix design with a maximum water-cement ratio of 0.40 when placing concrete with a slip form paving machine. Use the water-cement ratio shown in Section 802.01 B.2, “Concrete Class Designation” for all other paving methods.

550.04 CONSTRUCTION REQUIREMENTS

A. General.

Stockpile sufficient aggregate material to produce a minimum of 25 percent of the remaining quantity of concrete.

Do not mix, place, or finish concrete without adequate natural or artificial lighting.

Do not stockpile or mix material on the pavement.

Pad equipment used to handle epoxy coated bars where the equipment is in contact with the bars. Lift bundles of bars with multiple supports or a platform bridge to prevent abrasion in the bundle. Transport bundles without dropping or dragging. Do not expose bars to ultraviolet rays for 60 or more calendar days after fabrication, including the time the bars are placed before concrete placement. If covering the bars, provide ventilation to prevent condensation.

The Engineer will reject bars if damage to the epoxy coating exceeds 2 percent of the surface area of the coated reinforcing bar in any 1 foot length. Repair remaining bars as recommended

by the manufacturer. Remove rust before making repairs. The Engineer will reject bars if the patched area, excluding the cut ends, exceeds 5.0 percent of the surface area.

B. Mix Design

1. General.

Develop a mix design. Perform the tests for the mix design as specified in the *Field Sampling and Testing Manual*. Submit the completed mix design and all test data a minimum of 14 days before beginning paving operations.

During the development of the mix design, develop a maturity curve as specified in ASTM C 1074. The water/cement (w/c) ratio used to develop the maturity curve is the target w/c ratio for the mix. Provide mix with a w/c ratio with a tolerance of 0.01 from the target w/c ratio.

Deliver the samples and the mix design, including the test results, to the Materials and Research Division a minimum of 14 calendar days before beginning paving operations. The same day the material is delivered, notify the Engineer that the samples have been delivered. Provide the Engineer with a copy of the mix design and the test results at the same time they are submitted to the Materials and Research Division.

The Department requires a maximum of 14 calendar days to verify mix designs before the Engineer will allow paving operations to begin. The Engineer will verify the maturity curve on the first day of concrete placement according to ASTM C 1074, as modified in the Field Sampling and Testing Manual.

2. Samples.

The Engineer will verify the mix design. The materials used in the mix design shall be the same as those used on the project. Attach a tag to the samples identifying the Department's project number and type of material.

Supply samples of material based on the minimum sample size specified in Table 550-01. Provide additional material upon request.

Table 550-01
Minimum Mix Design Sample Size

Material	Sample Size
Cement	100 lb
SCM[1]	35 lb
Aggregate	1000 lb
Admixtures	1/2 pint each

[1] If SCM is not part of the mix design, provide 135 lb of cement.

C. Roadbed Condition.

Do not operate mixing equipment or haul material on the finished grade except when the operation of this equipment off the finish grade is impractical due to restricted access.

Place concrete on a smooth, compacted, and moist roadbed. Do not place concrete over standing water or mud.

D. Placing and Spreading Concrete.

1. General.

Do not use materials containing frost or lumps of frozen material.

Do not place concrete on or against frozen ground.

The Engineer will reject loads of concrete with air content outside the limits specified in Section 802.01 H, "Air Content". The Engineer will test each subsequent load of concrete to determine the air content until the concrete is within the limits Placement of concrete will not be allowed until the Engineer has determined the air content is within the limits.

Adjacent concrete may be used as a side form in the following conditions:

- In place for a minimum of 18 hours;
- Saw cuts are complete for the full length of the area to be used as a form; and
- Only foot traffic or light weight power screed are used on the surface.

Construction traffic is allowed on the concrete surface once the concrete has met the requirements of Section 550.04 L, "Opening to Traffic".

If concrete placement is interrupted and it appears that the head of concrete is drying out, cover the unfinished face with wet burlap. Keep the burlap damp.

Remove burlap and plastic sheeting and uniformly blend the concrete with the fresh concrete when resuming placement operations.

Install a transverse joint as specified in Section 550.04 G.4, "Transverse Construction Joints", if 45 minutes elapses between the placement of successive batches or loads.

Use a mechanical spreader for initial strike off and to spread concrete uniformly across the full width of the slab. The Engineer may approve other methods of spreading where a mechanical spreader is not feasible.

The Engineer will allow the use of approved portable vibratory equipment if full width vibratory equipment is not feasible.

Do not over vibrate. Remove and replace areas with excessive surface mortar and segregated material.

Protect the thermocouple wire that the Engineer places into the plastic concrete.

2. Formed Paving.

Securely stake the side forms. Reset forms that are disturbed or show evidence of an unstable foundation.

After staking, recompact the grade with a mechanical tamper at both the inside and outside edges at the base of the forms.

Install forms that do not deviate from the proposed alignment by more than:

- 1/8 inches vertically; and
- 1/2 inches horizontally.

Provide a minimum of two hours before paving to allow the Engineer to inspect the forms.

3. Slip Form Paving.

a. String Line.
Use and maintain a taut string line for operating the automatic equipment controls.

b. Consolidation Vibrator Operation.
Operate internal vibrators within a frequency range of 4,000 to 8,000 vibrations per minute.

Operate surface vibrators within a frequency range of 3,500 to 6,000 vibrations per minute.

Reduce vibrator frequency when forward motion of the paver is reduced and stop vibrators when forward motion of the paver is stopped.

Use a vibrator monitor that records at intervals of 25 feet or 5 minutes, whichever occurs first. Provide both electronic and printed records each day that state:

- time;
- station;
- speed; and
- operating frequency of individual vibrators.

Do not delete the data from the vibratory monitoring system until the records are in their final form and given to the Engineer. The Engineer will allow one of the records to be produced in an office. Provide the original record before taking the data into the office. Provide an electronic record that is a comma or spaces delimited text file, adequate for insertion into a computerized spreadsheet software package.

Provide a written explanation each week that details:

- vibrator setting changes;
- out of tolerance vibratory operations; and
- monitoring device malfunctions.

E. Placing Reinforcing Steel and Tie Bars.

1. General.
Use reinforcing steel and tie bars free of material that could impair the bond between the steel and concrete.

Place the reinforcing steel and tie bars on approved supports a minimum of 2000 feet ahead of the paving operation. On smaller placements, place reinforcement in advance of the pavement as far as practical.

Provide a micro covermeter on projects with over 20,000 square yards of concrete paving for the use of the Engineer to confirm bar locations.

2. Tie Bars.
Position the tie bars within the following tolerances:

- 1 inch vertically; and
- 3 inches transversely.

When installing tie bars in a sawed longitudinal joint, secure the location of the tie bars using tie bar baskets or other approved fixed supports.

Place tie bars used in longitudinal construction joints using one of the following methods:

- Into the side of plastic concrete when using a slip form paver;
- Through holes in the side forms; or
- Using approved two-piece connectors.

If the specified tolerance is not obtained by the insertion of tie bars into the side of the plastic concrete, support the tie bars approved fixed supports or two-piece connectors.

3. Reinforcing Steel.
Place reinforcement for continuously reinforced concrete to within 1 inch of the specified location, both horizontally and vertically. Use plastic, plastic coated, or epoxy coated bar supports to support epoxy coated reinforcing bars. Use plastic coated wire for tying epoxy coated reinforcing bar.

Under the observation of the Engineer, verify the placement of reinforcement in the plastic concrete pavement at the start of paving each day and every 500 feet during paving.

F. Uncontrolled Cracking.
Use any means and methods necessary to saw the joints in the concrete pavement to prevent uncontrolled cracking.

Repair or remove and replace concrete pavement where uncontrolled cracks have occurred. Perform removal and replacement work as specified in Section 570, "Concrete Pavement Repair". If the cracks have occurred due to Contractor operations the repairs will be at no additional cost to the Department.

If the Contractor can provide proof to the satisfaction of the Engineer that the uncontrolled cracking was not the fault of Contractor operations, the Department will pay for the repairs as specified in Section 104.02, "Contract Revisions".

Submit a corrective action plan that details how the uncontrolled cracked area will be repaired or removed and replaced within 7 days after the uncontrolled cracking occurs. Once the corrective action plan is approved, complete the corrective action plan within 30 days. Include in the plan dowel bar assemblies when applicable. Restore any base or subgrade that is damaged during the removal and replacement process at no additional cost to the Department. Restore drainable base by using Class 7 aggregate.

G. Joints.

1. General.

Repair spalls deeper than 1/4 inch by patching with an epoxy mortar. Perform patching when the ambient and pavement temperatures are greater than 40°F.

Clean the spall area. Prime the spall surface with a brush application of epoxy binder. Mix the epoxy binder as recommended by the manufacturer. Insert material in the joint that will not bond to the epoxy to form the faces of the spall patch. Blend dry concrete sand into the mixture to give an epoxy mortar of trowelable consistency. Place and finish the epoxy mortar in the spall area. Place dry concrete sand on the finished epoxy mortar surface. After the epoxy mortar has cured, remove the inserts.

2. Transverse Contraction Joints.

Mark the location of the joints to be sawed or formed on the plastic concrete surface. Saw the joints on mainline and shoulders. On small areas or tapers, create the joints by sawing, inserting preformed inserts, or forming 1 inch deep grooves in the pavement surface.

Stake a metal dowel bar assembly to the roadbed that holds the dowel bars within 1/8 inch of the proposed alignment and elevation. Mark the position of the assembly to locate the transverse joint over the center of the dowel bars. Do not cut the assembly ties running parallel to the dowel bars.

Place dowel bar assemblies a minimum of 2000 feet ahead of the paving operation.

Use dowel bars that have a uniform coat of Tectyl 506 applied by the manufacturer, field applied NLGI Grade #2 multipurpose lithium grease, or an approved equal that has been applied to the full length of the dowel bars.

a. Sawed Joints.

Begin relief sawing as soon as the concrete has hardened sufficiently to permit sawing without raveling or moving of aggregate.

Remove residue from joints immediately after sawing is completed using pressurized water.

If side forms are in place, saw within 1/2 inch of the forms.

If impervious membrane cure has been removed due to sawing or flushing operations during the curing period, reapply cure to the area within 30 minutes of the cure being removed.

b. Formed Joints.

Construct formed joints by installing a pre-formed insert into the plastic concrete before final surface finishing.

Vibrate the inserts into place or install in a groove formed by a vibrating cutter bar. Ensure the inserts top edges are flush with the concrete surface. Correct surface deformations caused by installation of inserts using hand-finishing methods and straight-edge the surface across the joint as specified in Section 550.04 H.1.c,

"Straightedging". Remove inserts, except those designed to remain, without damage to adjacent concrete.

3. **Transverse Expansion Joints.**
Install dowel bar assemblies in the expansion joint. Secure the dowel bars within 1/8 inch of the proposed alignment and elevation with a metal dowel bar assembly device staked to the roadbed. Coat the free half of each dowel with a thin uniform coat of Tectyl 506, NLGI Grade #2 multipurpose lithium grease, or an approved equal. Cover the free half of each dowel with a metal or plastic dowel cap or sleeve after application of release agent. Use caps or sleeves that fit the dowel bars tightly and the closed ends are watertight.

Install preformed expansion joint filler. Connect abutting ends of individual sections of filler without any gap. Pre-punch the filler to fit around the dowels.

Support the preformed filler perpendicular to the pavement surface by one of the following:
- An expansion joint assembly that is staked into the subgrade
- A load transfer assembly or a device designed to remain in the pavement
- A suitable installing bar or header

Protect the top edge of filler with a removable, non-aluminum channel cap that has flanges a minimum of 1.5 inches deep.

Do not place concrete against the joint until the Engineer has approved the installation of the expansion joint assembly.

Maintain equal pressure on both sides of the preformed filler while placing concrete. Vibrate the concrete on each side of the joint.

After the concrete has been finished, remove the protective channel cap and edge the concrete on each side of the joint.

Remove excess concrete that flowed around the ends of the joint.

Seal the expansion joint with a low modulus silicone sealant.

4. **Transverse Construction Joint.**
Install a transverse construction joint at the end of each day's pour and when the time between placement of successive batches or loads of concrete exceeds 45 minutes. Install transverse construction joints halfway between normally spaced transverse joints.

Stake a metal deformed splicer bar assembly to the roadbed that holds the deformed splicer bar within 1/8 inch of the proposed alignment and elevation.

Pave over the assembly far enough to maintain the elevation of the top of the slab. Make a full depth saw cut to expose the deformed splicer bar and install the deformed insert. Dispose of the excess concrete.

On shoulders or urban projects, if the Engineer determines it is not feasible to install a deformed splicer bar basket assembly, form a transverse construction joint by installing a header shaped to conform to the cross-section of the slab. Use a header designed to

accommodate proper placement of dowel bars or reinforcement extending across the joint. Construct a rigid header, secured to prevent bulging or displacement.

Consolidate the concrete adjacent to the header using an internal vibrator or other approved methods. Remove segregated concrete. After the pavement has been finished, edge the surface adjacent to the header.

5. Longitudinal Joints.
Complete sawing of longitudinal joints no more than 7 days after concrete placement. Remove sawing residue by flushing the joint with water.

If impervious membrane cure has been removed due to sawing or flushing operations during the curing period, reapply cure to the area within 30 minutes of the cure being removed.

H. Finishing Concrete.

1. General.

a. Water.
Do not use water to facilitate finishing.

b. Floating.
Use long-handled floats with blades that are at least 5 feet by 6 inches.

c. Straightedging.
Use a 10 foot straightedge parallel to the pavement centerline to reveal any irregularities. Strike off high areas and fill low areas with fresh concrete.

Consolidate the areas corrected and refinish them with a long-handled float. Start the float at the edge of the pavement and slowly move it to the crown and back again to the edge. Only float enough to seal the surface.

Recheck the corrected areas with the 10 foot straightedge.

Dispose of surplus water and laitance on the pavement surface outside the forms.

Overlap successive advances of the straightedge no less than 1/2 the length of the straightedge.

Continue straightedge testing and corrections until the entire surface is free from observable depression below the straightedge.

d. Final Surface Finish.

(1) General.
Uniformly texture the surface by dragging a seamless strip of stiff-fiber artificial grass carpet longitudinally along the full width of the pavement in a single pass.

Use and maintain a taut string line for operating the carpet drag. Attach the leading edge of the carpet drag to a bridge. If the Engineer determines it is not feasible to use a bridge or string line, other texturing methods will be allowed.

Maintain a clean carpet free of encrusted concrete.

Provide a minimum texture depth of 0.031 inches.

(2) Roadways with Speed Limits Less than 45 MPH.
The Engineer will test the texture achieved by the carpet drag in accordance with ASTM E 965 and the Field Sampling and Testing Manual. The Engineer will determine the test location.

If three or more lots have texture depths less than 0.031 inches but greater than or equal to 0.025 inches, perform diamond grinding on those lots.

Perform diamond grinding any lot having a texture depth of less than 0.025 inches.

Perform grinding as specified in Section 550.04 M.4, "Grinding."

The Engineer will determine the limits of any failing test by running additional tests at 100 foot intervals before and after the failing test. The Engineer will determine the location of the additional tests.

(3) Roadways with Speed Limits 45 MPH or Greater.
Run a clean, metal tine longitudinally along the surface immediately following the carpet drag. Exclude areas within 3 inches of the edge of the slab and longitudinal joints. Run the tine continuously across transverse joints.

Use a tine that provides:
- 1/8 inch ±1/64 inch groove width;
- 3/16 inch ±1/16 inch groove depth; and
- 3/4 inch spacing of between grooves.

If the concrete has becomes too stiff to receive the metal tine finish, use diamond bladed equipment to produce the longitudinal grooves.

e. Imprinting Pavement.
Use devices capable of imprinting the numerals between 3 and 4 inches in height and at least 1/4 inch deep. Create impressions after texturing the pavement.

Imprint numbers and markings into the surface:
- 20 inches from the edge of the concrete to the bottom of the number;
- Parallel to centerline; and
- Readable from the outside shoulder.

Imprint survey station numbers at every station that is divisible evenly by 5 (ex. 5+00, 10+00, etc.) and imprint tick marks at 100 foot intervals between the station markings.

Imprint the reference point (RP) number into the pavement at each RP.

Imprint edgedrain outlet locations with a “0” (zero).

On two-way roadways, imprint the station numbers in the direction of stationing.

At the beginning and end of each day’s placement, place the station number to the nearest foot at the right edge of slab.

Imprint the month, day, and year at the beginning and end of each day’s placement. Place these imprints on the opposite edge of the slab from that used for station imprints and so that the numbers can be read in the direction of concrete placement.

2. Additional Requirements for Formed Concrete.

Use machine methods to screed and consolidate the concrete.

If a screeding machine breaks down, discontinue the mixing of concrete until screed machine is operational. The Engineer will allow manual screeding of concrete that was mixed before breakdown.

Simultaneously operate two transverse screeding machines to finish each section of concrete.

Operate the screeding machines at the same speed as the concrete placement operations. Avoid stopping the screeding machines.

The Engineer will allow the use of one screeding machine if concrete is placed at a rate of less than 250 feet per hour. Operate the single screeding machine at least twice over the area.

Ensure concrete or mortar carried ahead of the screeds is not deposited on or adjacent to any joint.

Produce a surface with a uniform texture.

I. Curing Concrete.

1. General.

Apply the final cure within 30 minutes of screeding the concrete. Use wetted fabric cure or an impervious membrane cure. Obtain the Engineer’s approval to change the cure method.

If weather conditions cause rapid drying of the pavement surface, use a fogger to apply a fine mist to the concrete surface for interim curing. Begin fogging immediately behind the tining float. Maintain the fogging to produce a sheen on the surface until the curing is applied. Apply the fog over the entire placement width. Reduce fogging only if excess water accumulates on the surface. Do not apply water with brushes.

Cure concrete pavement for a period of at least 72 hours. Suspend curing when the pavement has attained the minimum strength specified in Section 550.04 L, “Opening to Traffic” for opening pavement to public traffic.

During the curing period, only equipment necessary for curing and for sawing joints will be allowed on the concrete.

If the ambient temperature falls below 40°F, maintain the concrete surface temperature between 40°F and 90°F for the duration of the curing period.

If ASE concrete is used, maintain the surface temperature between 50°F and 90°F.

Conduct heating operations to avoid sudden temperature changes in the concrete. Before removing any enclosures, decrease the concrete's surface temperature to the air temperature at a rate not to exceed 15°F per hour.

The Engineer will suspend paving operations if cure is not properly applied.

If hair cracking develops before placing the curing cover, modify curing procedures to prevent loss of moisture. Cease concrete placing and mixing if hair cracking continues.

Submit a detailed temperature maintenance plan before placing concrete, if the ambient temperature is expected to drop below 40°F.

2. Wetted Fabric Cure.
Cover the concrete pavement with wet mats of cotton, burlap, or geotextile fabric.

Place fabric mats to cover the entire concrete pavement surface. Cover the exposed sides of the concrete pavement after removing forms.

Keep the fabric mats wet continuously during the curing period.

If replacing the mats with impervious membrane, leave the mats in place a minimum of 12 hours.

3. Concrete Curing Compound.
Use a curing compound that meets the requirements of Section 810.01 B.2, "Type 2, Class B".

Apply the cure at a minimum rate of 1 gallon per 150 square feet of pavement in one or two applications. If applying two coats, apply the second application within 30 minutes of the first application.

Protect joints that require sealing from infiltration of the curing compound.

Immediately cover the exposed sides of the concrete pavement with curing compound if removing forms exposes curing concrete before the expiration of the curing period.

Immediately reapply curing compound to damaged areas within the curing period.

J. Removing Forms.
Do not remove forms until the concrete has hardened to the extent that forms can be removed without damage to the concrete.

Before applying curing compound, repair honeycombed areas using freshly mixed mortar. Use mortar having the same proportions of cement and sand as the concrete pavement.

Adjust the placement methods if honeycombing occurs.

K. Sealing Joints.

1. General.
Apply joint sealant to clean and dry joints. Use an air compressor to clean the joints.

Apply joint sealant when the air temperature is 40°F or higher. Seal the joints no more than ten days after placement of concrete and before opening to construction and public traffic.

Fill the joint from the bottom up with sealant.

2. Preformed Elastomeric Compression Joint Seal.
Apply the lubricant-adhesion to the joint groove walls or the preformed joint seal or both. Install the seal between 1/8 inch and 1/4 inch below the pavement surface. Install the seal using machine tools in a manner that prevents curling or twisting in the joint groove. The Engineer will allow the use of hand tools on ramps or locations where machine tools are not practical.

Install the seal with no splices when joints are 30 feet or less in length. Construct joints over 30 feet in length using no more than 2 splices.

Extend the preformed joint seal one inch beyond each edge of the concrete pavement. Do not stretch the preformed joint seal more than 5 percent.

L. Opening to Traffic.
Construction and public traffic will be allowed on newly placed concrete after the joints have been sealed and the concrete has attained a minimum compressive strength of 3,000 psi or a minimum flexural strength of 450 psi.

Pavement placed during development of the maturity curve may be opened to traffic when one of the following criteria has been met:

- the maturity factor of the placed concrete meets or exceeds the initial maturity factor as determined by the strength-maturity curve being developed; or
- at a particular test age, the average strength of the three beams used for development of the strength-maturity curve meets 450 psi.

M. Tolerance in Surface and Ride Quality.

1. General.
The Engineer will use a 10 foot straightedge to determine surface tolerances and ride quality. The Engineer may use the straightedge module in Proval.

2. Roadways with Speed Limits 45 MPH or Greater.
Use diamond grinding equipment to correct high spots of more than 1/8 inch and less than 1/2 inch in 10 feet. Ensure the deviation after grinding is less than 1/8 inch.

If the deviation exceeds 1/2 inch high or low, submit a corrective action plan that includes either grinding or removal and replacement of the pavement. If the corrective action plan contains grinding, the pavement must be ground to within the 1/8 inch tolerance. The Engineer will determine if corrective action will be implemented based on the corrective action plan.

If the corrective action plan is approved and consists of grinding, the Engineer will direct the Contractor to obtain cores in these areas, as specified in Section 550.04 N.1, "Contractor Coring", and will make a determination of the pavement thickness as specified in Section 550.04 N.2, "Determination of Pavement Thickness".

3. **Roadways with Speed Limits Less than 45 MPH.**
Use diamond grinding equipment to correct high spots of more than 1/4 inch and less than 5/8 inch in 10 feet. Ensure the deviation after grinding is less than 1/4 inch.

If the deviation exceeds 5/8 inch high or low, submit a corrective action plan that includes either grinding or removal and replacement of the pavement. If the corrective action plan contains grinding, the pavement must be ground to within the 1/4 inch tolerance. The Engineer will determine if corrective action will be implemented based on the corrective action plan.

If the corrective action plan is approved and consists of grinding, the Engineer will direct the Contractor to obtain cores in these areas, as specified in Section 550.04 N.1, "Contractor Coring", and will make a determination of the pavement thickness as specified in Section 550.04 N.2, "Determination of Pavement Thickness".

4. **Grinding.**
Use equipment that does not cause strain or damage to the underlying surface of the pavement. Do not cause excessive ravels, aggregate fractures, spalling, or disturbance of the joints.

Perform grinding in the longitudinal direction so grinding begins and ends at lines normal to the pavement centerline. Do not overlap more than 2 inches between passes and ensure the depth variance between adjacent passes is less than 1/8 inch. Feather the grinding at the beginning and end of each pass.

Ensure the surface of the ground pavement has a texture consisting of grooves between 0.090 and 0.130 inches wide. Keep the peaks of the ridges approximately 1/32 inch higher than the bottom of the grooves.

Grind high shoulders to provide drainage and safety.

Grind the full width of the lane and daylight grinding on the shoulder by performing a feather pass.

Grind a minimum length of 30 feet. Join grind sections if the distance between grind sections is less than 60 feet.

When grinding in areas with speeds less than 45 MPH, areas with curb and gutter, and areas adjacent to waterways continuously collect all slurry or residue resulting from the

grinding operation. Dispose of the slurry or residue as specified in Section 107.17, "Removed Material".

N. Acceptance.

1. Contractor Coring.

The Engineer will designate locations for obtaining pavement cores a minimum of 28 days after concrete placement. After grinding is complete, obtain one core in each lot under the observation of the Engineer. The Engineer will request additional coring, based on the test results in Sections 550.04 N.2, "Determination of Pavement Thickness" and 550.04 N.3, "Determination of Concrete Strength". Obtain the requested cores at no additional expense to the Department. Fill the core hole with fresh concrete mix and use a vibrator to consolidate the concrete in the holes. Screed the new concrete off and apply curing compound to the new concrete.

The Engineer will take possession of the cores immediately after they are obtained.

A lot is defined as:

- 4,000 square yards of concrete pavement of constant thickness and placement width;
- Fractional areas between 1,000 and 4,000 square yards; and
- Individual ramps, cross-overs, intersections, shoulders, or other irregular areas of pavement not included in the main line.

Fractional areas with less than 1,000 square yards are part of the adjacent lot.

2. Determination of Pavement Thickness.

a. General.

The Engineer will determine the concrete pavement thickness as specified in AASHTO T 148.

When determining the average pavement thickness, the Engineer will record the length of cores that exceed the designed thickness using Table 550-02.

Table 550-02

Excess Core Length	Length Used for Calculations
0.0 to 0.5 inch	Actual core length
Over 0.5 inch	Design thickness plus 0.5 inch

b. Thickness Deficient by less than 0.2 inch.

If the initial core is deficient in length by less than 0.2 inch from the specified pavement thickness, the Engineer will not request additional cores for determining thickness in that lot.

c. Thickness Deficient by 0.2 inch and less than 1.0 inch.

When the initial core is deficient in length by 0.2 inch and less than 1.0 inch, the Engineer will request two additional cores from the lot at intervals separated from each other and from the first core by at least 1/4 the length of the lot.

If neither of the two additional cores is deficient in length 1.0 inch or more, the Engineer will compute the average thickness of that lot of pavement as the average length of the three cores and will process a contract price adjustment as specified in Section 550.06 C, "Thickness Tolerance Contract Price Adjustments".

If either of the additional cores is deficient in length by 1.0 inch or more, Section 550.04 N.2.d, "Thickness Deficient by 1.0 inch or More" will apply.

d. Thickness Deficient by 1.0 inch or More.
When the pavement thickness is deficient by more than 1.0 inch the Department will not pay for the deficient material and the Engineer will determine the serviceability of the deficient area as specified in Section 105.07 A. "Performance of Work". If the Engineer determines that the deficient area is serviceable, the material may remain in place. If the Engineer determines that the deficient area is not serviceable, remove and replace the deficient concrete. The Department will pay for the replacement material, provided it meets the specifications.

When the length of the initial core is deficient by more than 1.0 inch, the Engineer will request exploratory cores at a minimum of 10 foot intervals parallel to the centerline in each direction from the random core until, in each direction, an exploratory core is obtained which is not deficient in length by more than 1.0 inch. The deficient area is the placement width and the length between the midway points of the last two exploratory cores at each end of the deficient area.

The Engineer will calculate the average thickness of the remainder of the lot from at least two additional cores obtained outside the area that is deficient by more than one inch. The Engineer will not use exploratory cores in computing average thickness for determining adjusted unit price.

3. Determination of Concrete Strength.
The Engineer will determine the strength of the in-place concrete by testing the initial core used to determine pavement thickness from each lot. The test will be conducted in accordance with AASHTO T 22.

When the concrete strength does not meet the specified strength, the Department will not pay for the deficient material and the Engineer will determine the serviceability of the deficient area as specified in Section 105.07 A. "Performance of Work". If the Engineer determines that the deficient area is serviceable, the material may remain in place. If the Engineer determines that the deficient area is not serviceable, remove and replace the deficient concrete. The Department will pay for the replacement material, provided it meets the specifications.

If the test shows that the concrete has not met the specified strength, the Engineer will request exploratory cores at a minimum of 10 foot intervals parallel to the centerline in each direction from the random core until, in each direction, an exploratory core is obtained which meets the specified strength. The deficient area is the placement width and the length between the midway points of the last two exploratory cores at each end of the deficient area.

4. **Reinforcing Steel Placement for Continuously Reinforced Concrete Pavement.**
The Engineer will measure vertical location of the reinforcement from the cores taken for determining pavement thickness and strength. The Engineer will determine the depth of the reinforcement below the top surface of the core from the average depth of the exposed steel members on the vertical surface of the core. The Engineer will consider each layer separately where two layers of reinforcement are evident in the core. The Engineer will make all measurements from the top surface of the core to the center of the exposed member, or if the member has been dislodged, to the center of the groove remaining on the vertical surface of the core.

The Engineer will process a contract price adjustment in accordance with Section 550.06 D, "Reinforcing Steel Placement Contract Price Adjustments" if the reinforcing steel is more than 1.0 inch and less than 2.0 inches outside the specified location.

If the vertical location of the reinforcement is 2.0 inches or more outside the specified location or the reinforcement is less than 2.0 inches from the top or bottom of the pavement slab, the Engineer will make a determination of serviceability as specified in Section 105.07 A. "Performance of Work".

The Engineer will not request additional cores for these determinations.

550.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities".

550.06 BASIS OF PAYMENT

A. General

Pay Item	Pay Unit
__IN Reinf Concrete Pavement Cl__	Square Yard
__IN Non-Reinf Concrete Pavement Cl__	Square Yard
__IN Continuous Reinf Concrete Pavement Cl__	Square Yard
__IN Non-Reinf Concrete Pavement Cl__ - Doweled	Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Thickness Tolerance Contract Price Adjustments.
The contract price adjustment for each lot will be determined by multiplying the lot size of by the contract unit price for concrete pavement and the appropriate Contract Price Adjustment Factor in Table 550-05. No price adjustments will be made for lots with a pavement thickness deficient by 0.2 inch or less.

Table 550-05
Pavement Thickness Contract Price Adjustments

Deficiency in Pavement Thickness (Inches)	Contract Price Adjustment Factor
Over 0.2 to 0.3	90%
Over 0.3 to 0.5	80%
Over 0.5 to 0.6	70%
Over 0.6 to 0.7	60%
Over 0.7 to 1.0	50%

The Department will not pay more than the contract unit price for any pavement that has an average thickness in excess of that specified.

C. Reinforcing Steel Placement Contract Price Adjustments.
For continuously reinforced pavements, the Engineer will process a contract price adjustment for each lot of pavement with reinforcing steel that is outside the specified location based by multiplying the lot size by the contract unit price for concrete pavement and the appropriate Contract Price Adjustment Factor in Table 550-06. No price adjustments will be made for lots with reinforcing steel within 1.0 inch of the specified location.

Table 550-06

Deviation from specified location	Contract Price Adjustment Factor
1.0 inch and less than 1.5 inches	10%
1.5 inches and less than 2.0 inches	20%

SECTION 570
CONCRETE PAVEMENT REPAIR

570.01 DESCRIPTION
This work consists of repairing concrete pavement.

570.02 EQUIPMENT

Item	Section
Concrete Equipment	155
Air Compressor	156.01

570.03 MATERIALS

A. General.

Item	Section
Portland Cement Concrete	802
Grouts and Epoxy	806
Impervious Membrane Cure	810.01 B.1
Class 5 Aggregate	816
Joint Materials	826
Deformed and Plain Steel Bars for Concrete Reinforcement	836.02 A
Dowel Bars for Pavement Joints	836.04

B. Concrete for Repairs.

1. **Full Depth Repairs.**
   Use Class AAE concrete with cement that meets the requirements of Section 804.01, "Cement", for full depth repairs.

2. **Spall Repairs.**

   a. **Concrete.**
      Use Class AE concrete with cement that meets the requirements of Section 804.01, "Cement", for spall repairs.

   b. **Grout.**
      Mix equal parts by weight of Portland cement and fine aggregate. Mix with sufficient water to produce a stiff grout.

C. Joint Stitching.

1. **Epoxy Resin.**
   Use an epoxy resin that meets AASHTO M 235, Type I, Grade 3.

   Mix the epoxy resin as specified by the manufacturer.

2. Tie Bars.
Use epoxy coated, Grade 60 tie-bars as specified in Section 836.02 A, "Deformed Bars and Plain Steel Bars for Concrete Reinforcement".

570.04 CONSTRUCTION REQUIREMENTS

A. Concrete Repair.

1. General.
Place forms as specified in Section 550.04 D.2, "Formed Paving" on all exposed edges. The Engineer will allow the use of two inch lumber if repairs are less than 15 feet in length.

Do not use heavy equipment adjacent to concrete in place less than 48 hours.

a. Spall Repair.

(1) General.
Conduct removals by chipping or partial depth milling to remove the deteriorated or delaminated concrete.

If when removing the pavement the Engineer determines the extent of damage requires a full-depth repair, change the repair to full-depth.

Sandblast the patch area. Remove loose particles by air blasting. Direct air blasting operations away from traffic lanes. Evenly apply a thin coat of grout to the cleaned surface. Place the concrete before the grout dries. Sandblast and regrout the patch area if drying occurs.

Place concrete for spall repairs when the air temperature is above 40˚F.

Texture the repair by dragging a carpet of artificial grass longitudinally over the repaired area.

(2) Milling.
Use milling machine that has a device for stopping at preset depths to prevent damage to dowel bars. Chip out spalling created by the milling process.

Taper all sides of the repair 30° to 60° from horizontal.

After the repair has cured, seal the edges of the repair with grout and reapply cure.

(3) Chipping.
Keep sawcuts beyond the patch outline to a minimum and seal sawcuts using a Type IV hot poured sealant.

Remove concrete using a 15 pound chipping hammer with a wide flat bit and hand tools. Cut off and remove reinforcing bars discovered during the removal process.

b. Full Depth Repairs.

Use the lift out method to remove concrete in full depth repair areas with minimal disruption to the subgrade and without damage to the remaining concrete. Do not operate equipment, other than compaction equipment, in areas where concrete has been removed. Fill voids deeper than 1 inch with aggregate and compact the material to the level of the existing subgrade.

Place concrete for repairs less than 100 feet long the same day that removals are initiated. Place concrete for repairs longer than 100 feet within 48 hours of initiating removals. Dampen the faces of existing concrete before placing new concrete.

Place, consolidate, finish, and cure concrete according to the following portions of Section 550.04, "Construction Requirements":

- 550.04 C, "Roadbed Condition";
- 550.04 D, "Placing and Spreading Concrete";
- 550.04 E, "Placing Reinforcing Steel and Tie Bars";
- 550.04 F, "Uncontrolled Cracking";
- 550.04 G, "Joints";
- 550.04 H, "Finishing Concrete", except parts 1.d, "Final Surface Finish" and 1.e, "Imprinting Pavement";
- 550.04 J, "Removing Forms";
- 550.04 K, "Sealing Joints"; and
- 550.04 L, "Opening to Traffic".

Provide finished concrete that is flush with all adjacent pavement surfaces. Before the concrete sets, check the repair utilizing a 10 foot straight edge and correct areas that deviate by 1/8 inch or greater.

Texture the repair by dragging a carpet of artificial grass longitudinally over the repaired area.

If repairs involve multiple lanes, fill the gap between the lane under repair and the existing concrete with cold bituminous material. Remove this material before making the repair to the adjacent lane.

(1) Repairs One Lane Wide.

Use a bond breaker along the centerline joint. Tie bars are not required on repairs that are one lane wide.

When the repair falls in a ramp, restore the longitudinal joints crossing the repair, but do not use tie bars.

(2) Repairs Wider Than One Lane.

Before placing the concrete in the second lane, install 30 inch #5 tie bars in the longitudinal joint using the original tie bar pattern. Drill holes for the bars and secure the bars in the holes using epoxy.

(3) Impervious Membrane Cure.

Use a curing compound that meets the requirements of Section 810.01 B.1, "Type 2".

Apply the cure at a minimum rate of 1 gallon per 150 square feet of pavement in one or two applications. If applying two coats, apply the second application within 30 minutes of the first application.

Protect joints that require sealing from infiltration of the curing compound.

Immediately cover the exposed sides of the concrete pavement with curing compound if removing forms exposes curing concrete before the expiration of the curing period.

Immediately reapply curing compound to damaged areas within the curing period.

2. Non-Reinforced Jointed PCC Pavement Repairs.

a. Concrete Removal.

Make a full depth saw cut along the perimeter of the repair. If using more than one pass, make the final full depth saw cut immediately after the partial depth saw cut.

If fixed joints are not used on the repair, make transverse saw cuts parallel to existing transverse joints. Extend transverse saw cuts only far enough into concrete to remain to ensure a full depth cut of the repair area, and seal the cut using a Type IV hot poured sealant.

Remove concrete within 48 hours of the transverse sawing.

b. Work Sequence.

Use the following work sequence after removing the concrete:

1) Perform subgrade repair, full depth concrete pavement repair, and partial depth spall repair.
2) Retrofit dowel bars, as specified in Section 575, “Dowel Bar Retrofit”.
3) Perform joint stitching.
4) Perform grinding.
   a) 12 foot driving lane
   b) 3 foot transitions in passing lane and outside shoulder
5) Clean and seal:
   a) Transvers Joints
   b) Random Cracks
   c) Logitudinal Joints
   d) 10 Foot Shoulder Joints

c. Dowel Bars.

Drill 1-3/8 inch diameter holes using a rigid frame-mounted drill. Clean the hole, inject epoxy into the hole, and insert dowels.

Lightly coat the free end of each smooth dowel with grease, of the type specified in Section 550.04 G.2, ”Transverse Contraction Joints”.

d. Transverse Joint Sealing at Full-Depth Repairs.
Seal smooth doweled transverse joints at full-depth repairs as specified in Section 550.04 G, "Joints".

Traffic is allowed on the new pavement from the end of the curing period to the beginning of the joint sealing.

Seal fixed transverse joints at full-depth repairs as specified in Section 550.04 G, "Joints". Use the sealant specified in Section 826.02 A.1, "Type I". Shape the reservoir to 3/8 inch wide by 1 inch deep.

e. Longitudinal Joint Sealing.
Shape the longitudinal joint reservoir 1/4 inches wide by 3/4 inches deep in areas of full depth repairs. Seal joints as specified in Section 550.04 G, "Joints", using a Type IV hot poured joint sealant.

f. Opening to Traffic.
Section 550.04 L, "Opening to Traffic" applies to this section.

3. Continuously Reinforced PCC Pavement Repairs.

a. Concrete Removal.
Sawcut the edges of the repair with a diamond blade.

Leave the edges free from frays or spalls on the pavement surface.

If existing reinforcing steel is damaged or bent within the 18 inch lap area, replace the damaged reinforcing steel.

Use a hammer that is 35 pounds or smaller in areas within 24 inches of the saw cut line.

b. Full-Width, Full-Depth Repairs.
If both lanes are to be repaired, utilize the following order of operations when constructing the first lane:

- Connect longitudinal rebars with mechanical splices, meeting the requirements specified in ACI Building Code for Reinforced Concrete, Chapter 12.14.3.4.
- Use Class ASE concrete.
- Place concrete between 4 p.m. and 8 p.m. Tie one rebar end and tie the other end less than 20 minutes before placing concrete.

B. Stitching.
Do not install bars within 9 inches of existing transverse joints. Install the tie bars the same day the holes are drilled.

1. Drilling.
Use hydraulic percussive type drills to make the holes. Mount the drills on a rigid frame.

2. Epoxy.
Clean the holes before injecting the epoxy resin. Inject the epoxy in the bottom of the hole. Ensure the epoxy is level with the top of the pavement after bar insertion.

3. **Tie Bars.**
   Rotate the tie bars 180 degrees to 360 degrees during the insertion.

C. Grinding.

Allow new concrete and dowel bar retrofit patch material to cure for a minimum of 24 hours before grinding.

1. **Grinding Depth.**
   Provide a uniform texture over the pavement surface. Remove a minimum of 1/16 inch of pavement at all locations except at culverts, dips, or other conditions. The Engineer will not require extra depth grinding to eliminate minor depressions in order to provide surface texture.

2. **Grinding Direction.**
   Perform grinding parallel to the centerline. Begin and end grinding at lines perpendicular to the pavement centerline within any one ground area.

3. **Texture.**
   Grind to a texture consisting of grooves between 0.090 and 0.130 inches wide. Distance between grooves shall be between 0.060 and 0.125 inches. Peaks of ridges shall be approximately 1/16 inch higher than the bottom of the grooves. Maintain the existing cross slope. Do not leave the area ground smooth or polished.

4. **Transitions.**
   Provide positive drainage by transitioning auxiliary or ramp lane grinding from the mainline edge.

5. **Slope.**
   Excluding longitudinal joints, provide a uniform transverse slope on the pavement surface with no more than 1/4 inch deviation in 10 feet when measured using a 10 foot long straightedge.

6. **Slurry Removal.**
   Continuously collect all slurry or residue resulting from the grinding operation.

   In areas with speed limits of 45 mph or less and in areas with curb and gutter, dispose of slurry as specified in Section 107.17, “Removed Material”.

   In areas with speeds greater than 45 mph and without curb and gutter, slurry may be place on the foreslope of the roadway. Prevent slurry from entering pipes, culverts, storm drains, ravines, streams, waterways, wetlands, and all other water conveyances. Install erosion control features as necessary to prevent contamination, or dispose of slurry as specified in Section 107.17, “Removed Material”.

D. Ride Quality.

1. **General.**
   The Engineer will use a 10 foot straightedge to determine surface tolerances and ride quality. The Engineer may use the straightedge module in Proval.

2. **Straight Edge Method Roadways with Speed Limits 45 MPH or Greater.**
Use diamond grinding equipment to correct high spots of more than 1/8 inch and less than 1/2 inch in 10 feet. Ensure the deviation after grinding is less than 1/8 inch.

If the deviation exceeds 1/2 inch high or low, submit a corrective action plan that includes either grinding or removal and replacement of the pavement. If the corrective action plan contains grinding, the pavement must be ground to within the 1/8 inch tolerance. The Engineer will determine if corrective action will be implemented based on the corrective action plan.

3. **Roadways with Speed Limits Less than 45 MPH.**
Use diamond grinding equipment to correct high spots of more than 1/4 inch and less than 5/8 inch in 10 feet. Ensure the deviation after grinding is less than 1/4 inch.

If the deviation exceeds 5/8 inch high or low, submit a corrective action plan that includes either grinding or removal and replacement of the pavement. If the corrective action plan contains grinding, the pavement must be ground to within the 1/4 inch tolerance. The Engineer will determine if corrective action will be implemented based on the corrective action plan.

E. Joints.

1. **Transverse Joint Cleaning and Sealing.**
Clean and reseal the portion of the transverse joint that were ground.

Remove foreign material from vertical edges of the joint. Clean the joint using compressed air removing any incompressible material.

Install backer rod before applying the silicon sealant.

2. **Longitudinal Joint Cleaning and Sealing.**
Remove existing sealant, sandblast, and clean the joint. Fill the joint with Type IV hot pour.

3. **Random PCC Crack Cleaning and Sealing.**
Remove existing sealant, sandblast, and clean the joint. Fill the joint with Type IV hot pour.

570.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, “Measurement of Quantities”, and as follows:

A. Spall Repair.
If the Engineer requires a spall repair to change to a full-depth repair as specified in Section 570.04 A.1.a.(1), “General”, the Engineer will measure the entire area as full-depth repair and in addition the Engineer will measure half of the area as spall repair.

B. Stitching.
The Engineer will measure each tie bar installed as “Epoxy Coated Deformed Bars”.

C. Full-Depth Repair - End Preparation.
For full depth repairs on continuously reinforce concrete pavement, the Engineer will measure each end of the repair sections as “Full Depth Repair-End Preparation”.

D. Full-Depth Repair - End Prep-Mech Splice.
The Engineer will measure each end of the repair section that requries mechanical splices as "Full-Depth Repair - End Prep-Mech Splice".

E. Full-Depth Doweled.
Include the cost of the end dowel bars in the contract unit price "___-Inch Concrete Pavement Repair – Full-Depth Doweled". The cost for intermediate dowel bar assemblies is paid by "Doweled Contraction Joint Assembly".

570.06 BASIS OF PAYMENT

Pay Item	Pay Unit
PCC Pavement Grinding	Square Yard
Doweled Contraction Joint Assembly	Linear Foot
Full-Depth Repair - End Prep - Mech Splice	Each
Full-Depth Repair - End Preparation	Each
__-Inch Concrete Pavement Repair - Full-Depth Doweled	Square Yard
__-Inch Concrete Pavement Repair - Full-Depth Continuous	Square Yard
Longitudinal PCC Joint Cleaning & Sealing	Linear Foot
Transverse PCC Joint Cleaning & Sealing	Linear Foot
Random PCC Crack Cleaning & Sealing	Linear Foot
Spall Repair – Partial Depth	Square Foot
Epoxy Coated Deformed Bars	Each

Such payment is full compensation for furnishing all materials, earthwork, equipment, labor, and incidentals to complete the work as specified.

SECTION 575
DOWEL BAR RETROFIT

575.01 DESCRIPTION
This work consists of performing a dowel bar retrofit in concrete pavement.

575.02 EQUIPMENT

Item	Section
Concrete Equipment	155
Air Compressor	156.01

Use a gang saw capable of sawing all required slots on a transverse joint or crack in the wheel paths of a single lane of the pavement simultaneously. The gang saw should be able to cut the slots parallel to the direction of traffic flow and parallel to one another.

575.03 MATERIALS

Item	Section
Portland Cement Concrete	802
Grouts and Epoxy	806
Class 5 Aggregate	816
Joint Materials	826
Reinforcing Steel	836.02
Dowel Bars	836.04

A. Patching Material Mix Design.
Mix and place the patching material as specified by the manufacturer.

Select one of the following patching materials:
- Five Star Highway Patch;
- Burke 928 Fast Patch;
- American Highway Technology's dowel bar retrofit mortar; or
- An approved equal.

A minimum of 5 working days before beginning dowel bar retrofit work, submit the manufacturer's product literature and a concrete mix design for the patching material that meets a minimum compressive strength of 4,000 psi in 6 hours. Include all additives and materials to be used in the mix design.

B. Dowel Bars.
Use dowel bars with tight fitting end caps made of nonmetallic materials that allow for 1/4 inch movement of the bar at each end. Submit sample end caps to the Engineer before use.

Use support chairs that are non-metallic or that are epoxy coated as specified in ASTM A 775.

C. Caulk.
Use a caulk for the crack at the bottom and sides of the slot that is compatible with the patch material being used.

D. Foam Core Board.
Use foam core board constructed of closed cell foam faced with poster board material or laminate on each side.

E. Curing Compound.
Use a wax-based liquid membrane-forming curing compound as specified in ASTM C 309 that conforms to the requirements of Type 2, Class A or B.

575.04 CONSTRUCTION REQUIREMENTS

A. Jack Hammers.
If using jack hammers, use 30 pound class or smaller jack hammers.

B. Cleaning.
Sandblast exposed surfaces and cracks in the slot. Clean the slot of saw slurry and deleterious material before installing the dowel.

C. Joint Caulking.
Caulk the existing transverse joint crack at the bottom and sides of the slot to provide a tight fit for the foam core board and prevent patch mix from entering the crack. Do not extend the sealant on the face of the slot more than 3/8 inch of each side of the existing transverse joint crack.

D. Dowel Bar Placement.
Place the dowel bar, parallel to the centerline, and parallel to pavement surface of the lower panel at the transverse joint, to a tolerance of 1/4 inch.

Center the dowel bar above the existing joint within a tolerance of one inch.

E. Mixing Patch Material.
Mix the patch material with a hand mixer. Do not use a mobile mixer. Add water using a metering or measuring device. Produce patch mix of uniform texture and consistency.

Produce a test batch a minimum of 1 working day before production of patch material begins. Use the same materials and equipment that will be used during production. The Engineer will produce cylinders and verify the compressive strength of the material before allowing full production.

The Engineer will test the patching material for compressive strength once for each four hours of production.

If compressive strengths are not being met, cease production and resubmit a mix design correcting the strength problems.

F. Slot Surface Preparation.
Place the patch mix on a dampened concrete surface and ensure there is no ponding in the bottom of the slot.

G. Placing Patch Mix.
Place the patch mix into the slot and vibrate it with a small hand-held vibrator. Prevent material from entering the joint surrounding the slots. Completely fill up the slots, including the area under the bar.

H. Curing.
Place curing compound on a set of dowel bar retrofits in single wheel path no more than 30 seconds after the retrofits have been finished.

I. Opening to Traffic.
Before opening the repaired lane to traffic, perform grinding as specified in Section 570.04 C, "Grinding".

575.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities", and as follows:

The Engineer will measure each dowel bar installed as "Dowel Bar Retrofit".

Grinding will be measured as specified in Section 570.05, "Method of Measurement".

575.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Dowel Bar Retrofit	Each

Such payment is full compensation for furnishing all materials, earthwork, equipment, labor, and incidentals to complete the work as specified.

Grinding will be paid for as specified in Section 570.06, "Basis of Payment".

SECTION 602
CONCRETE STRUCTURES

602.01 DESCRIPTION
This work consists of the construction of bridges, cast-in-place box culverts, and cast-in-place retaining walls.

602.02 EQUIPMENT

A. General.
Do not use aluminum tremies, forms, hoppers, downspouts, or chutes.

Use a batch plant and equipment as specified in Section 155, "Concrete Equipment".

B. Deck Finishing Equipment.
Use a deck finishing machine as specified in Section 155.07 C, "Bridge Deck Finishing Equipment".

C. Sandblasting Equipment.
Use compressed air type sandblasting equipment to clean concrete surfaces.

D. Water-Washing Equipment.
Use water washing equipment that meets the requirements of one of the following:
- A water pressure washer with a minimum of 160°F water at 1,800 psi minimum nozzle pressure;
- A hydroblast washer using water at 7,000 psi minimum nozzle pressure; or
- A steam cleaning unit using a minimum of 320°F water at 305 psi minimum operating pressure.

E. Curing Concrete.
Use a fogging machine as specified in Section 156.02, "Fogger" for exposed surfaces.

F. Shot Blasting Equipment.
Use centrifugal or wheel type shot blasting equipment that is designed to clean concrete surfaces and leave no oil or other foreign material on concrete surfaces. Use a shot blaster capable of collecting blast media and dust.

602.03 MATERIALS

A. General.

Item	Section
Portland Cement Concrete	802
Epoxy Resin Adhesives	806.02
Burlap Cloth	810.01 A
Penetrating Water Repellent	822
Preformed Expansion Joint Fillers	826.02 C, D, or F
Selant	826.02 B.1

B. Waterproof Membrane.
Provide self-adhesive black polyethylene membrane that meets the following requirements:
- Has sheeting with a minimum thickness of 0.004 inch; and
- Has rubberized asphalt coating with a minimum thickness of 0.056 inch.

602.04 CONSTRUCTION REQUIREMENTS

A. Falsework.

1. Design and Construction.
Design, construct, and maintain structurally adequate falsework. Do not adjust falsework after the concrete reaches its initial set.

2. Removal of Falsework.
Leave supporting wedges and falsework in place for 14 days or until the concrete has reached 70 percent of the design strength.

Remove all falsework. Uniformly lower the falsework to avoid excessive stresses in any part of the structure.

Backfill and compact all open excavations resulting from the construction and removal of falsework as specified in Section 210, "Structural and Channel Excavation, Foundation Fill and Preparation" with approved material at no additional cost to the Department.

B. Forms.

1. Design and Construction.
Design, construct, and maintain forms. Use forms that are clean and in good condition. Construct the forms to be mortar tight and to have a smooth surface.

Use forms that are impervious to water when using tubes for column forms or to produce voids.

Use deck forms that have adjustable positive risers.

Perform initial adjustments to the deck form risers after all beams are in place. Perform final adjustments to the deck form risers after placing reinforcement.

Form a 3/4 inch chamfer at all permanently exposed corners of the structure.

Before placing concrete, treat forms with a form release agent that will not adhere to or discolor the concrete. Do not allow the release agent to come in contact with the reinforcing steel.

Use steel or fiberglass form ties. Only use steel ties that are entirely removable, or removable to a depth of at least one inch below the finished concrete surface. Fill marks caused by steel form ties with grout meeting the requirements of Section 806.01, "Rapid-Hardening Cementitious Materials". Grind all fiberglass breakoffs flush with the concrete surface. Do not use wire ties.

If the bottom of the forms are inaccessible, provide temporary openings for cleaning out all extraneous material before placing concrete.

a. Wood Forms.
For exposed surfaces construct forms using dressed lumber of uniform thickness lined with smooth sheathing. Plywood shall be of maximum sizes that can be cut from standard size sheets. The Engineer will allow use of undressed lumber forms for unexposed surfaces.

b. Steel Forms.
Use steel forms that are free from rust, grease, and substances that may discolor the concrete.

2. Removal of Forms.
Leave deck slab forms in place for a minimum of 14 days and a maximum of 28 days after concrete is placed. Leave forms other than deck slab forms in place until the 7 day or 10 day curing period is complete.

C. Placing Concrete.

1. Placement.

a. General.
After all preparations are complete, notify the Engineer a minimum of 24 hours before placing concrete.

Remove deleterious material inside the form area, before placing concrete. Do not place concrete on or against frozen ground. Remove struts, stays, and braces used to temporarily hold forms in correct shape and alignment when fresh concrete reaches the elevation that makes them unnecessary.

Place and consolidate concrete without causing segregation of the aggregates. Place concrete in continuous horizontal layers. Place subsequent layers of concrete before the preceding layer attains initial set. Place concrete as close to the final position as possible.

If the placement location or the dimensions of the forms prevent the use of chutes or tremies and concrete must be placed with a free fall greater than 5 feet, use placement methods that prevent segregation of the concrete.

If necessary, extend open chutes down inside the forms or through holes left in the forms. Arrange chutes to avoid steep slopes. When steep slopes are necessary, terminate the chutes into a hopper with a vertical downspout or equip the chutes with baffle boards made in short lengths that alter the direction of movement of the concrete.

Keep tremies full of concrete during placement. Keep the lower end of the tremie buried in the concrete throughout the pour.

When placing concrete in caisson foundations, bury the lower end of the tremie at least 5 feet in the concrete throughout the pour.

The Engineer will allow concrete to be pumped from the mixer or the truck to the point of deposit in the forms. When pumping deck concrete use a 90 degree elbow with a minimum of 10 feet of flexible conduit placed horizontally. Use one of the following configurations at the discharge end in other locations:

- An S-shaped configuration or
- A 90 degree elbow with a minimum of 10 feet of flexible conduit placed horizontally.

b. Foundations and Substructures.

(1) General.

Use a wooden template to strike off unformed upper surfaces. Force the coarse aggregate below the surface. Work the surface with a wooden or cork float to obtain a fine-grained, smooth texture. Do not use mortar topping or water to facilitate finishing.

(2) Column or Wall Placement.

Place concrete in one continuous operation.

Allow the concrete to reach 70 percent of design strength, determined from cylinder breaks, before placing pier cap reinforcing and concrete.

(3) Foundation Seal Concrete.

The Engineer may allow placement of foundation seal concrete. Submit work drawings that include buoyancy calculations. The Engineer will determine if the designed piling can support the additional weight.

If the placement of foundation seal concrete is allowed, place the concrete as follows:

- In a manner so the water remains still during placement and curing;
- With cement content 10 percent greater than normally required for the class of concrete specified;
- With a method that prevents segregation;
- Continuously from start to finish;
- Keeping the surface of the concrete horizontal; and
- Without manipulating the concrete during placement.

Remove all concrete that interferes with clearance required for reinforcing steel placement for the permanent structure.

c. Deck Placement.

Do not place deck concrete until all the previously placed substructure concrete is at least 14 days old or has reached 70 percent of the design strength based on cylinder breaks.

Build the deck to the designated thickness. Make the required adjustments in deck elevation and riser dimensions to accommodate the variations in the camber of beams and girders.

Before concrete placement, move the finishing machine across the rails to check and adjust the screed to ensure proper cross slope, concrete deck thickness and cover over the reinforcing steel.

If concrete placement is to occur after an interim or final completion date in the contract, consult with the Engineer and the Department's Bridge Division to determine a course of action to complete the work.

Do not start placing concrete if inclement weather is anticipated at any time during the concrete pour up until the time of initial set.

Carry a uniform quantity of concrete in front of the screed for its entire length.

Place deck concrete between designed construction joints in one continuous operation and at a minimum rate of 25 cubic yards per hour. Place concrete curbs and rails in one continuous operation.

If an emergency occurs in which the concrete placement operations are stopped with the approval of the Engineer, install a keyed transverse construction joint at a location determined by the Engineer. Remove all concrete beyond the joint. If corrective measures are not feasible and the deck is not within the specified tolerances, remove the unacceptable work. Allow the concrete to cure for a minimum of 72 hours before continuing concrete placement.

2. **Vibration.**
Consolidate the concrete using an internal or external vibrator. Ensure the vibration does not displace reinforcing steel or forms. Vibrate for a sufficient duration and intensity to thoroughly consolidate the concrete without causing segregation.

Use vibrators capable of visibly affecting the concrete mixture a distance of at least 18 inches from the vibrator.

Do not apply vibration directly to reinforcement that extends into non-plastic sections or layers of concrete. Do not use vibrators for moving concrete in the forms.

3. **Removal of Excess Mortar.**
Keep reinforcing steel and surfaces of forms free from accumulations of mortar from previously placed concrete. Clean reinforcing steel without damaging or breaking the concrete-steel bond at and near the surface of the previously placed concrete. Keep surfaces of previously placed concrete clean.

4. **Weather Limitations.**
Obtain the Engineer's approval to place concrete if the air temperature is expected to fall below 40°F during the curing period specified in Section 602.04 F, "Curing Concrete". Submit a written request that includes provisions for maintaining the required curing temperatures. The Engineer's acceptance of the written request does not relieve the Contractor of the obligation to remove and replace concrete that is damaged due to not maintaining concrete temperature within the required range during the curing period.

D. Deck and Bridge Approach Slab Finishing.

1. General.

Do not use water to facilitate finishing.

If approach slabs are constructed and no deck or deck overlay is constructed with the approach slabs, finish approach slabs as specified in Section 602.04 D.2 "Approach Slab Tining".

If either a deck or deck overlay is constructed with or without approach slabs, finish the deck and approach slabs as specified in Section 602.04 D.3, "Deck and Approach Slab Grooving".

2. Approach Slab Tining

Run a clean metal tine longitudinally along the approach slab. Begin tining 6 inches from the beginning and ending of the approach slab. Stop tining 24 inches from the face of barrier and curb. The tine may be hand-operated. Use a tine that provides grooves that are 1/8 inch in width (±1/64 inch) and 1/8 inch in depth (±1/64 inch) with a center to center spacing of 3/4 inch.

3. Deck and Approach Slab Grooving.

After curing is complete and any corrective action is taken for surface tolerance, perform grooving by cutting longitudinal grooves into the deck and approach slabs using a mechanical cutting device.

Cut grooves that are 1/8 inch in width (±1/64 inch) and 1/8 inch in depth (±1/64 inch) with a center to center spacing of 3/4 inch.

Begin grooving 6 inches from the beginning and ending of the deck, approach slabs, and expansion joints. Stop grooving 24 inches from the face of barrier and curb.

E. Surface Tolerances.

After the concrete has cured, the Engineer will test the bridge deck, approach slabs, and adjacent pavement, if applicable, for surface irregularities with a 10 foot straightedge.

The Engineer will check the profile using a 10 foot straightedge oriented in the longitudinal direction and starting at one end of the deck, move the straightedge transversely across the deck to the other edge with constant contact with the deck. Repeat this process in 5 foot intervals from one end of the deck to the other. Check the cross slope using the 10 foot straightedge oriented in the transverse direction and starting at one end of the deck, move the straightedge longitudinally from one end of the deck to the other end with constant contact with the deck. Repeat this process in 5 foot intervals from one side of the deck to the other.

Grind areas with a deviation greater than 1/8 inch, but less than or equal to 1/2 inch, until the deviation is 1/8 inch or less. The Engineer will apply a contract price reduction as specified in Section 602.06 B, "Surface Tolerance".

The Engineer will make a serviceability determination as specified in Section 105.07, "Conformance with the Contract Requirements" for any deviations greater than 1/2 inch.

F. Curing Concrete.

1. General.

Maintain the concrete surface temperature between 40°F and 90°F for the duration of the curing period.

Use a curing period of at least seven days. Use a curing period of at least ten days if using pozzolans to replace greater than 10 percent of the cement used in the mix.

Cure all surfaces not covered by forms with a double thickness of burlap. Keep the burlap continuously moist until the end of the curing period. Do not use a waterproof material to cover the wet burlap during the curing period.

If the concrete is exposed to air temperatures lower than 40°F on any day, extend the curing period by the number of days the concrete is exposed to these low temperatures.

If concrete is exposed to air temperatures below freezing during the curing period, the Engineer and Department's Bridge Division will perform an evaluation of the in place concrete to determine serviceability. The results of the evaluation may require remedial action or removal of the affected material or structural element.

If enclosures are used, heat the enclosure with an electric heater or properly vented combustible heater. Before removing the enclosure, decrease the concrete's surface temperature to the air temperature at a rate not to exceed 15°F per hour.

2. Deck and Approach Slab Concrete.

Cover deck concrete with a double thickness of burlap placed within 15 minutes of the passing of the finishing machine.

Use a work bridge to place the burlap without marring the surface. Pre-wet burlap prior to placing on the deck or approach slab.

A light fog spray may be used after finishing to moisten the concrete surface after finishing to prevent the surface from drying before placement of the wet cure. Keep the burlap continuously moist at all times.

Do not perform work and do not allow vehicles and equipment on the deck or approach slabs during the curing process.

G. Barriers.

1. General.

Perform corrective actions on any surface that deviates by 3/8 inches or more when measured with a 10 foot straightedge. Make corrections by grinding, filling with an approved epoxy mortar, or replacing.

Except at expansion joints, construct V-grooves that are 3/4 inch wide and 3/4 inch deep in all faces of the barriers at each pier and at equal spaces between piers and abutments at approximately 10 foot spacing.

2. Conventional Forming.
Adequately tie forms to avoid any shifting during concrete placement.

If concrete inserts in the deck slab are holding the barrier forms in place, remove the inserts. Clean and fill the cavities flush with the deck slab using an epoxy resin adhesive.

3. Slipforming.
Conventional form a minimum distance of 4 feet on each side of expansion joints before slip forming.

After the reinforcement is installed, check the clear distance between the reinforcement and the slipform for the entire length of the pour.

The Engineer will allow slab overhang distance to be increased up to 1 inch provided the specified gutter line is maintained.

The Engineer will allow a radius to be used instead of a bevel on all edges of the barrier.

H. Construction Joints.
Clean the existing concrete surface and steel of all rust scale, oil, concrete lattice, dirt, and other deleterious material. Paint the existing concrete surface with a bonding grout that is equal parts cement and sand.

Apply the bonding grout to a dry surface. Control placement of the grout so it does not dry before concrete placement.

I. Surface Finish.

1. Surface Finish A.
Use surface finish A on formed concrete surfaces.

Within 24 hours after form removal, remove all fins and irregular projections from surfaces that are to receive surface finish C or D or to be waterproofed.

Remove form ties to a minimum depth of 1 inch.

Repair sand pockets, honeycombed areas, cavities resulting from form ties, and other holes as follows:

- Clean the repair area;
- Saturate with water;
- Fill with mortar that is less than one hour old and made of one part cement and two parts fine sand; and
- Compact the mortar to fill all voids.

2. Surface Finish B.
Use surface finish B on all unformed upper surfaces at the time of concrete placement.

Use a wooden template to strike off unformed upper surfaces not including floors, curbs, or sidewalks. Force the coarse aggregate below the surface. Work the surface with a wooden or cork float to obtain a fine-grained, smooth texture. Do not use mortar topping.

3. Surface Finish C.

Use surface finish C on all surfaces of concrete visible to the public unless surface finish D is specified in the Plans.

Produce a surface that is uniform in texture and appearance and free of imperfections.

After completion of surface finish A or B immediately:

- Saturate the surface with water;
- Using a small quantity of mortar, rub surfaces with a medium coarse silicon carbide stone or mechanical finisher. Mix the mortar using cement and fine sand and water mixed in the proportions used in the concrete being finished;
- Rub until form marks and imperfections are removed and the surface is smooth
- Do not expose the coarse aggregate;
- Rub patches after they set without delaying the rubbing of the remainder of the surface; and
- Spread or brush the paste produced by rubbing uniformly over the surface and allow it to set.

Perform the final rubbing after the curing period has expired and after all concrete above the surface being finished has been cast. Produce the final surface finish by rubbing the concrete with water and a fine silicon carbide stone. Continue rubbing until the surface has a smooth texture and is uniform in color and appearance.

4. Surface Finish D.

Use surface finish D on all surfaces designated in the Plans.

After achieving surface finish A or B and after the curing period has ended, roughen the surface by sandblasting.

Use a commercially packaged cement based masonry coating material. Place one or more coatings using the rates and application methods specified by the manufacturer.

Finish the surface with a uniform texture, color, and appearance free from fins, projections, cavities, and porous spots.

J. Penetrating Water Repellent Treatment.

Apply the penetrating water repellent after the following conditions are met:

- The concrete bridge deck and approach slab have been in place for 21 days;
- Grooving has been completed;
- Bridge deck barriers and curbs are placed;
- All surface finishes are complete; and
- Silicone sealant is applied to the joint where the deck and barriers meet.

Apply penetrating water repellent solution to the following surfaces:

- Top of bridge deck;
- Top of approach slabs;
- Front face and top of medians;
- Front face and top of curbs and walls;
- Front face and top of barriers; and

- Top of abutment and pier cap bearing surfaces.

Clean all surfaces receiving treatment using either sandblasting, shot blasting, or water-washing equipment. Remove dirt, dust, grease, oil, laitance, asphalt, or other materials that may inhibit the coverage and penetration of the solution. Use hand tools or solvents approved by the penetrating water repellent manufacturer to remove any bonded foreign materials. Do not remove or alter the existing surface finish or expose the coarse aggregate.

Allow any wet concrete surfaces to dry a minimum of 48 hours or longer if required by the manufacturer.

Apply the penetrating water repellent when the following conditions are met:

- The air temperature is within the following:
  - 40 °F and rising; or
  - 95 °F and falling;
- Wind is less than 25 mph; and
- Rain is not expected within 4 hours.

Use airless equipment that has a pressure range between 15 to 40 psi and apply the penetrating water repellent uniformly to the surface. Use the manufacturer's recommended rate or 200 sf per gallon, whichever is less. Squeegee or broom excess material to avoid ponding.

K. Waterproof Membrane.

1. General.
When shown in the plans, apply membrane and primer to surfaces that are dry, clean, free of sharp protrusions and when the air temperature is above 40°F.

2. Primer.
Prime the surface according to the manufacturer's recommendation and at the recommended rate.

3. Membrane Installation.
Roll membrane on to surfaces within 36 hours of the surface being primed. Keep the membrane free of wrinkles and bubbles.

Lap joints a minimum of 2.5 inches. Seal the joints and exposed edges with a joint sealing mastic recommended by the manufacturer of the membrane.

L. Anchor Bolts.
Place anchor bolts directly into plastic concrete or secure them in preformed or drilled holes using an epoxy resin adhesive.

M. Bearings Surfaces.
Set bearings within 0.01 feet of the specified elevation. If necessary, finish bearing areas to a true plane and elevation by grinding. If bearing elevation is too low, contact the Engineer of Record for recommendations and approval. Perform bearing elevation adjustments at no additional cost to the Department.

Clean and lubricate the sliding surfaces of expansion bearings.

N. Opening to Traffic.
Do not operate construction equipment on the structure until the concrete has reached 70 percent of its design strength, based on concrete cylinder breaks. After the concrete has achieved 70 percent of its design strength and before it reaches full design strength, limit the weight of each piece of construction equipment to 14,000 pounds gross vehicle weight.

Do not allow public traffic on the structure until the concrete has reached its full design strength.

602.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place as specified in Section 109.01, "Measurement of Quantities" and as follows:

The plan quantity of concrete will be used for measurement and payment.

602.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Class _____ Concrete	Cubic Yard
Class _____ Box Culvert	Cubic Yard
Concrete Bridge Approach Slab	Square Yard
Jersey Barrier Formed or Slip Formed	Linear Foot

A. General.
Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Surface Tolerance.
The Engineer will process a contract price adjustment for deck concrete based on the surface tolerance measurements determined in Section 602.04 E, "Surface Tolerances". The amount of the contract price adjustment will be determined by multiplying the contract unit price for "Class AAE-3 Concrete" by the total area that is ground to meet tolerance, measured in square yards, and the appropriate Contract Price Reduction Factor in Table 602-01.

Table 602-01

Deviation	Contract Price Reduction Factor
> 1/8 inch and ≤ 1/4 inch	**2.5%**
> 1/4 inch and ≤ 1/2 inch	**7.5%**

Table 602-01

Deviation	Contract Price Reduction Factor
> 1/8 inch and ≤ 1/4 inch	2.5%
> 1/4 inch and ≤ 1/2 inch	7.5%

SECTION 604
PRESTRESSED CONCRETE BEAMS

604.01 DESCRIPTION
This work consists of furnishing required materials and fabricating, transporting, erecting, finishing, and prestressed concrete beams.

604.02 EQUIPMENT
Use a plant and equipment as specified in Section 155, "Concrete Equipment". The Engineer may grant written permission to use other types of concrete mixers.

604.03 MATERIALS

A. General.

Item	Section
Portland Cement Concrete	802
Deformed Steel Bars for Concrete Reinforcement	836.02 A
Steel Welded Wire Reinforcement, Plain, for Concrete	836.03 B
Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement	836.03 E

Use the same brand and grade of cement and admixture for all beams in any one bridge structure.

B. Concrete Mix Design.

1. General.
Develop a mix design that produces concrete that will achieve a minimum compressive strength of 5,000 psi within 28 days.

Modify Section 802.01 H, "Air Content" will not apply.

Obtain the Engineer's approval for admixtures before developing the mix design. Include any admixtures in the mix design.

2. NDDOT Quality Assurance Procedures.
If the beam fabrication plant meets the requirements of the Department's Quality Assurance procedure, the following apply:

a. The Department will waive the sampling, testing, and inspection requirements specified in Sections 604.03 D, "Inspection" and 604.03 E, "Sampling and Testing During Manufacture of Beams" and substitute the following:

- Furnish a certificate of compliance that also includes the source of the materials used in manufacturing.

- Furnish the required certificate for the wire, strand, and reinforcing steel. Furnish a certificate analysis of the aggregates and stating that the aggregates have been tested and approved.

- At the time of stress transfer, test two concrete test cylinders for a single beam pour, and three concrete test cylinders for a continuous pour representing the beams as provided for in Section 604.03 E.1 “Concrete”.

b. The Department will waive the requirements of Section 604.03 B.3, “Trial Mix”.

3. Trial Mix.
Produce a trial mix using the mix design in the presence of the Engineer.

Cast, cure, and test a minimum of ten cylinders under the observation of the Engineer. Produce the cylinders as specified in ND T 23. Test four cylinders at 14 days and the remaining six at 28 days. Test the cylinders as specified in AASHTO T 22.

Submit the test results with the mix design to the Engineer for approval at least 14 days before casting the beams.

4. Mix Design Revisions.
If any material or material source changes, develop and submit a revised mix design as specified in Section 604.03 B, “Concrete Mix Design”.

C. Wire, Strand, and Bars
Assign lot numbers to all wire, strands, and bars and tag them for identification.

D. Inspection.
Notify the Engineer a minimum of two weeks before manufacturing the beams.

Allow the Engineer free entry to all parts of the work involving the manufacture of the beams.

E. Sampling and Testing During Manufacturing the Beams.

1. Concrete.
Cast cylinders as specified in ND T 23.

Cast cylinders in a sequence so all concrete used in the beams is represented by tests.

If casting a single beam, cast and test a minimum of five cylinders. Test 2 cylinders to determine concrete compressive strength at the time of stress transfer. Test 3 cylinders on or before the 28 day test period to determine the compressive strength for delivery and the Engineer’s acceptance.

If casting two or more beams during one continuous operation, cast and test a minimum of six test cylinders:

- 3 cylinders per bed, to be tested at the time of stress transfer, that include:
  - 1 cylinder representing the first beam cast;
  - 1 cylinder representing a beam near the center of the bed; and
  - 1 cylinder from the last beam cast.
- 3 cylinders for determining compressive strength to make delivery and obtaining acceptance by the Engineer on or before the standard 28 day test period.

2. Wire, Strand, and Bars.
Submit a certified mill test report and a certificate of compliance for reinforcing installed in beams. Include the diameters, elongation at rupture, and ultimate tensile strengths in the mill report.

F. Acceptance.
Deliver the beams after the design compressive strength requirements are obtained.

The Engineer will reject beams not meeting the design compressive strength requirements at 28 days.

Furnish a certified statement showing the number of beams cast in each continuous operation and the number of each beam.

- If the fabrication plant meets the requirements of the Department's Quality Assurance procedure, the manufacturer's representative shall sign the statement.
- If the plant does not meet the requirements of the Department's Quality Assurance procedure, the Department's representative at the plant shall sign the statement.

604.04 CONSTRUCTION REQUIREMENTS

A. General.
Determine the prestress force applied to the strands by strand elongation and check the force applied using hydraulic jacks. Furnish a statement of curve showing the load elongation relationship at 75 percent (low elongation strand) of ultimate stress for the prestress steel that will be used and a certified calibration curve for each hydraulic jack that is used. Submit these items with the certificate of compliance specified in Section 604.03 E.2, "Wire, Strand, and Bars".

B. Work Drawings.
Provide work drawings that include:

- Beam dimensions;
- Size and location of all reinforcing and prestressing steel including;
  - Strand layout;
  - Pull down locations;
  - Tensioning forces;
  - Elongation; and
  - Proposed changes in the reinforcing steel;
- Initial prestress forces;
- Location of handling hooks or devices; and
- Losses in the prestress due to:
  - Elastic shortening;
  - Shrinking or creeping of concrete; and
  - Relaxation of steel stress as determined by the Contractor method of stressing.

Submit calculations and work drawings that are signed, sealed, and dated by a Professional Engineer registered in the State of North Dakota as set forth in NDCC Title 43.

C. Placing and Fastening Steel.
Place steel as specified in Section 612.04, "Construction Requirements" and as follows:

Maintain distances between the forms and steel reinforcing using stays, ties, hangers, or other approved supports. Ensure metal bar chairs and bolsters in contact with the forms are galvanized or noncorrosive metal. Do not leave wooden blocks in the concrete.

Straighten prestressing elements by applying low initial tension to insure proper positioning. Include this initial tension in the total tension applied. If required, provide suitable horizontal and vertical spacers to hold elements in true position.

D. Placing Concrete.
Place concrete in forms made entirely of steel.

Vibrate concrete for the beams. Vibrate without displacement of reinforcing, conduits, voids, or wire. Vibrate for a sufficient duration and intensity to thoroughly consolidate the concrete without causing segregation.

Rough float and transversely broom the top of the beams.

E. Curing Concrete.
Steam or water cure members until the concrete has reached the compressive strength required for stress transfer. Protect members from rain, cold weather, and moisture loss between placement of the concrete and the beginning of the steam or water cure.

Cover all exposed surfaces with two layers of burlap as soon the covering is able to be placed without damaging the concrete.

Maintain a uniform curing temperature.

1. **Steam Cure.**
   Cover steam cured members with a suitable covering to contain the live steam. Distribute the steam uniformly throughout the enclosure and do not jet the steam directly on the beam. Maintain the temperature of the enclosure below 90°F until the beam has cured for a minimum of three hours. After this period the Engineer will allow the temperature within the beam enclosure to be raised to a maximum of 160°F in increments less than 40°F per hour.

2. **Water Cure.**
   Apply water to the burlap cover so that the concrete surfaces are kept continuously wet.

F. Pretensioned Beams.
Debond strands, if needed, using a rigid polymer sheathing with no split seam.

Accurately hold prestressing tendons in position and stress the tendons with jacks. Submit a record of the jacking force and the elongation produced.

Do not allow bond stress to be transferred to the concrete and do not release end anchorages until the concrete has reached the compressive strength required for stress transfer.

Cut tendons only after heating them to relieve the stress. Cut tendons so the lateral eccentricity of prestress force is minimized.

G. Transportation and Storage.
Transport precast beams in an upright position, and ensure the points of support and directions of the reactions with respect to the beam are approximately the same during transportation and storage as when the beam is in its final position.

H. Beam Placement.
Do not place beams on structure until previously placed concrete is at least 14 days old or has reached 70 percent design strength.

604.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities”.

604.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Prestressed Beams	Linear Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 606
PRECAST REINFORCED CONCRETE BOX (PRCB) CULVERTS

606.01 DESCRIPTION
This work consists of furnishing required materials as well as fabricating, transporting, and installing Precast Reinforced Concrete Box Culverts (PRCB).

606.02 EQUIPMENT
Reserved.

606.03 MATERIALS

A. General.

Item	Section
Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement	836.03 E
Geosynthetic	858

B. Waterproof Membrane.
Provide self-adhesive black polyethylene membrane that meets the following requirements:
- Has sheeting with a minimum thickness of 0.004 inch; and
- Has rubberized asphalt coating with a minimum thickness of 0.056 inch.

606.04 CONSTRUCTION REQUIREMENTS

A. Design and Manufacture.
Design and manufacture the PRCB as specified in the applicable portions of AASHTO LRFD Bridge Design Specifications, Section 12, and AASHTO Materials Specification M 259.

Use an ACPA or NPCA certified plant in the construction.

B. Concrete.
Use concrete that will achieve a minimum compressive strength of 3,000 psi after 28 days. Use a mix design having a minimum cement content of six sacks per cubic yard.

C. Barrels.
Use barrel sections that are a minimum of 4 feet long measured along the shortest side. Construct the sections with a minimum concrete thickness of 8 inches. Do not allow any haunch or fillet at the inside corners of the barrel to exceed a triangular shape with 12 inch horizontal and 12 inch vertical legs. Use tongue and groove section joints in which the tongue is a minimum of 4 inches long and 3.5 inches thick at the end of the tongue.

D. Work Drawings.
Submit work drawings containing the following information:
- Layout showing PRCB placement;
- Type and strength of concrete and reinforcing steel;
- All concrete and reinforcing dimensions;
- Reinforcing steel clearances;
- Method of tying sections together;

- Method of covering the joints; and
- Installation and handling instructions.

Notify the Engineer of the date and location of fabrication at least 10 working days before fabrication begins. Provide design calculations and work drawings that are signed, sealed, and dated by a Professional Engineer registered in the State of North Dakota as set forth in NDCC Title 43.

Do not fabricate material before the Department has responded to a set of work drawings with "No Exceptions Noted".

E. Installation.

1. Bedding.
Provide a 2 inch minimum thickness of uncompacted and screedable sand material under the PRCB for a leveling course.

2. Laying Culvert.
Begin laying PRCB from the downstream end, with the bell end pointing upstream. Adjust grade without applying external force on the culvert.

If a culvert section is not on grade after joining, completely remove the section. Regrade the bedding material to proper grade and reset the section.

Maintain the correct grade throughout the culvert.

3. Joints.
Install the barrel sections so that joints between sections fit as tight as possible, with a maximum gap of 3/4 inch wide.

Connect each section using the approved ties before setting the next section.

Provide watertight joints on the floor, on the exterior walls, and roof using a preformed mastic meeting ASTM C 990.

Use a waterproof membrane that is a minimum of 24 inches wide. Prepare the walls and roof exterior surface of the joint according to the waterproof membrane manufacturer's recommendation. Roll the membrane to the surface keeping it free of wrinkles and bubbles.

Lap waterproof membrane joints a minimum of 2.5 inches. Seal the joints and exposed edges with a joint sealing mastic recommended by the manufacturer of the membrane.

606.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities".

606.06 BASIS OF PAYMENT

Pay Item	Pay Unit
___ FT X ___ FT Precast RCB Culvert	Linear Foot
DBL ___ FT X ___ FT Precast RCB Culvert	Linear Foot
___ FT X ___ FT Precast RCB End Section	Each
DBL ___ FT X ___ FT Precast RCB End Section	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 612
REINFORCING STEEL

612.01 DESCRIPTION
This work consists of furnishing and placing reinforcing steel.

612.02 EQUIPMENT
Reserved.

612.03 MATERIALS

Item	Section
Reinforcing Steel, Dowel Bars, and Tie Bars	836

Fabricate reinforcing steel in accordance with CRSI's Manual of Standard Practice.

Furnish reinforcing steel in the full length specified without using splices.

612.04 CONSTRUCTION REQUIREMENTS

A. Bar List.
Add a prefix to all bar designations to differentiate between the different structures on the same project.

B. Storage of Reinforcing Steel.
Do not store reinforcing steel in direct contact with the ground. Incorporate reinforcement into the work only if it is free of deleterious material and detrimental scale or rust.

C. Field Bending.
Do not field bend bars, unless specified. If field bending is specified, bend reinforcing bars cold.

D. Placing and Tying.
Provide the Engineer 24 hours to inspect reinforcing steel before concrete placement. Tie bars at intersections unless the spacing is less than 12 inches in any direction, then only tie alternate intersections. Use 16 gauge non-corrosive wire ties.

Do not weld, flame cut, or heat bars.

Tie the top layer of transverse deck slab reinforcing steel to the shear connectors at each beam/girder line with two wraps of 16 gauge non-corrosive wire ties at a maximum longitudinal spacing of 6 feet. Anchor the top layer of transverse approach slab reinforcing steel to the ground using steel stakes at a maximum spacing of 7 feet in the longitudinal and transverse directions.

Use bar supports that are made of plastic or metal. Use corrosion-proof legs if metal bar supports rest on the forms. Place bolsters and bar supports for deck slabs, approach slabs, and box culvert roof slabs at a maximum of 4 foot spacing.

Tie bundled bars at 6 foot maximum spacing.

E. Epoxy Coated Reinforcing Steel.

Pad equipment used to handle epoxy coated reinforcing bars where the equipment is in contact with the bars. Lift bundles of bars with multiple supports or a platform bridge to prevent abrasion in the bundle. Transport bundles without dropping or dragging. Do not expose bars to ultraviolet rays for 60 or more calendar days after fabrication, including the time the bars are placed before concrete placement. If covering the bars, provide ventilation to prevent condensation.

The Engineer will reject bars if damage to the epoxy coating exceeds 2 percent of the surface area of the coated reinforcing bar in any 1 foot length. Repair remaining bars as according to ASTM D 3963. Remove rust before making repairs. The Engineer will reject bars if the patched area, excluding the cut ends, exceeds 5 percent of the surface area.

Use plastic, plastic coated, or epoxy coated bar supports to support epoxy coated reinforcing bars. Use plastic coated wire for tying epoxy coated reinforcing bar.

612.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will use Table 612-01 when calculating weights:

Table 612-01
Reinforcing Steel Weights

Size	Pounds per Linear Foot
No. 3	0.376
No. 4	0.668
No.5	1.043
No.6	1.502
No.7	2.044
No.8	2.670
No.9	3.400
No.10	4.303
No.11	5.313
No.14	7.650
No.18	13.600

612.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Reinforcing Steel – Grade 60	Pounds
Reinforcing Steel – Grade 60 – Box Culvert	Pounds
Reinforcing Steel – Grade 60 – Epoxy Coated	Pounds

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 616
STRUCTURAL STEEL

616.01 DESCRIPTION
The work consists of fabricating, furnishing, delivering and erecting structural steel.

If structural steel is included in the contract as a “Lump Sum” item, verify the estimated weight of structural steel before submitting a proposal. The contract unit price for “Lump Sum” structural steel will only be revised if contract revisions are issued or authorized. No revisions will be made to the contract unit price of structural steel if the actual weight of the required structural steel varies from the estimated plan weight.

616.02 EQUIPMENT
Reserved.

616.03 MATERIALS

Item	Section
Structural Steel and Related Materials	834
Three Coat Organic Zinc Rich Paint System	852.02

Use welded stud shear connectors meeting the requirements of AASHTO LRFD Bridge Construction Specifications, Section 11.3.3 and AASHTO/AWS D1.5 Bridge Welding Code, Clause 7.

The Department does not require performance of the Charpy V-Notch test on structural steel used in the following locations:

- Bearings;
- Bearing stiffeners;
- Transverse web stiffeners;
- Ice noses;
- Cross frames;
- Gusset plates
- Diaphragms;
- Transverse connection plates;
- Deck drains; and
- Barrier expansion plates.

616.04 CONSTRUCTION REQUIREMENTS

A. Work Drawings.
Submit work drawings for the fabrication and erection of steel. Show dimensions and sizes of materials for fabrication, bolt lists for field erection, a match-marking diagram, and a complete field erection plan.

The Engineer’s review applies only to the requirements for strength, details and arrangements of parts and details.

B. Shop Inspection.

Ensure shop inspection personnel are qualified as specified in the latest AASHTO/AWS D 1.5 Bridge Welding Code.

The Department will not accept welded plate girders without a Department shop inspection. Provide the Engineer at least three weeks notice before beginning fabrication.

Furnish facilities for the inspection, allow the Inspector access to all areas, and furnish the inspector at least two 4 inch by 18 inch samples of each grade and brand of structural steel.

C. Fabrication.

1. General.

Fabricate as specified in the latest AASHTO/AWS D 1.5 Bridge Welding Code except as modified by this Specification. For structures that carry railroad traffic, fabricate the structural steel as specified by AREMA Specifications.

2. Structural Steel.

Position shear connectors on splice plates to clear the bolt holes.

The Engineer will allow shop-welded connections of diaphragm angles to gusset plates in place of the bolted connections. On the shop drawings, indicate which connection method will be used.

Do not attach any devices that are not shown on the Plans to the structural steel members during the fabrication and construction process without written permission from the Department’s Bridge Engineer.

3. Blast Cleaning of Weathering Steel.

After fabrication for weathering applications, blast clean the exterior faces of outside beams or girders, including stiffeners, flanges, and other steel readily exposed to view as specified in the Steel Structures Painting Council Surface Preparation Specification “No. 6 Commercial Blast Cleaning”, (SSPC-SP 6). Do not use a corrosion inhibitor.

4. Painting.

a. General.

Shop apply the paint system to all structural steel surfaces except, intermediate and finish coats on splice and filler plates may be field applied.

Spray apply coatings according to the manufacturer's instructions. Apply the coating with a brush on surfaces inaccessible to spray.

(1) Submittals.

Submit the manufacturer’s written recommendations for equipment, spray pressures, shelf life, pot life, cure time and top coat window. Apply coatings in a uniform, even coat and work into all corners and crevices.

Submit quality control records that include the following for each coating layer:

- Date and Time of Application;
- Ambient Air Temperature;

- Humidity;
- Dew Point;
- Surface Profile Measurements; and
- DFT Readings.

(2) Application.
Apply each coating layer so its Dry Film Thickness (DFT) is in accordance with the manufacturer's instructions when measured according to SSPC PA-2. Re-blast, clean, and recoat any surfaces that have a coating thickness outside of the manufacturer's specified range.

(3) Mixing and Thinning Paint.
Thoroughly mix all paint system components so the pigment is completely in suspension and the consistency is uniform. Strain the zinc primer over a sieve having openings no larger than a No. 50 sieve and continuously agitate until application is completed.

Thinners may be used if they are part of the paint manufacturer's instructions. Follow the manufacturer's instructions regarding the quantity and type of thinner used.

b. Shop Painting.

(1) Surface Preparation.
Remove oil and grease from surfaces to be painted before blast cleaning. Remove the oil or grease by solvent cleaning according to SSPC SP-1.

Blast clean surfaces to be painted to a near white finish according to SSPC SP-10. Produce a surface profile depth that is consistent with the paint manufacturer's recommendations.

Remove blast residue from the steel surfaces before painting. Keep the steel dry. Apply prime to surfaces within 24 hours after blasting and cleaning.

(2) Paint System Application.
The paint system is composed of 3 layers; primer, intermediate coat, and finish coat.

Mask contact or faying surfaces of bolted field splices of the main members, shear connectors, and the upper surface of the top flanges during the intermediate and finish coat application.

Do not apply subsequent layers of the paint system until the Engineer has approved the previous application.

(3) Handling, Shipping, and Erection.
If the coating system is damaged prior to shipment, repair the damaged coating using the same process that was used to apply the coating initially.

Load the steel for shipment after the Engineer has approved the finish coat.

If damage to the coating system occurs during transport or erection, repair damaged areas as specified in Section 616.04 C.4.c, "Field Application".

c. Field Application.

(1) General.
Do not allow paint or paint materials to come in contact with surfaces not intended to be painted. Provide a means to protect traffic from spattering of paint or paint materials. Prevent deleterious material from adhering to freshly painted surfaces.

(2) Surface Preparation.
Remove areas of damaged coating down to bare metal. Remove all rust and loose paint. Feather edges of cleaned repair areas to ensure a bond of new paint to old paint and to provide a smooth finish.

(3) Paint System Application.
Apply paint only when environmental conditions, such as temperature, humidity, and dew point, are within the manufacturer's recommended range.

D. Shop Welding.
Perform shop welding as specified in the latest AASHTO/AWS D1.5 Bridge Welding Code. Do not use the electroslag and electrogas welding processes for welding bridge members. Perform flange-to-web welds and shop welded splices in flanges or webs using the automatic submerged arc and welding process.

1. Built-up Plate Girders.
Cut web plates of built up beams and girders to the prescribed camber with allowance for shrinkage due to cutting and welding.

Make shop butt welds in the flange plates before final fitting and welding into the girders.

2. Nondestructive Testing.
Perform nondestructive testing (NDT) on welds as specified in AASHTO/AWS D 1.5 Bridge Welding Code and the following:

- Perform the NDT under the observation of the Engineer. Testers shall be certified by the American Society for Nondestructive Testing (ASNT) at Level II or higher and shall have at least two years of experience at that level.
- Submit a written report of all NDT to the Engineer along with material certification documenting compliance of the welds with contract requirements.

a. Radiographic and Ultrasonic Inspection.
Test groove welds in main members of built up girder structures by radiographic or ultrasonic inspection as follows:

- Completely inspect tension splices and splices subject to reversals of stress;
- Test 1/6 of the web depth beginning at the point or points of maximum tension and 25 percent of the remainder of the web depth on girder and beam web splices; and
- Test all compression flange splices.

Test welds after grinding and retest repaired welds.

b. Magnetic Particle Inspection.
Use the magnetic particle inspection method to test longitudinal beam or girder web butt splices and fillet welds in main members, including the end connections, as follows:

- Test at random locations in the members so as to be typical for each size of weld and type of joint;
- Test 1 foot of every 10 foot length of weld; and
- Test 1 foot of each weld less than 10 feet in length.

If defects are found in a test area, repair the full length of the weld or 5 feet on either side of the test length, whichever is less.

Retest the repaired area plus at least 2 inches on each side of the repaired area.

E. Handling, Marking, Shipping, and Storing Materials.
Mark each member with an erection mark for identification, and furnish an erection diagram showing the erection marks.

Pack bolts of one length and diameter, and loose nuts and washers of each size separately. Ship pins, small parts, small packages of bolts, washers, and nuts in suitable containers with a list and description of the material plainly marked on the outside of each container.

Load, transport, unload, and store structural material without stressing, deforming, or damaging the structural members and so the metal is kept clean.

Handle long steel members by placing saddles at approximately the quarter points and during storing and shipping placing blocking at intervals that prevent sag and distortion. Store, ship and handle rolled beams and built-up plate girders in a vertical position.

Keep stored materials properly drained. Store steel above ground on platforms, skids or other supports. Support girders, beams, and long members such as columns and chords to prevent damage from deflection. Handle girder sections with beam clamps or other approved devices and do not use wire rope slings.

Keep AASHTO M 270 Grade 50W steel clean and free of materials that may affect the metal's natural oxidation. Place match marks for Grade 50W steel on the top flange and remove the match marks as soon as they are no longer necessary. Provide temporary protection during concrete operations and all operations that can affect uniform natural oxidation.

F. Falsework, Methods, and Equipment.
Submit falsework plans to the Engineer. If changes in an existing structure are necessary for maintaining traffic, submit plans to the Engineer for review.

G. Assembling Steel.
Do not assemble steel on structure until previously placed concrete is at least 14 days old or has reached 70 percent design strength

Before assembly, clean bearing surfaces and surfaces that will be in permanent contact.

Assemble parts using the match marks. Bring splice points in beam or girder spans to proper elevation and support them in position before the fasteners are tightened.

1. **Bolts.**
   Make permanent field connections using 7/8 inch diameter ASTM F3125 Grade A325 high-strength bolts.

   Make the diameter of the bolt holes 1/16 inch greater than the diameter of the bolts used. Use bolts for transmitting shear that are threaded to a length that a maximum of one thread is within the grip of the metal. Use bolts that are long enough to extend entirely through the nuts but not more than 1/4 inch beyond the face of the nut. Place one lock washer under the nut of each bolt connecting handrails. Install a hardened washer over slotted holes.

   When using galvanized nuts, use nuts with a visible lubricant on the threads.

   When using black bolts and nuts, use bolts and nuts that are oily to the touch when delivered and installed.

   If bolts and nuts lose lubrication, clean and lubricate the bolts and nuts before installation. Test recleaned or relubricated bolt, nut and washer assemblies as specified in Section 616.04 G.2.a, "Bolt-Nut-Washer Assembly Testing".

2. **Bolt Connections.**
   Tighten high strength steel bolts using the following requirements:

   a. **Bolt-Nut-Washer Assembly Testing.**
      Perform the rotational-capacity test specified in Section 834.03 A.2, "Rotational Capacity Testing of Assemblies" on each rotational-capacity lot before starting bolt installation. A Skidmore-Wilhelm Calibrator tension measuring device will be provided by the Engineer at each project site during erection. Use hardened steel washers for tests.

      If using the calibrated wrench method, perform the test each day that bolts are installed. If using other methods, perform the tests on each production lot. The Engineer will verify the installation test procedures.

      Use direct tension indicators when testing bolts that are too short for the Skidmore-Wilhelm Calibrator. Calibrate the direct tension indicators in the Skidmore-Wilhelm Calibrator using longer bolts.

   b. **Installation Preparation and Tension Requirements.**
      Ensure bolted parts fit firmly together when assembled. Descale contact surfaces, including washers that carry more than normal tight mill scale. Contact surfaces shall be free of defects that would prevent solid seating of the parts. Install bolts with nuts on the interior side of the web and on the top side of the flange.

      Install bolts with a hardened washer under the bolt head or nut, whichever is turned in tightening. Use a flat washer when the abutment surface adjacent to the bolt head or nut does not have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where an outer face of the bolted parts has a slope of more than 1:20 with respect

to a plane normal to the bolt axis, use a smooth beveled washer to compensate for the lack of parallelism. Tighten all fasteners to the minimum bolt tension values shown in Table 616-01 “Required Fastener Tension” on completion of the joint.

Table 616-01
Required Fastener Tension

Bolt Size (Inches)	Minimum Bolt Tension[1] (Pounds)
1/2	12,000
5/8	19,000
3/4	28,000
7/8	39,000
1	51,000
1-1/8	56,000
1-1/4	71,000
1-3/8	85,000
1-1/2	103,000

[1] Equal to 70 percent of specified minimum tensile strength of bolts as specified in ASTM Specifications for tests of full size ASTM F3125 Grade A 325 bolts with UNC threads loaded in axial tension.

c. Installation Methods.

Do not use high strength bolts that were previously tightened to requirements of Table 616-01. Replace the assembly with a new bolt and nut. Replace the assembly at no additional cost to the Department.

(1) Turn-of-Nut Tightening.

Snug tighten all bolts in the joint with a few impacts of an impact wrench or the full effort of a worker using an ordinary spud wrench. Ensure the parts of the joint are in full contact with each other. Match mark the nuts and protruding bolt ends before final tensioning so that the actual rotation can be determined.

Perform final tensioning by the applicable nut rotation specified in Table 616-02 with tightening progressing systematically from the rigid part of the joint to its free edges. During this operation, do not allow rotation of the part not turned by the wrench.

For bolts installed by 1/2 turn or less, rotate within a tolerance of plus or minus 30 degrees. For bolts installed by 2/3 turn or more, rotate within a tolerance of plus or minus 45 degrees.

Table 616-02 “Nut Rotation from Snug Tight Condition Disposition of Outer Faces of Bolted Parts” applies only to connections in which all material within the grip of the bolt is steel.

Table 616-02
Nut Rotation from Snug Tight Condition
Disposition of Outer Faces of Bolted Parts

Bolt Length (underside of head to end of bolt)	Both faces normal to bolt axis	One face normal to both axis and other sloped not more than 1:20 (beveled washer not used)	Both faces sloped not more than 1:20 from normal to the bolt axis (beveled washers not used)
4 Diameters and smaller	1/3 turn	1/2 turn	2/3 turn
Over 4 thru 8 Diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 thru 12 Diameters[1]	2/3 turn	5/6 turn	1 turn

[1] For bolt lengths exceeding 12 diameters, determine the required rotation by actual test in a suitable tension measuring device which simulates conditions of solidly fitted steel.

(2) Calibrated Wrench Tightening.

Set calibrated wrenches to the minimum tensions required in Table 616-03 "Required Fastener Tension – Calibrated Wrench Tightening".

Table 616-03
Required Fastener Tension –
Calibrated Wrench Tightening

Bolt Size (Inches)	Minimum Bolt Tension (Pounds)
1/2	12,600
5/8	19,950
3/4	29,400
7/8	40,950
1	53,550
1-1/8	58,800
1-1/4	74,550
1-3/8	89,250
1-1/2	108,150

Calibration: Calibrate wrenches using the Skidmore-Wilhelm Calibrator. Calibrate by tightening three typical bolts of each diameter, length and grade from the bolts being installed. Use a hardened washer from the washers being used in the work under the element turned in tightening.

Recalibration: Recalibrate wrenches when there is significant difference in the surface condition of the bolts, threads, nuts, or washers.

Verification: Verify that the wrench adjustment selected by the calibration does not produce a nut or bolt head rotation from snug tight greater than that permitted in Table 616-02 during actual installation in the assembled steelwork. If manual torque wrenches are used, measure torque when turning nuts in the tightening direction.

Installation: Install and tighten bolts in all holes of the connection to a snug tight condition. Use hardened washers under the element turned. Following the initial tightening operation, further tighten the connection using the calibrated wrench. Tighten systematically from the most rigid part of the joint to its free edges.

Recheck: Recheck previously tightened bolts to ensure they have not relaxed as a result of the subsequent tightening of adjacent bolts. Keep rechecking bolts until all bolts are tightened to the specified minimum required tension.

(3) Direct Tension Indicator (DTI) Tightening.

Use DTI's that indicate the minimum tensions specified in Table 616-01. Follow the manufacturer's installation procedure for installation of bolts in the calibration device and in all connections. Properly install flat hardened washers when using DTI with bolts installed in oversize or slotted holes and when using the DTI under the turned element.

(a) Calibration Testing of DTI.

Assemble a minimum of 3 DTI test assemblies for each length, diameter, and grade of fastener. Perform the rotational-capacity test specified in Section 834.03 A.2, "Rotational Capacity Testing of Assemblies" on each rotational-capacity lot before starting bolt installation. The test assemblies shall be identical to the assemblies required in the connection. Test the assemblies in a calibration device capable of indicating bolt tension.

(b) Installation.

Install bolts in all holes of the connection and tighten to achieve partial compression of the DTI protrusions. Tighten all fasteners, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened fasteners. Proper tensioning of the bolts may require more than a single cycle of systematic partial tightening before final tightening to deform the DTI protrusions to the specified gap.

(4) Alternate Design Fasteners (ADF).

Use alternate design fasteners (ADF) that meet the specifications in Section 834.03, "Bolts, Nuts, and Washers". Follow the manufacturer's installation procedure for installation of bolts in the calibration device and in all connections.

(a) Verification Testing of ADF.

Assemble a minimum of 3 ADF test assemblies for each length, diameter, and grade of fastener to be used in the work. If required in the actual connection, include flat-hardened washers in the test assembly arranged as in the actual connections to be tensioned. Test the samples at the job site in a device capable of indicating bolt tension. Only use ADF represented by samples that develop a tension required by Table 616-01.

(b) Installation.

When ADF are used, install bolts in all holes of the connection and initially tighten them sufficiently to bring all plies of the joint into firm contact but without

yielding or fracturing the control or indicator element of the ADF. Then, further tighten all ADFs, progressing systematically from the most rigid part of the connection to the free edges in a manner that will minimize relaxation of previously tightened ADFs. Ensure proper tensioning of the bolts by systematically partially tensioning them until final twist-off of the control or indicator element of individual ADFs during the final tightening cycle. Use more than a single cycle of systematic partial tightening. If twist-off occurs on an individual ADF prior to the final tightening cycle, replace the fastener with a new one.

3. Welded Stud Sheer Connectors.

Install welded stud sheer connectors in the field after the structural steel has been erected and the deck forms are in place, but before the installing reinforcing steel. Use automatically timed stud welding equipment to weld sheer connectors.

Perform production testing as specified in Clause 7.7, “Production Control”, of the AASHTO/AWS D1.5 Bridge Welding Code. In addition to the stud bend test specified in Clause 7.7, perform stud bend tests at the following times:

- At the start of each work day;
- When welding has been interrupted for one hour or more;
- When changing grounds;
- When changing weld settings; and
- When changing cable loop due to arc blow.

Do not weld more than 500 studs without performing a bend test.

Bent studs that show no signs of failure may be left in the bent position.

H. Straightening Steel Members.

If members are bent, they must be replaced or returned to fabricator for repair. Do not straighten bends in main structural members in the field.

Straighten bent members without producing embrittlement, fracture, or damage. Straighten all material cold. Do not use members that cannot be straightened.

The Engineer may authorize heating mild steel and structural grade steel. Do not allow the temperature of the heated area to exceed 1,200°F (a dull red) as controlled by temperature indicating crayons, liquids, or bimetal thermometers.

I. Rust Stains.

When Weathering Steel is used protect substructure units with reinforced polyethylene or similar material. Leave the protection material in place to prevent staining until the superstructure is completed.

Use a concrete rust stain remover to remove all rust stains on the substructure units. Flush all areas receiving applications of rust stain remover with water.

616.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

A. Measurement by Weight.

Measurement by weight will be by the Pound. The quantity paid for will be the total weight, determined as specified. If the structural steel is measured by weight, furnish two copies of calculated weights and dimensions.

The Engineer will measure and pay for all castings and miscellaneous metal parts as Structural Steel. The Engineer will use Table 616-04 to determine the weight of structural steel components.

Table 616-04

Material Type	Lbs/CF
Aluminum, Cast or Wrought	173.0
Brass	534.0
Bronze, Cast	536.0
Bronze, Wrought	555.0
Copper, Sheet	558.0
Iron, Cast	445.0
Iron, Malleable	470.0
Lead, Sheet and Plate	707.0
Steel	490.0
Zinc, Sheet	450.0

1. Structural Steel and Wrought Metals.

The Engineer will not measure or pay for the weight of permanent bolts 6 inches or less in length. The Engineer will not make deductions for cuts, copes, bevels, or open holes; and will not make allowance for mill overruns.

2. Structural Plates.

The plan quantity structural plates will be used for measurement and payment.

The Department will not make allowance for planed or sheared edges.

The Engineer will compute the weight of irregular shape on the basis of the dimensions of the smallest rectangular plate from which it can be cut. When plates are machine finished, the Engineer will consider the dimension of the plates the maximum machine finished dimension plus 1/8 inch for each finished surface.

3. Structural Shapes and Bars.

The plan quantity will be used for measurement and payment of structural shapes and bars.

The Engineer will compute the weight of each structural shape with mitered ends on the basis of the section and overall length measured parallel to the axis of the shape.

For identical structural shapes with mitered ends that are less than 5 feet long, the Engineer will consider ends multiple cut. The Engineer will compute their total weight as

the weight of the shortest parent section from which they can be cut, provided the length of the parent section is not more than 30 feet.

4. **Pins and Rollers.**
   The Engineer will consider the parent section for forged segmental rollers square in section, and of the same length, width, and thickness as the finished roller.

   The Engineer will compute the weight of hot-rolled bar steel pins and rollers on the basis of the length shown on the Plans and on the basis of a diameter 1/4 inch greater than that of the finished pin or roller.

   The plan quantity will be used for measurement and payment of cold finished bar steel pins and rollers.

5. **Bolts and Tie Rods.**
   The Engineer will compute the weight of bolts over 6 inches long and tie rods including necessary nuts and washers used for connecting structural steel parts from the nominal weights as given by the American Institute of Steel Construction.

6. **Castings.**
   The Engineer will compute the weight of each casting from the net dimensions shown on the approved shop drawings, with an addition of 10 percent to compensate for fillets and overruns. Where machine-finished surfaces are required, the Engineer will make an allowance of 1/8 inch in thickness for each surface so finished. If cored holes are shown on the Plans, the Engineer will make a deduction for the full size of the core.

7. **Pipe.**
   The plan quantity of pipe will be used for measurement and payment.

B. Lump Sum Basis.
When the quantity of structural steel is included in the plans as a “Lump Sum”, the “Lump Sum” includes all required structural steel.

If changes are made to the contract that increase or decrease the weight of the material required, the Engineer will determine the weight of additional material using Table 616-04.

616.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Structural Steel	Pound
Structural Steel	Lump Sum
Structural Steel M270 – Grade 36	Pound

For changes to structural steel quantities as specified in Section 616.05 B, “Lump Sum Basis”, the Engineer will make payment for the changed quantity as follows:

- If changes are made to the contract that increase the quantity of structural steel, payment for additional structural steel will be made at a contract unit price per pound. The contract unit price will be obtained by dividing the lump sum contract unit price by the estimated quantity of structural steel included in the plans.

- If changes are made to the contract that reduce the weight of material required, the contract unit price for the lump sum item will be reduced proportionally to the reduction in material weight.

Such payment is full compensation for furnishing all materials, connection devices, swedge bolt, equipment, labor, and incidentals to complete the work as specified.

SECTION 622
PILING

622.01 DESCRIPTION
This work consists of furnishing and driving piles.

622.02 EQUIPMENT
Reserved.

622.03 MATERIALS

Item	Section
Portland Cement Concrete	802
Reinforcing Steel, Dowel Bars, and Tie Bars	836
Steel Piling H-Piling and Special Sections	840.01 A
Shells for Steel-Encased Concrete Piling	840.01 B
Timber Piling	840.02
Steel Sheet Piling	840.03 A
Corrugated Steel Sheet Piling	840.03 B
Paints, Oils, and Thinners	852
Three Coat Organic Zinc Rich Paint System	852.02
Galvanizing	854

622.04 CONSTRUCTION REQUIREMENTS

A. Pile Formulas.

Pile formulas will be included in the plans. The Engineer will apply the formulas when computing the bearing value by pile penetration for all piles. The Engineer will not make penetration measurements to determine pile bearing values immediately after inserting fresh cushioning material over the head of the pile or when pile heads are damaged by burring, corrugating, or crushing.

If water jets are used with the driving, the Engineer will determine the bearing value by the formulas from the results of driving after the jets have been withdrawn.

The Engineer will make a reduction in the rated energy of an open top diesel hammer if the hammer does not maintain the minimum measured stroke. This reduction will be based on the percentage of the reduced stroke.

B. Pile Driving.

1. General.

Give at least 24 hours advance notice of any pile driving operations. Drive piling in the presence of the Engineer.

Drive piling through guide templates that are rigidly held in position. Remove guide templates after the pile driving is complete for a particular substructure unit. Drive pile without using followers.

Do not drive pile within 80 feet of concrete which has cured less than 3 days.

For all types of hammers use pile driver leads that allow free movement of the hammer and rigidly hold the pile in correct alignment during the driving operation.

If a pile is damaged, the Engineer will determine if the pile must be replaced or if it can be repaired.

Remove any section of piling that is drilled or burned and do not incorporate it into the structure.

After pile driving is completed backfill and compact excess excavation and voids to the bottom of the footing elevation with Class 3 or Class 5 material that meets the requirements of Section 816, "Aggregates".

Before driving foundation piles, complete the excavation to the bottom of the footing elevation.

Drive foundation piling as follows:

- Limit deviation from the vertical or from the specified batter to less than 1/2 inch per foot of pile length; and
- Keep the center of the pile at the cutoff within 3 inches of the specified location.

2. Steel and Corrugated Steel Sheet Piles.

Drive the sheet piles with a hammer of sufficient weight and driving capacity to overcome the inertia of the pile and the resistance of the soil, without damaging the pile ends. Use a driving cap made for the type of sheeting being driven.

Repair damaged galvanized sheet piling surfaces by applying a paste of approved zinc powder and flux, using a minimum quantity of water. Heat the surface to be coated sufficiently with a torch so all metallic material in the paste is melted when applied.

3. Special Requirements for Steel Encased Concrete Piles.

Drive steel encased concrete piles using a steel combination driving head and pilot of the proper size that distributes hammer blows on the pile shells. Do not allow clearance between the pilot ring and the pile shell to exceed 1/4 inches. Use a timber cushion block between the hammer and the driving head.

Provide adequate lighting to facilitate inspection of the pile shell throughout the full length of the shell.

Use an end enclosure plate that is:

- Circular;
- 3/4 inches thick or more; and
- The Diameter of the pile shells outside diameter or less.

Place a temporary water tight seal at the tops of the pile shells after completion of pile driving and until concrete placement.

Completely drive all pile shells for any one bent, pier, or abutment before any concrete is placed in the pile shells. If this is not practical, allow concrete placed in a pile shell to attain a compressive strength of 2,000 psi before driving additional piling in the same bent, pier, or abutment.

C. Bearing Value.

Drive piling to minimum bearing value determined by the Engineer. The Engineer will determine the bearing value by the formula specified which is applicable to the type of hammer used.

The Engineer will determine if it is necessary to continue to drive piles when bearing capacity is achieved before the estimated pile length is driven.

D. Cutoff and Treatment of Pile Heads.

Cut off steel piles at the specified elevation at approximately 90 degrees to the axis of the pile.

E. Extensions for Steel Piling and Steel Encased Concrete Piling.

Construct splices to provide and maintain true alignment and position of the component parts of the pile.

Construct splices in steel pile shells to be watertight and to develop the full strength of the shell.

Do not splice lengths of pile less than 10 feet. The Engineer will allow a shorter length to make the last splice below cutoff.

If splicing steel piling sections together do not exceed the following variation in straightness in inches:

$$\frac{(\frac{1}{8}\ Inch\ \times Number\ of\ Feet\ Total\ Length)}{10}$$

F. Welders.

Weld as specified in the latest AASHTO/AWS D 1.5 Bridge Welding Code. Welders shall have the listed AWS certifications when performing the types of welding listed below:

1. **Horizontal Welding.**
   Welders shall be qualified for 3G and 4F positions.

2. **Vertical Welding Reinforced Concrete Pile Shells and Vertical Steel H-Piling (without reinforcing plates).**
   Welders shall be qualified for the 2G position

3. **Vertical Welding Steel H-Piling (with reinforcing plates).**
   Welders shall be qualified for the 2G, 3F and 4F positions.

For base metals 3/4 inches or less, preheat the base metal so that the area within 3 inches of the spot where the weld metal is being deposited is at least 50°F at the time the weld is made. Do not preheat the surface to more than 400°F.

Ensure the base metal is dry before welding.

If the air temperature is 0°F or less, provide protection that maintains the air temperature around the work area above 0°F. Provide protection around the work area if wind speeds are 25 mph or greater.

Use electrodes that meet the requirements of AWS-A5.1, Classification E6010, E6011, or E7018.

Furnish a Certificate of Compliance for the electrodes that includes the results of the tests required in AWS-A5.1. Ensure the tests were for process qualification or quality control and performed less than one year before the manufacture of the furnished electrodes.

Keep electrodes in a warm, dry, and weatherproof location when the electrodes are in the factory sealed package. Use electrodes within four hours of opening or store them at a minimum temperature of 250°F. Bake the electrodes for two hours at a temperature between 450°F and 500°F if the electrodes have been open or outside the temperature controlled storage for more than four hours. Bake electrodes only once. Do not use electrodes that have been wet.

G. Steel Encased Concrete Piling.

1. Filling with Concrete.

Do not place concrete in pile shells containing water or deleterious material.

Fill the pile with Class AE concrete. Place the concrete in one continuous operation and avoid the formation of air pockets.

Wait a minimum of 2 hours after filling the last pile in the pile group with concrete before placing the footing or cap.

2. Reinforcement.

Place reinforcement as specified in Section 612.04, “Construction Requirements”. Ensure the reinforcement is a rigidly tied cage. Place reinforcement at a clear distance of one inch from the face of the pile shell, use spacers to ensure the specified clearance for the bars. Place concrete in the shell to a point approximately two feet below the bottom elevation of the reinforcing steel assembly before placing the reinforcing steel assembly in the pile shell.

H. Painting.

Paint parts of steel piles and steel encased concrete piles exposed to view in the finished structure as specified in Section 616.04 C.4.c, “Field Application”. Paint the portions of piles starting three feet below the final ground surface elevation.

622.05 METHOD OF MEASUREMENT

The Engineer will measure completed and in place as specified in Section 109.01, “Measurement of Quantities” and as follows:

A. Steel Encased Piling.
The Engineer will not measure concrete and reinforcing steel used in Steel Encased Concrete Piling as separate items.

B. Sheet Piles.
The Engineer will determine the area in square feet by multiplying the nominal width by the total length of the sheet piles remaining in place after the cutoff.

C. Test Piles.
The Engineer will not measure the length of test piles, unless the Engineer directed an increase to the quantity above the amount included in the bid item list.

622.06 BASIS OF PAYMENT

A. Steel or Steel Encased Concrete Piling.
Section 104.02 C, "Significant Changes in the Character of Work" does not apply to steel H-pile or steel encased piling quantities.

If the final in-place quantity of each size of Steel or Steel Encased Piling driven and accepted for payment varies from the original estimated quantity by more than 25 feet, the Department will pay for the difference in the two quantities as follows:

1. If the final piling quantity of each size underruns the Plan quantity, the Department will pay the Contractor 20 percent of the Contract Unit Price for the entire difference in quantities. The Department will pay the Contract Unit Price for the in-place and accepted piling.

2. If the final piling quantity of each size overruns the Plan quantity the Department will pay the Contractor the Contract Unit Price plus 10 percent for the excess over Plan quantity. The Department will pay for Plan quantity of the in-place piling at Contract Unit Price.

B. Test Piles.
If it becomes necessary to drive test piles of greater length than is shown, the Department will pay for the additional length driven as specified in Section 109.03.D, "Negotiated Price".

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 624
RAILINGS AND PEDESTRIAN FENCE

624.01 DESCRIPTION
This work consists of furnishing and installing metal railings, rail retrofits, pedestrian canopies and fences.

624.02 EQUIPMENT
Reserved.

624.03 MATERIALS

A. General.

Item	Section
Structural Steel	834.01
Cast Metal	834.02
Paints, Oils, and Thinners	852
Galvanizing	854

Use galvanized steel for all elements and hardware. Galvanize the steel elements after fabrication.

B. E-Rail Retrofit.

Item	Reference
Epoxy Resin Adhesive	806.02
Steel Plates, Bars and Angles	ASTM A 36
Threaded Rods	AASHTO M 270, Grade 36
Bolts and Anchor Bolts	ASTM F 3125 Grade A 325 or ASTM A 449
Reduced Base Studs	ASTM F 1554, Grade 36
Nuts	ASTM A 563
Washers	ASTM F 436
Square Structural Steel Tubing	ASTM A 500, Grade B

C. Free Standing Rail Retrofit.

Item	Reference
Steel Posts, Plates, Bars, and Angles	ASTM A 36
Bolts and Anchor Bolts	ASTM F 3125 Grade A 325 or ASTM A 449
Reduced Base Studs	ASTM F 1554, Grade 36
Nuts	ASTM A 563
Washers	ASTM F 436
Square Structural Steel Tubing	ASTM A 500, Grade B

D. Pedestrian Canopy or Fence.

Item	Reference
Epoxy Resin Adhesive	806.02
Pipe and Fittings	AASHTO M 181, Grade 1
Fence Fabric	AASHTO M 181, Type IV, Class B
Steel Anchor Base Plates	ASTM A 36
Bolts and Anchor Bolts	ASTM FF 3125, Grade A 325 or ASTM A 449

Provide fence fabric with the following characteristics:

- 9 gauge wire;
- 2 inch mesh; and
- Bottom selvage that is barbed.

624.04 CONSTRUCTION REQUIREMENTS

A. General.

Grind or file welded joints to provide a smooth appearance.

Field verify all dimensions for accuracy before submitting work drawings. Submit work drawings before fabrication.

B. E-Rail Retrofit.

Fabricate the railing to the horizontal and vertical alignment of the structure. Attach each rail segment to a minimum of two posts.

Furnish and install the guardrail connection plates. Installation may include sawing and removing portions of the curb.

Embed the anchor bolts into the concrete using a chemical adhesive system as specified in Section 806.02, “Epoxy Resin Adhesives”.

C. Free Standing Retrofit.

Fabricate the railing to the horizontal and vertical alignment of the structure. Posts shall be normal to grade. Attach each rail segment to a minimum of two posts.

Embed the front anchor bolt a minimum of 9 inches and embed the back anchor bolt a minimum of 6 inches into the concrete using a chemical adhesive system with a minimum tensile strength of 17,500 pounds.

Conduct a static tension test at the first four field installed anchor bolts and on 10 percent of the remaining installations on a bridge, as selected by the Engineer. Perform the installation of the anchor bolts to be tested and the static tension test in the presence of the Engineer and in accordance with the test procedures prescribed in ASTM E 488. Do not have any portion of the testing device bearing on the concrete surface within a distance equal to the anchor bolt embedment depth to the bolt being tested.

Provide a minimum static tension of 15,000 pounds for all anchor bolt anchorage systems that are tested. If the anchor bolt slips during the test, the anchorage system has failed. Tap all

tested bolts with a hammer to determine if the bond has been broken. Failure of any anchor bolt anchorage system tested will require modification of the installation procedures or use of a different anchor bolt anchorage system.

D. Pedestrian Canopy and Fence.
Use self-locking nuts for bolts.

Place bolt heads on the side of the fence adjacent to pedestrians.

Use one of the following methods to install the 1/2 inch swedge bolts for anchor base plates:

- Drill and place the bolt into epoxy mixed according to the epoxy manufacturer's recommendations. Use epoxy that meets the requirements of Section 806.02, "Epoxy Resin Adhesives"; or
- Place the bolt into the plastic concrete.

624.05 METHOD OF MEASUREMENT

The Engineer will measure completed and in place as specified in Section 109.01, "Measurement of Quantities".

624.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Pedestrian Railing	Linear Foot
Pedestrian Canopy	Linear Foot
Traffic Rail – Steel	Linear Foot
Railing	Linear Foot
W-Beam Retrofit	Linear Foot
Double Box Beam Rail Retrofit – Free Standing	Linear Foot
Double Box Beam Rail Retrofit – E-Rail	Linear Foot
Connection Plate Modification	Each

Include all costs for required sawing and removing portions of the curb in the contract unit price for "Double Box Beam Rail Retrofit - E-Rail" or "Double Box Beam Rail Retrofit – Free Standing."

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 626
COFFERDAMS

626.01 DESCRIPTION
This work consists of designing, constructing, dewatering, maintaining, removing, and backfilling cofferdams.

626.02 EQUIPMENT
Reserved.

626.03 MATERIALS
Reserved.

626.04 CONSTRUCTION REQUIREMENTS

A. General.
Design and construct cofferdams to be watertight as necessary to perform the work. Provide sufficient clearance in the cofferdam for:

- Construction;
- Inspection of the exterior forms; and
- Placement of pumping equipment.

If foundation seal concrete is necessary, it must be placed as specified in Section 602.04 C.1.b(2), "Foundation Seal Concrete".

B. Excavation.
Perform cofferdam excavation as specified in Section 210, "Structural and Channel Excavation, Foundation Fill and Preparation".

C. Removal of Cofferdams.
Remove cofferdams when no longer needed. Do not excavate below the natural channel bottom outside the cofferdam to facilitate removal.

After removing the cofferdam, place backfill material as specified in Section 210.04 B.2, "Ordinary Backfill". Fill the excavated area to the natural channel bottom.

626.05 METHOD OF MEASUREMENT
The Engineer will measure as specified in Section 109.01, "Measurement of Quantities" and as follows:

If multiple cofferdams are constructed to protect a single portion of the work, the Engineer will measure it as a single cofferdam.

Excavation for cofferdams will be measured as specified in Section 210.05, "Method of Measurement". Excavation inside the cofferdam and outside the limits defined in the plans will not be measured.

626.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Cofferdam	Each
Pier Cofferdam	Each

The Department will pay 50 percent of the contract unit price when the cofferdam is installed.

The Department will pay 50 percent of the contract unit price when the cofferdam is removed.

Excavation for cofferdams will be paid for as specified in Section 210.06, “Basis of Payment”. Include excavation inside the cofferdam and outside the excavation limits defined in the plans in the contract unit price for cofferdam items.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 650
OVERLAY OF CONCRETE BRIDGE DECKS

650.01 DESCRIPTION
This work consists of removing and replacing unsound concrete and/or chloride contaminated concrete and resurfacing a bridge deck.

650.02 EQUIPMENT

A. General.

Equipment	Section
Bridge Deck Overlays Finishing Equipment	155.07 D
Sawing	155.09
Grinding	155.11
Concrete Buggy	155.12
Fogger	156.02
Milling Machine	156.03

B. Sandblasting Equipment.
Use sandblasting equipment that removes rust scale, oil, and concrete lattice from the surface of the bridge deck and uncoated reinforcing bars. Do not use equipment that employs the wet sandblasting method.

Equip airlines with filters that remove all oil from the air used by the sandblaster.

C. Pneumatic Hammers.
Use hammers that are no larger than the nominal 30 pound class. Use chipping hammers no larger than the nominal 15 pound class to remove concrete around or beneath reinforcing bars. Pointed bits for pneumatic hammers may only be used when performing Class 4 removals.

D. Hand Tools.
Provide hand tools, such as hammers and chisels, for the removal of final particles of unsound concrete or to achieve the required depth.

E. Hydrodemolition Equipment.
Use hydrodemolition equipment with a water filter and pumping unit that operates in conjunction with a remotely controlled robotic water jet unit. Use equipment that produces high velocity water streams capable of removing concrete to the specified depth and is capable of removing rust and concrete from reinforcing bars. Use potable water.

Calibrate the equipment by adjusting water pressure, robot speed, and jet oscillation speed to achieve the required depth of removal.

F. Placing and Finishing Equipment.
Placing and finishing equipment includes hand tools used for placing and brushing mixed mortar and for distributing concrete to a depth sufficient for the concrete to be struck off with a screed.

650.03 MATERIALS

A. General.

Item	Section
Concrete Admixtures	808
Burlap Cloth	810.01 A
Water	812

B. Deck Concrete.

Use Class AAE-5 Concrete that meets Section 802, "Portland Cement Concrete," except the design compressive strength required will be 4,000 psi at 28 days.

C. Overlay Concrete.

1. General.

Item	Section
Fine Aggregate	802.01 C.3
Coarse Aggregate – Size 5	802.01 C.2

Use cement that meets the requirements of AASHTO M 240, Type IL(MS).

Use coarse aggregate composed of crushed stone. Use crushed stone that has at least one fractured face on 75 percent of the particles retained on the number 4 sieve.

Entrain air within the concrete as specified in Section 802.01 H, "Air Content", except supply concrete with an air content between 5.0 and 7.0 percent of the volume of the concrete at the time of placement.

Produce concrete that has a slump of 1 inch or less, when determined according to ND T 119.

2. Mix Design.

Use a mix design that has the percentages by volume shown in Table 650-01.

Table 650-01

Coarse Aggregate	31% ±1%
Fine Aggregate	31% ±1%
Air	6% ±1%
Water	16% ±1%
Cement	16% ±1%
Total	100%

D. Bonding Grout.

Produce grout for bonding the new concrete with existing deck concrete consisting of equal parts, by weight, of cement and fine aggregate mixed with water. Produce grout with a consistency that allows application with a stiff brush or broom and that does not puddle or run. Thin the grout as necessary when used for sealing construction joints.

650.04 CONSTRUCTION REQUIREMENTS

A. General.

Operate removal equipment without cutting, stretching, or damaging reinforcing steel remaining in place.

Do not allow loads on the portion of the deck from which concrete has been removed, other than the equipment needed to remove and replace concrete.

Use a buggy or pump to place concrete on the bridge deck.

Do not open the overlay concrete to traffic until the curing period is complete.

B. Removals with Mechanical Equipment.

1. General.

Angle pneumatic hammers at 65 degrees or less, as measured from the slab.

Use non-powered hand tools to remove fine particles of concrete or to reach the required depth.

2. Class 1.

Use a milling machine or grinding equipment to remove deck concrete to the depth designated in the plans for Class 1 removals.

3. Class 2.

The Engineer will chain the deck after Class 1 removals are complete to determine the Class 2 removal areas. Remove concrete using a 30 pound pneumatic hammer or a combination of pneumatic hammers and grinding or milling.

4. Class 2-A.

The Engineer will determine the amount of Class 2-A removal after Class 2 removal is complete. The Engineer will direct Class 2-A removal when more than one-half of the circumference of a bar has lost bond with the surrounding concrete. The Engineer may direct Class 3 removals in place of Class 2-A removal if unsound concrete is encountered between reinforcing layers.

Use 15 pound pneumatic hammers and hand tools to remove concrete around the periphery of the reinforcing steel. Obtain a minimum clearance of 3/4 inch around the bar.

5. Class 3.

The Engineer will chain the deck after Class 2 removals are complete to determine the Class 3 removal areas. Remove concrete using 15 pound pneumatic hammers.

6. Class 4.

The Engineer will chain the deck after Class 3 removals are complete to determine Class 4 removal areas. Remove concrete using 15 pound pneumatic hammers, through the full depth of the deck. Leave the edges of the hole tapered inward from top to bottom.

C. Removals with Hydrodemolition Equipment.

1. General.
Immediately after performing each class of removal, use hand or mechanical means to remove loose debris from the deck to prevent debris from adhering to the surface.

In areas inaccessible for using hydrodemolition equipment, remove concrete using mechanical equipment as specified in Section 650.04 B, "Removals with Mechanical Equipment" or handheld hydrodemolition equipment.

2. Class 1H.
The Engineer will designate a trial area of 30 square feet representing sound concrete. Use the trial area to set the hydrodemolition equipment to remove 1/2 inch of sound concrete.

After calibrating the equipment, remove deck concrete to a depth of 1/2 inch below the existing surface. Clean the deck after performing Class 1H removals.

3. Class 2H.
The Engineer will chain the deck after Class 1H removals are complete to determine the Class 2H removal areas that will receive a second pass from the hydrodemolition equipment.

4. Class 3H.
The Engineer will chain the deck after Class 2H removals are complete to determine the Class 3H removal areas that will receive a third pass from the hydrodemolition equipment.

D. Final Preparations Prior to Deck Concrete and Overlay Concrete.
At longitudinal construction joints, saw the previously placed overlay concrete to produce a straight vertical edge before placing the adjacent overlay concrete.

Sandblast the deck and clean the deck surface with compressed air before placing concrete.

Sandblast all exposed reinforcing steel to remove rust scale, oil, and concrete lattice from the surface of the bridge deck and reinforcing bars. Remove reinforcing bars which have lost 25 percent or more of the original cross section and replace with a new lap-splice bar. If a lap-splice is needed, contact the Engineer of Record to determine the required lap length. Use an epoxy coated lap-splice bar only if tying to existing epoxy reinforcing steel. Include fabricating, transporting and installing new lap-splice bars in the bid item "Deck Concrete".

Repair any damaged epoxy coating on reinforcing steel according to ASTM D3963. Remove rust before making repairs. Protect the concrete surface from contamination during rebar coating repairs.

After all preparations are complete, notify the Engineer a minimum of 24 hours before placing concrete.

E. Mixing of Materials.
Set up concrete mixing equipment at the bridge site. Operate the concrete mixer at a rate that allows the finishing operation to proceed at a steady rate.

Perform a yield box test before each pour to determine if the mobile mixer meets the manufacturer's calibration requirements. Perform the yield test as follows:

- Use a 1/4 cubic yard yield box;
- Set the cement meter to zero;
- Discharge concrete until the yield box is full, but not overflowing; and
- Determine the cement meter count for the full yield box.

If the meter count is within 1 percent of the previous meter count, it becomes the new calibrated meter count. If the meter count is not within 1 percent of the previous meter count, recalibrate the mixer as specified by the manufacturer.

Do not use the material placed in the yield box in the deck.

F. Placing, Curing, and Finishing.

1. General.

a. Surface Preparation.

Dry the deck surface, without the use of an open flame. Evenly and thoroughly coat all vertical and horizontal surfaces with a bonding grout using a brush, broom or sprayer system. Do not allow the bonding grout to dry before covering with new concrete.

Place and cure deck concrete prior to placing overlay concrete.

b. Weather Requirements.

Place deck concrete and overlay concrete when the ambient air temperature is 45°F and rising and below 80°F.

c. Finishing Deck and Overlay Concrete.

Do not use water to facilitate finishing deck and overlay concrete.

d. Curing Deck and Overlay Concrete.

Use a curing period of at least 5 days and maintain the temperature of the concrete above 55°F during the curing period.

Place a double thickness of burlap over the concrete within 15 minutes of the screed passing over the concrete. If the wet cure is not applied within 15 minutes of the passing of the finishing equipment, remove and replace the affected concrete. Use a work bridge to place burlap without marring the concrete. Prewet the burlap before placement and keep the burlap continuously moist for the duration of the curing period. Burlap may not be covered by other materials.

Do not perform work or allow vehicles and equipment on the concrete during the curing period.

If enclosures are used to maintain curing temperatures, heat the enclosure with an electric heater or properly vented combustible heater. Before removing the enclosure, decrease the concrete's surface temperature to the air temperature at a rate not to exceed 15°F per hour.

If concrete is exposed to air temperatures below freezing during the curing period, the Engineer and the Department's Bridge Division will perform an evaluation of the in-place concrete to determine serviceability. The results of the evaluation may require remedial action up to and including removal of affected material. Perform remedial action at no additional cost to the Department.

2. Deck Concrete.

a. General.
Use mixing equipment that meets Section 155.03, "Mixers".

Fill up removal areas to the bottom of the Class 1 or 1H removal. Strike off concrete at the bottom of the Class 1 or 1H removal. Leave the top of the deck concrete surface rough.

If the deck concrete placement is less than 1 inch in depth, place deck concrete with overlay concrete, using the material specified in Section 650.03 C, "Overlay Concrete".

b. Full Depth.
If removal is full depth, provide forms to facilitate placement of new concrete. Leave the underside of the deck with a neat and smooth appearance.

3. Overlay Concrete.
Use mixing equipment that meets Section 155.03 C, "Mobile Mixers".

Before concrete placement, move the finishing machine across the rails to check and adjust the screed to ensure proper concrete overlay thickness.

Consolidate the concrete and screed to final grade.

Complete placement before September 15 unless preauthorized by the Bridge Engineer.

Place overlay concrete in one operation leaving no transverse construction joint.

After machine finishing is completed, hand finish with a wood float to produce a tight, uniform surface.

Seal all vertical joints by painting the joint with a thinned grout prior to placing overlay concrete.

G. Surface Tolerances.
After the concrete has cured, the Engineer will test the bridge deck and approach slabs or adjacent pavement, if applicable, for surface irregularities with a 10 foot straightedge.

The Engineer will check the profile by performing the following:

"Check the profile using a 10 foot straightedge oriented in the longitudinal direction and starting at one end of the deck, move the straightedge transversely across the deck to the other edge with constant contact with the deck. Repeat this process in 5 foot intervals from one end of the deck to the other. Check the cross slope using the 10 foot straightedge oriented in the transverse direction and starting at one end of the deck, move the

straightedge longitudinally from one end of the deck to the other end with constant contact with the deck. Repeat this process in 5 foot intervals from one side of the deck to the other."

Grind areas with a deviation greater than 1/8 inch, but less than or equal to 1/2 inch, until the deviation is 1/8 inch or less. The Engineer will apply a contract price reduction as specified in Section 650.06 B, "Surface Tolerance".

The Engineer will make a serviceability determination as specified in Section 105.07, "Conformance with the Contract Requirements" for any deviations greater than 1/2 inch.

H. Grooving.
Perform grooving according to Section 602.04 D.3, "Deck and Approach Slab Grooving".

I. Sealant.
Apply a silicone sealant that meets the requirements of Section 826.02 B.1, "Sealant" to the joint where the deck overlay meets the barrier.

J. Penetrating Water Repellent Treatment.
After grooving operation is complete and the silicone sealant is applied, apply penetrating water repellent solution that meets the requirements of Section 822, "Penetrating Water Repellent" a minimum of 21 days after placement of the concrete deck overlay according to Section 602.04 J, "Penetrating Water Repellent Treatment".

650.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities" and as follows:

A. Class 2-A Removal.
Class 2-A removal is paid for along the upper bar in the top mat of reinforcing only. If a bar that is identified for 2-A is in an area that becomes Class 3 or Class 4, it will not be paid for as 2-A removal.

B. Overlay Concrete.

1. General.
The Engineer will measure overlay concrete at plan quantity unless it is the only concrete material placed due to the thickness requirement specified in Section 650.04 F.2.a, "General". In that instance, the Engineer will measure overlay concrete based on Section 650.05 B.2, "Yield Box Method".

2. Yield Box Method.
The Engineer will measure overlay concrete based on the mobile mixer count and the yield box. The Engineer will obtain counter readings from the mixer before and after each placement and multiply the readings by the meter count determined by the yield test, to determine the concrete quantity.

The Engineer will deduct waste concrete from the measured quantity. The Contractor and Engineer will agree upon the amount of waste, including the material used in the yield test, at the end of each day.

650.06 BASIS OF PAYMENT

A. General.

Pay Item	Pay Unit
Deck Concrete	Cubic Yard
Overlay Concrete	Cubic Yard
Class 1 Removal	Square Yard
Class 2 Removal	Square Yard
Class 2-A Removal	Linear Foot
Class 3 Removal	Square Yard
Class 4 Removal	Square Yard
Class 1H Removal	Square Yard
Class 2H Removal	Square Yard
Class 3H Removal	Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Surface Tolerance.

The Engineer will process a contract price adjustment for overlay concrete based on the surface tolerance measurements determined in Section 650.04 G, "Surface Tolerances". The amount of the contract price adjustment will be determined by multiplying the contract unit price for "Overlay Concrete" by the area ground, measured in square yards, by the appropriate Contract Price Reduction Factor in Table 650-02.

Table 650-02

Deviation	Contract Price Reduction Factor
> 1/8 inch and ≤ 1/4 inch	0.6%
> 1/4 inch and ≤ 1/2 inch	1.8 %

SECTION 702
MOBILIZATION

702.01 DESCRIPTION
Mobilization consists of costs incurred for preparatory work and operations that must be performed before beginning work on the project site.

702.02 EQUIPMENT
Reserved.

702.03 MATERIALS
Reserved.

702.04 CONSTRUCTION REQUIREMENTS
Prepare and move personnel, equipment, and materials to project site.

702.05 METHOD OF MEASUREMENT
The Engineer will measure as specified in Section 109.01, “Measurement of Quantities”.

702.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Mobilization	Lump Sum

Payment for mobilization will be based on Table 702-01:

Table 702-01

Original Contract Amount Earned	Payment will be the Lesser of:	
	Mobilization Bid Amount	Original Contract Amount
5%	25%	2.5%
10%	50%	5.0%
50%	100%	7.5%
75%	100%	10.0%

Upon completion of all original work on the Contract, the Department will make payment for any amount bid for Mobilization in excess of 10 percent of the original Contract amount.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 704
TEMPORARY TRAFFIC CONTROL

704.01 DESCRIPTION
This work consists of furnishing, installing, and maintaining all required traffic control devices, personnel, and necessary precautions for protecting the public and workers.

704.02 EQUIPMENT
Reserved.

704.03 MATERIALS

A. General.

Provide traffic control devices that meet the standards and requirements of the MUTCD and the Standard Highway Signs and Markings Book, published by the FHWA.

Provide traffic control devices that meet the following crash testing requirements:

- Devices manufactured on or before December 31, 2019 must meet the requirements of any of the following:
  - NCHRP 350,
  - MASH 2009, or
  - MASH 2016;
- Devices manufactured on or after January 1, 2020 must meet the requirements of MASH 2016.

Submit a Certificate of Compliance for all temporary traffic control materials before installation.

B. Flagging.

Fabricate STOP/SLOW paddles from light, semi-rigid material with a paddle attached to a rigid handle between 5 and 8 feet in length.

C. Pilot Car.

Mount the “Pilot Car Follow Me” sign on the rear of the pilot car and mount high-intensity rotating, flashing, oscillating, or strobe lights on the roof of the vehicle.

D. Sign Backing Materials.

Use aluminum or plastic sign backing. Use aluminum backing that meets Section 754.04 B, “Sign Fabrication”. Process plastic backing using recommendations of the reflective sheeting manufacturer.

E. Reflective Sheeting.

Traffic Control Device	Section
Tubular Markers and Flexible Delineators	Type III Section 894.02 B
Barrels and Drums	Type IV Section 894.02 C
Cones	Type VI Section 894.02 D
Diamond Signs, Rectangular Signs, Square Signs, Barricades, Vertical Panels, and Stackable Panels	Type XI Section 894.02 E

Traffic control devices and signs fabricated before 04/01/2015 that meet the requirements of the reflective sheeting 2008 Standard Specifications may be used until they fall into the "marginal" classification as defined by ATSSA's *Quality Guidelines for Temporary Traffic Control Devices and Features.*

F. Barricades.
If using aluminum rails, use aluminum that meets the requirements of ASTM Designation B 221, Alloy 6063-T6.

Cover both sides of the barricade rail surface with reflective sheeting.

G. Delineator Drums.
Use delineator drums that are constructed of durable plastic with horizontal, circumferential, orange and white reflectorized stripes.

Weight the delineator drums or design them to be stable.

H. Stackable Vertical Panel.
Use stackable vertical panels that are constructed of hollow low density polyethylene orange plastic that is held in an upright position by a molded rubber base.

Provide reflective sheeting on both sides of the stackable vertical panels using the striping pattern and dimensions specified for vertical panels in the MUTCD.

I. Traffic Cones.
Weight the traffic cones or design them to be stable.

J. Delineators.
Equip each delineator with an acrylic plastic or reflective sheeting reflector mounted on a post support.

Use delineators that meet the requirements of Section 894.04, "Delineators".

K. Portable Precast Concrete Median Barriers.
Unless the Department furnishes the barriers, provide barriers that meet the requirements of Section 704.03 A, "General".

L. Warning Lights.

Use warning lights that are portable, lens directed and enclosed. Use warning lights that meet the requirements of MUTCD and the requirements of Table 704-01.

Table 704-01

	Type A	Type B	Type C
	Low Intensity	**High Intensity**	**Steady Burn**
Lens Directional Faces	1 or 2	1	1 or 2
Flash Rate Per Minute	55 to 75	55 to 75	Constant
Flash Duration[1]	10%	8%	Constant
Min. Effective Intensity[2]	4.0 Candles	35 Candles	
Min. Beam Candle Power[2]			2.0 Candles
Hours of Operation	Sunset to Sunrise	24 hrs./day	Sunset to Sunrise

[1] Length of time that instantaneous intensity is equal to or greater than effective intensity.
[2] These values shall be maintained within a solid angle 9 degrees on each side of the vertical axis, and 5 degrees above and below the horizontal axis.

M. Advance Warning Flashing or Sequencing Arrow Panels.

Use advance warning arrow panels that meet the requirements of Table 704-02.

Table 704-02

Type	Minimum Size (Inches)	Minimum No. of Panel Lamps	Minimum Legibility Distance[1]
A	24 x 48	12	1/2 Mile
B	30 x 60	13	3/4 Mile
C	48 x 96	15	1 Mile

[1] Minimum legibility requirements are the distances at which the arrow panel message can be comprehended by a driver on a sunny day or a clear night.

Provide panel faces with a black, non-reflective finish.

Mount panels on a vehicle, trailer, or other suitable support with a minimum vertical clearance of 7 feet, measured from the ground to the bottom of the panel. If using vehicle mounted panels, equip the panels with remote control capabilities.

Equip arrow panels with one of the following mode selections:

- Left or right flashing or sequencing arrows and double flashing arrows; or
- Left or right sequencing chevrons and caution.

Provide automatic light dimming controls capable of reducing rated lamp voltage a minimum of 50 percent on each arrow panel. Control the dimming with a photoelectric cell that operates between sunset and sunrise. Use arrow panel lamps that flash at a rate between 25 and 40 flashes per minute.

Use lamps that have a minimum “on” time of 50 percent for the flashing arrow and 25 percent for the sequential chevron.

Recess mount the arrow panel lamps or lenses or equip them with an upper hood of not less than 180 degrees. Use lamps that emit yellow light.

704.04 CONSTRUCTION REQUIREMENTS

A. General.

1. Requirements Before Device Installation.
Before beginning work, coordinate and hold a meeting with the Engineer to review the traffic control plans.

2. Placement.
If the placement of work zone signs interferes with permanent signs or an obstruction makes the required location impractical, place the work zone signs at an approved location. Revise the sign messages if necessary.

Place traffic control devices to meet the standards and requirements of the MUTCD and the Standard Highway Signs and Markings Book, published by the FHWA.

Do not lean the sign face or sign supports on sign anchors. Install the sign supports and face or mark the anchors so that they are visible.

Only place traffic control devices that are applicable to actual conditions of the project site. Remove devices once they are no longer necessary. Remove sign bases at the same time that sign faces are removed.

Have all required devices available for installation when needed. Maintain, relocate, cover, or remove devices as necessary.

Install and maintain devices so that they function in the manner that they were crash tested.

3. Traffic Control Maintenance and Revisions.
When the Engineer notifies the Contractor, Traffic Control Supervisor, Watchperson, or Traffic Signal Maintenance Person of the need for traffic control to be furnished, installed, relocated, maintained, removed, or otherwise revised; the Contractor, Traffic Control Supervisor, Watchperson, or Traffic Signal Maintenance Person must be on the project addressing the issue within one hour of the notification.

If additional resources or time are needed, the Engineer and the traffic control personnel on site will agree on an action plan and a time for completion. If the the action plan is not executed or the the Contractor fails to meet the time for completion, the Engineer will take the action detailed in this section.

If the Engineer issues notification of the need for traffic control to be furnished, installed, relocated, maintained, removed, or otherwise revised and the Contractor, Traffic Control Supervisor, or Watchperson fail to comply, the Engineer will perform any combination of the following:

1. The Engineer will apply a contract price reduction of $1,000 if the Contractor, Traffic Control Supervisor, or Watchperson is not on the project addressing the issue within one hour.

2. The Engineer will apply a contract price reduction of $1,000 per day.
3. The Engineer will have the work completed by other means, without additional notification, and deduct the cost of the work from monies due or to become due the Contractor.
4. The Engineer will direct all other work to cease until the deficiencies have been corrected.

B. Traffic Control Device Condition Classifications.

Classify traffic control devices according to ATSSA's *Quality Guidelines for Temporary Traffic Control Devices and Features*, using the designations "acceptable", "marginal", and "unacceptable".

1. Initial installation of Traffic Control Devices.

If traffic control devices are to remain the property of the Contractor upon project completion, provide devices that are classified as "acceptable" at the time of installation.

If traffic control devices are to remain the Department's property upon project completion, the devices must be new at the time of installation and must be classified as "acceptable" when the Department takes possession. If devices are not classified as "acceptable" when the Department takes possession, provide identical devices that meet the "acceptable" designation at no additional cost to the Department.

2. Replacement of Traffic Control Devices.

For each type of device used, except warning lights, a maximum of 25 percent of the quantity may fall into the "marginal" classification during the course of the work. Replace devices as needed so that at least 75 percent of the devices remain classified as "acceptable". Replace any devices that become classified as "unacceptable".

Install replacement devices that are classified as "acceptable" within 24 hours of discovering that the previously installed device falls below the specified classification limit.

Replace devices not covered by ATSSA's *Quality Guidelines for Temporary Traffic Control Devices and Features* when they are no longer in an operable condition.

Clean traffic control devices as necessary to maintain the proper brightness of reflectorized material or warning lights.

C. Personnel.

The traffic control supervisor and traffic signal maintenance person shall be able to access the project site within one hour of notification and be "on call" on a 24 hour basis.

1. Traffic Control Supervisor.

If designated in the plans, provide a traffic control supervisor.

If the designated traffic control supervisor becomes unavailable, designate a replacement supervisor.

a. Qualifications.

Designate a traffic control supervisor that:

1. Has completed a traffic control course as outlined in Section 704.04 C.1.c, "Traffic Control Course".

2. Is familiar with the requirements of the Department traffic control plans and specifications.
3. Has a total of at least 12 months experience with traffic control plans, layouts and maintenance.
4. Is competent to supervise personnel in traffic control operations.

b. Duties.

The traffic control supervisor shall:

1. Provide traffic control as required
2. Perform and document a daily inspection of the installation, operation, maintenance, and removal of all traffic control devices. Submit copies of the daily inspection documents on a weekly basis.
3. Correct traffic control conditions that cause erratic vehicle movements, unexpected braking, etc.
4. Propose changes to improve traffic flow through the work zone.

c. Traffic Control Course.

A 16 hour minimum traffic control course shall be one of the following:

- ATSSA Traffic Control Supervisor Course;
- AGC Traffic Control Supervisor Course;
- NHI's Design and Operation of Work Zone Traffic Control, course number 133112A; or
- Approved subject courses with a minimum of 3 hour per subject of the following(combined total must be at least 16 hours):
  - Manual and standard signs used in work areas;
  - Channelizing devices and temporary barriers, pavement markings, lighting devices, arrow displays and special devices, and devices location and placement;
  - Layout for traffic control devices, motorist characteristics, and options and alternatives;
  - Installation and removal of the traffic control zone, and operation and maintenance of the traffic control zone; and
  - Flagging operations, legal liability and record keeping, and emergency situations.

Each course or subject course shall include a workshop covering:

- Designing traffic control;
- Installation and removal; and
- Operations and maintenance.

Each workshop shall also include a question and answer portion.

A valid Minnesota Department of Transportation Traffic Control Supervisor Certification will be accepted in lieu of traffic control courses listed above.

2. Watchperson.

Provide a watchperson that patrols the project to ensure that the traffic control devices are properly placed. If the plans specify a traffic control supervisor, the traffic control supervisor may be designated as the watchperson.

On days when work is in progress, the watchperson shall patrol the project at least three times per day, with a minimum of 6 hours between inspections.

On days when no work is in progress the watchperson shall patrol the project twice per day, once each morning and once each evening before sunset.

The watchperson shall perform at least one inspection per week after dark.

If work is being performed 24 hours a day, the watchperson shall patrol the project every 8 hours.

The watchperson shall perform and document a daily inspection of the work that they perform. Submit a copy of the daily inspection documentation and watchperson's hours on a weekly basis.

Immediately assist the watchperson to correct conditions that cause erratic traffic movement, unexpected braking, etc., and erect, repair, replace, or relocate the required traffic control devices.

The Engineer may allow suspension of watchperson service during periods of authorized suspension of work or after substantial completion of the work.

3. Traffic Signal Maintenance Person.

If permanent or temporary traffic signals are being installed, designate a traffic signal maintenance person. This person is in addition to the traffic control supervisor and the watchperson as specified in Sections 704.04 C.1, "Traffic Control Supervisor" and 704.04 C.2, "Watchperson". The Engineer may allow the traffic control supervisor to perform the responsibilities of the traffic signal maintenance person provided that they have the appropriate training or experience.

The traffic signal maintenance person shall be responsible for maintenance of interim and permanent traffic signals.

4. Emergency Contact Information.

Provide written documentation to the Engineer, Highway Patrol, 911 Coordinator, and local law enforcement agencies of the name, address, and phone number of the:

- Superintendent as outlined in Section 105.02, "Contractor Requirements";
- Traffic Control Supervisor as outlined in Section 704.04 C.1, "Traffic Control Supervisor";
- Watchperson as outlined in Section 704.04 C.2, "Watchperson"; and
- Traffic Signal Maintenance Person as outlined in Section 704.04 C.3, "Traffic Signal Maintenance Person".

If any of the listed personnel change, provide written notification containing the new name, address, and phone number to the Engineer, Highway Patrol, 911 Coordinator, and local law enforcement agencies, within 24 hours of the change.

5. **Flaggers.**
Before individuals will be allowed to perform flagging, the Engineer must receive written verification that the flaggers provided for the project have passed the written examination found at http://www.ndsc.org/.

Furnish each flagger with the North Dakota Flagging Handbook. Ensure each flagger observes the rules and regulations contained in the North Dakota Flagging Handbook. If there are any differences between the requirements in the handbook and specifications, the specifications will govern over the handbook. The handbook is available for download at www.ndltap.org and at http://www.ndsc.org/.

Do not assign flaggers other duties while working as authorized flaggers.

If flagging is performed after sunset, provide each flagger with a flashlight topped with a transparent red glow cone and a reflectorized STOP/SLOW paddle. Illuminate the flagger's location using floodlights as specified in Section 704.04 K.6, "Floodlights".

6. **Pilot Car.**
Use a pilot car to guide vehicles through or around the construction area when traffic is reduced to a single lane. At each end of the single lane section, coordinate the pilot car operation with flaggers.

D. Signing.

1. **Project Terminal Signing.**
Before starting work, erect the required traffic control devices at each end of the project and at intersecting roadways shown on plans. Leave these devices in place and maintain them for the duration of their use.

2. **Work Area Signing.**
Do not start construction work until the proper traffic control devices for the work area are in place. If no details are provided for the particular type of construction work involved, install traffic control devices according to the MUTCD or as directed by the Engineer.

If additional signing is required due to Contractor operations:
- Furnish flaggers at no additional cost to the Department until the additional signs are installed; or
- Cease construction operations in that area until the additional signs are installed.

Relocate, remove, or change traffic control devices so that the devices match the actual conditions of the project site.

When no work is in progress, completely cover or remove signs that are only necessary when work is being performed.

Ensure all portable sign mounts that are in place longer than 24 hours or in place after sunset are perpendicular to the ground.

If portable signs are trailer mounted, use trailers that meet the crash test requirements of NCHRP Report 350 or MASH.

Place portable signs on the shoulder or outside of the traveled lane without posing a hazard to traffic and in clear view of oncoming traffic without sight obstructions.

When portable signs are not in use:

- Move the signs a minimum of 60 feet from the edge of the traveled lane and place so that the message cannot be read by traffic; or
- Lay the signs face down on the foreslope. Only lay signs on the foreslope if the laydown height is 6 inches or less.

3. Existing Signs.
Reset existing traffic signs that are moved to accommodate construction activities.

4. Route Markers.
The Department will furnish necessary route marker signs. Furnish all necessary hardware to install the Department furnished signs.

Install the Department furnished route marker signs on Contractor furnished posts.

E. Barricade and Vertical Panel Application.

1. General.
Barricade rails and vertical panels with stripes that begin in the upper right corner and slope down and to the left are “right” devices. Install “right” devices on the right side of a traffic lane. Barricade rails and panels with stripes that begin in the upper left corner and slope down and to the right are “left” devices. Install “left” devices only on the left side of a traffic lane.

2. Barricades.
Use Type I or Type II barricades to mark a specific hazard or to channelize traffic. If using Type I or Type II barricades to channelize traffic, install barricades so that they face the oncoming traffic.

When closing a section of road, install Type III barricades at the points of closure. Extend the Type III barricades completely across the roadway including the shoulders or from curb to curb.

If access for equipment and authorized vehicles is necessary, use Type III barricades with gates or movable sections that can be closed when work is not in progress, or with indirect openings that discourages public entry.

If the road is closed, but access to local traffic must be furnished, arrange the Type III barricades to permit local traffic only.

Do not use Type III barricades to channelize traffic.

If the construction limits encroach onto pedestrian routes and the pedestrian traffic cannot be diverted to other existing pedestrian routes, install Type III barricades to define the temporary pedestrian access.

3. **Vertical Panel – Back to Back.**
   Use vertical panels that are faced on both sides as channelizing devices, warning devices, or windrow markers.

4. **Stackable Vertical Panel.**
   Use stackable vertical panel to channelize traffic.

F. Drum Application.
Use drums to channelize or delineate traffic flow or to mark specific hazards.

G. Traffic Cone and Tubular Marker Application.
Use traffic cones and tubular markers to channelize traffic. Use additional weighting as required to prevent overturning or displacement.

H. Flexible Delineator Application.
If using a two-sided delineator, keep the wide side of the delineator toward traffic. If the delineator is to be seen by side traffic, use an additional delineator with its wide side placed facing the side traffic. The Engineer will not measure the additional delineator for payment.

I. Delineator Application.
Use delineators within project site for traffic guidance. Do not use delineators as warning devices.

Mount delineators on supports so the reflector is 4 feet above the roadway edge. Use white reflectors for delineators installed along the right side of the road. Use yellow reflectors for delineators installed along the left edge of divided streets, divided highways, and one-way roads.

Along roadway curves, space delineators as specified in the MUTCD.

J. Precast Concrete Median Barrier (State Furnished).

1. **Pickup.**
   At least two weeks before taking control of State furnished barriers; notify the Engineer of the date that control will be taken. Notify the Engineer 24 hours in advance to verify the time of pickup.

   Before taking control of the barriers, perform an inventory of all barriers and associated materials to be received with the Engineer, and document the results. Both parties must sign and date the inventory. Each party must retain a signed copy of the inventory.

   Provide necessary equipment to load and secure the barriers.

2. **Return.**
   At least two weeks before transporting barriers to the designated storage location, notify the Engineer of the transportation date. Notify the Engineer 24 hours in advance to verify the time of return.

   When returning, stack barriers on 4 inch by 4 inch boards on the ground and in between stacked rows of barriers.

At the time of storage, place a connecting bolt assembly, including two washers and a nut, through the barrier loop on each barrier. Thread the nut onto to the bolt a sufficient distance to secure the bolt assembly to the barrier during transport.

After completing delivery, perform an inventory of the barriers and associated materials with the Engineer, and document the results. Replace any barriers or materials that have been damaged or lost at no additional cost to the Department. After any replacement items have been delivered, the Engineer and the Contractor will sign and date the inventory and both parties will retain a copy.

Provide necessary equipment to unload the barriers.

3. **Barrier Markers.**
   Replace missing barrier markers on the State furnished barriers before allowing two way traffic and throughout the usage of the barriers.

K. Lighting Device Application.

1. **Flashing Lights (Type A, Low-Intensity).**
   Use Type A low-intensity flashers to warn drivers that they are approaching or traveling in a hazardous area.

2. **Flashing Lights (Type B, High-Intensity).**
   Use high-intensity flashers at extremely hazardous site conditions. Operate the high-intensity flashers 24 hours per day.

3. **Steady-Burn Lights (Type C).**
   Use steady-burn warning lights to delineate the edges of the traveled way on detour curves, on lane changes, and along tapers.

4. **Mounting Height of Warning Lights.**
   Mount warning lights on:
   a. Barricade and portable barriers with a minimum height of 36 inches from the bottom of the lens to the roadway.
   b. Signs with the bottom of the light housing between 2 and 12 inches above the top of the sign.
   c. Vertical channelizing devices and independent supports between 4 and 5 feet above the pavement.

5. **Sequencing Arrow Panels.**
   During nighttime operations, use an automatic dimmer on the lamps to dim them to 50 percent of the output.

6. **Floodlights.**
   If construction activities are performed at night, provide floodlighting for the construction area, inspection area, and flagger stations. Adequately illuminate the area without creating glare in the eyes of drivers.

L. Attenuation Devices.

In addition to the modules for layouts as required in the plans, provide additional replacement modules for each layout location, up to a maximum of 20 modules per contract. Place the replacement modules at a location acceptable to the Engineer.

Maintain the modules in each layout. Replace any damaged modules. If the replacement modules are installed, have additional replacement modules available within 3 calendar days.

M. Protection Vehicle with Truck Mounted Attenuation Device (TMA).

Provide a protection vehicle with a truck mounted attenuation device to protect personnel and equipment from damage during mobile operations.

Use truck-mounted attenuation devices that meet the test requirements of NCHRP Report 350 or MASH test level TL-3.

Use a protection vehicle equipped with a TMA. Use a protection vehicle that is of a weight recommended by the manufacturer of the TMA.

Equip the protection vehicle with an advance warning flashing or sequencing arrow panel conforming to Section 704.03 M, “Advance Warning Flasher or Sequencing Arrow Panel” and the MUTCD.

N. Obliteration of Pavement Marking.

1. Removal.

Remove existing markings and place the new delineation before opening the affected lane or lanes to traffic.

Do not permanently damage the surface or texture of the pavement when removing pavement markings. Where blast cleaning is used for removal of markings immediately remove the blast material from the pavement.

2. Masking.

Masking of existing pavement markings will be allowed when indicated in the plans and will allow the option of masking or require the use of masking.

When masking is used, overlap the masking over the existing marking by 1 inch on each side.

Mask markings using paint or tape. Mix paint so as to closely approximate the color of the in-place pavement. Use removable, non-reflective, preformed tape that minimizes contrast with the pavement.

O. Traffic Control for Uneven Pavement.

1. General.

If pavement in adjacent lanes or the shoulder adjacent to an open lane is uneven at the completion of a day’s work, install traffic control devices as specified in this section.

Leave these devices in place until the pavement surface in the adjacent lanes or shoulder are even.

2. Two Lane Roadways.

Install an “Uneven Lanes” sign (Sign W8-11-48) and a supplementary plaque identifying the length of the uneven pavement (Sign W20-52-54). Place this assembly on the right shoulder, in both directions, in advance of the uneven pavement.

Between the “Uneven Lanes” sign and the beginning of the uneven pavement, install a “Do Not Pass” sign (Sign R4-1-48) on the right shoulder in both directions.

Install “Uneven Lanes” signs and a supplementary plaque identifying the length of the uneven pavement at the following intersections:

- County Major Collectors;
- State Highways;
- US Highways; and
- Interstate Ramps.

Install tubular markers spaced at 2 times the posted speed limit through the uneven pavement area.

3. Multilane Roadways.

a. Uneven Pavement 2 Inches or Less.

Install an “Uneven Lanes” sign (Sign W8-11-48) and a supplementary plaque identifying the length of the uneven pavement (Sign W20-52-54). Place this assembly on the right shoulder, in advance of the uneven pavement.

Install “Uneven Lanes” signs and a supplementary plaque identifying the length of the uneven pavement at the following intersections:

- County Major Collectors;
- State Highways;
- US Highways; and
- Interstate Ramps.

b. Uneven Pavement Greater Than 2 Inches.

Install an “Uneven Lanes” sign (Sign W8-11-48) and a supplementary plaque identifying the length of the uneven pavement (Sign W20-52-54). Place this assembly on the right shoulder, in advance of the uneven pavement.

Between the “Uneven Lanes” sign and the beginning of the uneven pavement, install a “Do Not Pass” sign (Sign R4-1-48) on the right shoulder.

Install “Uneven Lanes” signs and a supplementary plaque identifying the length of the uneven pavement at the following intersections:

- County Major Collectors;
- State Highways;
- US Highways; and
- Interstate Ramps.

Install tubular markers spaced at 2 times the posted speed limit through the uneven pavement area.

4. Uneven Shoulder and Adjacent Lane.
If the shoulder and adjacent driving lane are not even at the end of the day, the following criteria will apply:

Install “Shoulder Drop Off” signs (Sign W8-9a-48) and supplemental plate W20-52P-54 at the following locations:

- In advance of the drop off;
- Spaced at each mile from the advance sign; and
- At major intersections (CMC routes, state and US highways, and Interstate ramps).

If the difference in elevation between the shoulder and the driving lane is 2” or greater, construct a slough at the edge of the driving lane that is 4:1 or flatter.

If the difference in elevation between the shoulder and the driving lane is less than 2”, no slough is required.

704.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will only measure traffic control devices that were authorized by the Engineer before their installation. The Engineer may authorize but will not measure devices beyond the quantity included in the plans that become necessary due to the Contractor’s methods or work sequence. This includes instances where the type of operation is included in the work area layouts included in the plans.

704.06 BASIS OF PAYMENT

A. General.
The Engineer will pay for the maximum required number of each type of device used at one time. The Engineer will not pay for the reuse, relocation, and replacement of devices.

If an Engineer order or a contract revision necessitates the relocation of signs mounted on fixed supports, the Engineer will determine the number of sign units that were relocated and the Department will pay the Contractor for 50 percent of those units at the contract unit price as payment for the relocation.

The Department will not make payment for any existing traffic control devices that are turned away, covered, taken temporarily out of service, and then returned to use.

The Department will not make payment for any traffic control devices relocated as required by construction operations.

Pay Item	Pay Unit
Flagging	Man Hour
Traffic Control Sign	Unit
Attenuation Device – Type B - __	Each
Type __ Barricade	Each
Delineator Drums	Each

Pay Item	Pay Unit
Traffic Cones	Each
Tubular Markers	Each
Delineator	Each
Flexible Delineators	Each
Stackable Vertical Panels	Each
Vertical Panels – Back to Back	Each
Sequencing Arrow Panel – Type __	Each
Traffic Control	Lump Sum
Pilot Car	Hour
Portable Precast Concrete Median Barrier	Linear Foot
Portable Precast Concrete Median Barrier – State Furnished	Each
Portable Changeable Message Sign	Each
Obliteration of Pavement Marking	Square Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

B. Lump Sum Traffic Control.

If traffic control is included in the contract as a lump sum, the Department will make payment equal to:

- 50 percent of the unit price at the time the traffic control is installed;
- 25 percent of the unit price when the contract is 50 percent complete; and
- The remaining 25 percent of the unit price when the traffic control is removed from the project.

C. Nonstandard Signs.

A nonstandard sign is defined as a sign that is unique to a project specific situation.

If the Contractor is required to furnish a nonstandard sign that was not included in the Contract, the Engineer will make payment at invoice price plus 15 percent.

D. Precast Concrete Median Barrier (State Furnished).

The Department will make payment for Precast Concrete Median Barrier (State furnished) as follows:

- 50 percent of the contract unit price will be paid when the barriers have been placed on the project site.
- The remaining 50 percent of the contract unit price will be paid when the barriers have been removed from the project, transported to the storage area designated in the Contract and accepted by the Engineer with all applicable hardware accounted for in the Contractor provided written inventory.

Include the cost of obtaining, transporting, installing, moving, and maintaining the barriers in the contract unit price for “Portable Precast Concrete Barriers – State Furnished”.

E. Attenuation Devices.

The Department will make payment for "Attenuation Devices Type B" by the number of arrays installed.

The Department will reimburse the Contractor for damaged modules based on module invoice price plus 10 percent.

SECTION 706
LABORATORIES

706.01 DESCRIPTION
This work consists of furnishing and placing a field laboratory.

706.02 EQUIPMENT

A. General.

Provide a level, fully insulated, and weather tight building

Equip the exterior doors with a working latch and a hasp that is capable of receiving a padlock.

Provide a laboratory that has the following:

1. A minimum of six screened windows on two or more sides, with a minimum of one window in each room. Windows shall have a minimum area of 4 square feet;
2. A constant source of electricity;
3. A minimum of 6 convenience outlets spaced throughout the building;
4. Sufficient light fixtures to uniformly light the interior;
5. A constant potable water supply with a minimum pressure of 5 psi or a minimum head of 12 feet when a gravity tank is used;
6. A faucet and sink. The sink shall drain to the exterior and away from the laboratory;
7. A heating system capable of maintaining a minimum temperature of 70°F;
8. An air conditioning system capable of maintaining a temperature below 80°F;
9. An operable portable fire extinguisher capable of controlling Class A, B, and C fires in each room of the laboratory;
10. Entry steps with a 4 feet x 4 feet landing that meet the following:
    - A non-slip surface;
    - Securely fastened to the building;
    - Position the landing so a person carrying a load can stand on the platform and safely enter the laboratory; and
    - A safety railing.
11. Workbenches shall be:
    - Sturdy;
    - A minimum of 24 inches deep; and
    - 36 inches to 42 inches above the floor.
12. A Microwave with a minimum of 900 Watts of power, 1 cubic foot of interior space, and a removable glass tray;
13. 30 inch range with an oven capable of maintaining a temperature between 221°F and 239°F;
14. A chair; and
15. A table or desk.

Furnish Aggregate and Bituminous labs with DSL broadband internet and a router that broadcasts Wi-Fi and will allow for hard wiring of a computer.

The building and fixtures remain the property of the Contractor after the work is completed.

B. Aggregate Laboratory.

Place the laboratory at a location acceptable to the Engineer. The Engineer will have the full control and the exclusive use of the laboratory.

Provide a laboratory with a minimum floor area of 230 square feet, minimum exterior width of 8 feet, and a minimum ceiling height of 7 feet.

Partition the building into a minimum of two rooms, a smaller room having a floor area of approximately 70 square feet.

Provide a workbench with a length of 7 feet in the smaller room:

Provide the following equipment in the larger room:

1. Mechanical shaker capable of receiving 6 trays that have a screen size of 14 inches by 14 inches and the following compatible sieves:
   - 1-1/2 inch;
   - 1-1/4 inch;
   - 1 inch;
   - 3/4 inch;
   - 1/2 inch;
   - 3/8 inch;
   - No. 4; and
   - An enclosed dust pan.
2. Mary Ann shaker capable of being adjusted to receive 8 and 12 inch diameter sieves;
3. Splitter with a maximum hopper capacity of 0.6 cubic feet;
4. Splitter with a minimum hopper capacity of 1.0 cubic feet; and
5. An exhaust fan capable of changing the air in the room every minute.

C. Bituminous Laboratory.

Place the laboratory at the plant site near the Contractor's laboratory and where plant operations will not interfere with the laboratory equipment. The Engineer will have the full control and the exclusive use of the laboratory.

Provide the following items:

1. Mary Ann shaker capable of being adjusted to receive 8 and 12 inch diameter sieves.
2. Splitter with a maximum hopper capacity of 0.6 cubic feet.
3. Splitter with a minimum hopper capacity of 1.0 cubic feet.
4. A water bath that holds a minimum of 5 gallons. Equip the water bath with thermostatic controls capable of maintaining a water temperature between 76°F and 78°F. Equip the water bath with an overflow system to maintain a uniform water level and a recirculation system with on/off controls.
5. An orbital shaker with:
   - An orbit size of 0.75 in and a stirring speed range between 40 and 400 RPM;
   - A top plate large enough to accommodate two 2,000 milliliter filtering flasks; and
   - Two clamps to hold flasks in place.
6. A vacuum pump capable of evacuating air from a 2000 milliliter filtering flask to a residual pressure of 30 millimeters mercury (4.0 kilopascals).
7. A vacuum gauge capable of measuring a minimum pressure of 30 millimeters mercury (4.0 kilopascals).

8. A forced draft oven with an interior capacity of 6 cubic feet and that is capable of maintaining a temperature between 320°F and 330°F.
9. An insulated container to transport bituminous mix from the paver to the laboratory. Provide a container large enough to hold 22 pounds of mix that will be in other containers.

D. Contractor's Laboratory.
Provide a laboratory and equipment necessary to perform the Quality Control (QC) tasks required in Section 430, "Hot Mix Asphalt". Include a gyratory compactor that meets the requirements of AASHTO T 312.

The Engineer will use the gyratory compactor in this laboratory to perform required Quality Assurance testing. Allow the Engineer access to the gyratory compactor for inspection and use.

706.03 MATERIALS
Reserved.

706.04 CONSTRUCTION REQUIREMENTS

A. General.
Level, block, and tie down the lab when placing.

Notify the Engineer when the laboratory is ready for occupancy. Do not begin work associated with the laboratory until the Engineer has accepted the laboratory.

Do not remove the laboratory until it is released by the Engineer.

B. Aggregate and Bituminous Laboratories.
Aggregate and Bituminous laboratories are for the Engineer's exclusive use. Perform all functions requiring the use of laboratory equipment in the Contractors Laboratory or other facilities separate from those provided for the Engineer.

Once the Engineer has accepted the laboratory, the Engineer and Contractor will perform a review of the condition of the contents and the laboratory. Provide an inventory of the initial condition of the contents and the laboratory. The Engineer must review and sign the inventory. The Contractor and Engineer will perform a second review of the condition of the contents and the laboratory before the Engineer releases the laboratory. If any of the contents need to be repaired and replaced due to misuse or negligence, the Department will compensate the Contractor as specified in Section 104.02, "Contract Revisions".

C. Contractor's Laboratory.
Notify the Engineer when the gyratory compactor is ready for initial inspection. Do not begin work that requires the Engineers use of the gyratory compactor until the Engineer has approved the gyratory compactor and the access to the gyratory compactor.

706.05 METHOD OF MEASUREMENT
The Engineer will measure as specified in Section 109.01, "Measurement of Quantities".

706.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Aggregate Laboratory	Each
Bituminous Laboratory	Each
Contractor’s Laboratory	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 709
GEOSYNTHETICS

709.01 DESCRIPTION
This work consists of furnishing and installing geosynthetics.

709.02 EQUIPMENT
Reserved.

709.03 MATERIALS

Item	Section
Geosynthetics	858

709.04 CONSTRUCTION REQUIREMENTS

A. General.
Package, label, identify, handle, and store geosynthetic according to ASTM D 4873. Wrap each geosynthetic roll (excluding Geogrid – Type G and Reinforcement Geogrid – Type RG) with a material that will protect the roll, including the ends of the rolls, from damage due to shipment, water, sunlight, and contaminants. Maintain protective wrapping during periods of shipment and storage. Store geosynthetic onsite elevated off the ground.

Install geosynthetic only after receiving approval from the Engineer. Place the geosynthetic on a surface that is smooth and free of stones, sticks, and other debris or irregularities that could damage the geosynthetic. Manually pull the geosynthetic taut to remove wrinkles. Do not operate construction equipment directly on the geosynthetic.

After laydown, cover geosynthetic material within 5 days. Remove and replace material that is not covered within 5 days.

B. Geosynthetic Drainage Material (Type D).
Secure geosynthetic using the manufacturer's recommended methods. After securing geosynthetic material in place, deposit the aggregate using methods that will not tear, puncture, or reposition the geosynthetic. Do not drop aggregate on the geosynthetic from a height greater than 3 feet.

C. Geosynthetic Geogrid (Type G).

1. General.
Unroll geogrid parallel to the centerline of the road. Do not drag the geogrid across the underlying material.

Overlap geogrid a minimum of 18 inches at all splices and joints when placing on subgrade. Overlap geogrid a minimum of 12 inches at all splices and joints when placing on base.

Construct overlaps at the end of a roll so the previous roll laps over the subsequent roll in the direction of the cover material placement. Mechanically tie transverse joints to maintain

the minimum overlap. Place pins, staples, or small piles of aggregate to maintain the geogrid position before placement of cover material.

Place geogrid in straight segments only; when placing around curves increase overlap distances or create smaller straight segments.

Patch damaged areas of geogrid. Place a patch that overlaps all sides of the damaged area by 36 inches. Mechanically tie the patch to the underlying grid.

2. Cover Material Placement.
Place the first lift of material over geogrid to a depth of 8 inches of loose material.
Use low ground pressure equipment to spread the initial lift of material. If rutting occurs, fill the ruts with additional material before placing the subsequent lift. Blading out ruts is not an allowable method of rut removal. Do not turn construction equipment on the first layer of material.

D. Geosynthetic Reinforcement (Type R).

1. General.
Unroll geosynthetic parallel to the centerline of the road. Place the geosynthetic taut and pin the geosynthetic using pins at least 6 inches in length. Place pins at all corners and at 15-foot intervals along all edges, before placing material on the geosynthetic.

Overlap the geosynthetic a minimum of 18 inches at all splices or joints. Construct joints at the end of a roll so that the previous roll laps over the subsequent roll in the direction of the material placement.

Patch damaged areas by overlapping the tear a minimum of 36 inches with geosynthetic and secure the perimeter of the patch area with pins or staples.

2. Cover Material Placement.
Place an 8 inch loose initial lift of material above the geosynthetic.

Use low ground pressure equipment to spread the initial lift of material. If rutting occurs, fill the ruts with additional material before placing the subsequent lift. Blading out ruts is not an allowable method of rut removal. Do not turn construction equipment on the first layer of material.

E. Geosynthetic for Riprap (Type RR).
Place geosynthetic with the longest dimension parallel to the direction of water flow. Place overlaps so the upstream strip overlaps the downstream strip. Overlap splices and joints at least 18 inches. Overlap splices and joints placed underwater at least 36 inches. Pin or staple all overlaps at 3-foot intervals.

Patch damaged areas by overlapping the tear a minimum of 36 inches with geosynthetic and secure the perimeter of the patch area with pins or staples.

Material placed to protect against wave action may be unrolled parallel or perpendicular to the water’s edge.

F. Geosynthetic Separation Material (Type S).

1. General.
Unroll the geosynthetic in line with the placement of the new material. Do not drag the geosynthetic across the underlying material. Use geosynthetic widths that produce overlaps of parallel rolls at the centerline and at the shoulders and so that no overlaps are required along wheel paths.

Overlap the geosynthetic a minimum of 18 inches at all splices or joints. Construct joints at the end of a roll so that the previous roll laps over the subsequent roll in the direction of the material placement.

Patch damaged areas by overlapping the tear a minimum of 36 inches with geosynthetic and secure the perimeter of the patch area with pins or staples.

Secure the geosynthetic using the manufacturer's recommended methods.

2. Cover Material Placement.
Place the initial lift of material above the geosynthetic to a depth of 8 inches of loose material. When placing the initial lift of material, limit construction equipment in size and weight so rutting in the initial lift is less than 3 inches. If rutting occurs, fill the ruts with additional material before placing the subsequent lift. Blading out ruts is not an allowable method of rut removal. Do not turn construction equipment on the first layer of material.

G. Geosynthetic Reinforcement Geogrid (Type RG).

1. General.
Place the geosynthetic reinforcement in continuous longitudinal panels with the strength (roll) direction oriented perpendicular to the face of the embankment slope/retaining wall face. Do not drag the geogrid across the underlying material. Do not splice the geosynthetic reinforcement by any method in the primary strength direction. Overlap geogrid a minimum of 12 inches at all joints.

Mechanically tie transverse joints to maintain the minimum overlap. Place pins, staples, or small piles of aggregate to maintain the geogrid position before placement of cover material. Cut or increase overlaps to conform to curves.

2. Cover Material Placement.
Place the first lift of material over the geosynthetic reinforcement geogrid to a depth of 8 inches of loose material. Use low ground pressure equipment to spread the initial lift of material. If rutting occurs, fill the ruts with additional material before placing the subsequent lift. Blading out ruts is not an allowable method of rut removal. Do not turn construction equipment on the first layer of material.

709.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and as follows:

The Engineer will not measure overlaps, drainage trenches, or cutoffs.

709.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Geosynthetic Material Type __	Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 714
CULVERTS, STORM DRAINS, EDGEDRAINS, AND UNDERDRAINS

714.01 DESCRIPTION
This work consists of installing culverts, storm drains, edgedrains, and underdrains.

714.02 EQUIPMENT
Reserved.

714.03 MATERIALS

A. Culverts and Storm Drains.

Item	Section
Reinforced Concrete Culvert, and Storm Drain Pipe	830.01 A
Precast Reinforced Concrete Manhole Sections	830.01 B
Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts, Storm Drains, and Underdrains	830.02 B
Smooth Wall Steel Pipe Culverts	830.02 F
Polymer Coated Corrugated Steel Pipe	830.02 C
Corrugated Polyethylene Culverts	830.03 F
Geosynthetic Material – Type S2	858.01

Provide mortar consisting of a mixture of one part Portland Cement to two parts mortar sand, and sufficient water to furnish proper consistency.

Where placing new end sections on existing pipe, identify whether the type of end section needed is male or female.

If using polymer coated corrugated steel pipe, install end sections that meet the requirements of Section 830.02 C “Polymer Coated Corrugated Steel Pipes” or 830.02 B, “Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts, Storm Drains, and Underdrains”.

B. Underdrains.

Item	Section
Perforated, Corrugated Polyethylene	830.03 A.4

Table 714-01
Underdrain Aggregate Gradation

Sieve Size	Percent Passing
3/8 Inch	100
No. 4	95 – 100
No. 16	45 – 80
No. 50	10 – 30
No. 100	0 – 10
No. 200	0 – 3

C. Bridge Approach Drains.

Item	Section
Plastic Pipe (perforated and non-perforated)	830.03 A.4
Geosynthetic Material – Type D1	858

Table 714-02
Bridge Approach Drain Gradation

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 – 10
No. 8	0 – 5
No. 200	0 – 1.0

D. Edgedrains.

Item	Section
Class 43 Aggregate	816.03
Perforated, Corrugated, P.E. Pipe	830.03 A.4
PVC Discharge Pipe	830.03 A.3
Geosynthetics	858

The shale and L.A. abrasion requirements will not be required for Class 43 Aggregate

E. Structural Plate Pipe.
Material shall meet Section 830.02, "Metal Pipe".

714.04 CONSTRUCTION REQUIREMENTS

A. General.

1. Existing Drainage Facilities.
If the existing drainage facilities become inoperable before the new drainage system is functioning, provide sufficient temporary pumping and drainage facilities to keep the roadway drained. Include the cost of providing sufficient temporary pumping and drainage in the price bid for other items.

2. Excavation.
Dispose of unsuitable or excess excavation at an approved location.

3. Geosynthetic Reinforcement.
Install geosynthetic reinforcement transversely along the length of the pipe. Overlap geosynthetics as specified in Section 709.04, "Construction Requirements" for the applicable material type.

Place 10 inches of loose aggregate over geosynthetic material, except directly under pipe, before compacting.

4. **Bedding.**
   Tamp bedding material in place under both haunches of the pipe up 15 percent of the total height by hand-held air-operated, mechanical tampers.

5. **Laying Pipe.**
   Begin laying pipe at the downstream end. Place the pipe in contact with the shaped bedding throughout its full length. Place bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe facing upstream.

6. **Joining Pipe.**
   Provide rigid pipe with bell and spigot or tongue and groove joints. Join pipe sections so the ends are fully entered and the inner surfaces are flush and even. Wrap joints on concrete pipes in Type S2 geotextile fabric.

7. **Relaid Pipe.**
   Clean all salvaged pipe of foreign material before reinstallation.

   Furnish connecting devices or seals needed to join pipe or end sections.

8. **Deflection Testing.**
   Test all metal and thermoplastic pipe used for mainline and paved intersecting roadways for deflection a minimum of 30 days after the pipe is installed. Pass a nine point mandrel or other approved object through the pipe to check for deflection. Use a mandrel with a diameter not less than 95 percent of the inside diameter of the pipe. If the mandrel cannot be passed through the pipe, replace the pipe.

   The Engineer will visually inspect all metal and thermoplastic pipe under unpaved approaches for deflection. If the Engineer sees any deflection, the Engineer will require the Contractor to pass a nine point mandrel or other approved object through the pipe to check for deflection. Use a mandrel with a diameter not less than 95 percent of the inside diameter of the pipe. If the mandrel cannot be passed through the pipe, replace the pipe.

   Perform the deflection test under the observation of the Engineer.

9. **Connection to Manholes, Inlets, and Pipes.**
   If connections are required to a manhole, inlet barrel, or pipe entrance, connect pipe by cutting the opening and grouting in the connecting pipe.

10. **Compaction Control for Aggregate.**
    Compact aggregate to at least 90 percent of the maximum dry density with a moisture content at the time of compaction not less than 2.0 percentage points below, nor more than 3.0 percentage points above the optimum moisture content. The Engineer will determine the maximum dry density and optimum moisture content as specified in ND T180.

    Compact aggregate for approach pipes according to the conduit manufacturer’s recommendation

    Use a maximum lift thickness of 6 inches.

11. Compaction Control for Non-Aggregate Material.
Compact non-aggregate material to the compaction requirements in Section 203.04 G.2, "Compaction Control, Type A." Use a maximum lift thickness of 6 inches.

Compact material for approach pipes according to the conduit manufacturer's recommendations.

12. Construction Cover.
Meet the pipe manufacturer's recommendation cover requirements during construction operations.

Repair or remove and replace any pipe damaged by construction traffic.

B. Polymer Coated Corrugated Steel Pipe.
Use a wide canvas slings or wide padded skids when handling polymer coated corrugated steel pipe.

Replace or repair pipe that has damaged polymer coating. If the Engineer determines that repairs can be made to the polymer coating, perform repairs in accordance with AASHTO M 243.

C. Smooth Wall Steel Pipe.
Perform boring concurrently with the installation of the steel pipe. Install smooth wall steel pipe culverts using equipment that encases the bore hole as the earth is removed. Extend steel pipe through the undisturbed fill and install it without disrupting traffic or damaging the roadway grade and surface. Perform the boring or jacking without use of water.

Bore pipe in straight lines. Place the flow line elevation at the starting point for jacking within 0.1 foot of the staked grade. Install the pipe so the flow line is not reversed at any point and the line and grade at any point within the pipe does not vary by more than 1/2 foot from the designated line and grade.

Smooth wall steel pipe must be spliced by welders qualified for groove welded pipe position 5G. The Department will require welders be qualified according to AWS D1.1 with the exception that qualification for the full penetration portion of the test is not required. Construct the splice so the root pass and the remaining part of the weld, including the reinforcement, meets the requirements of AWS D1.1. Use reinforcement that is less than 1/8 inch in height.

When transitioning between smooth wall steel pipe culverts and other pipe material, provide a connection constructed in accordance with the pipe manufacturer's guidelines. Submit a detail drawing showing the construction of the connection before fabrication.

D. Underdrains.
Encase the perforated underdrain in a granular fill trench section with the trench section enclosed with filter fabric. Use filter fabric that meets the requirements of Section 709.04 B, "Geosynthetic Drainage Material (Type D)". Dig the trench section 1.5 feet wide and 2.0 feet deep. Place the underdrain to rest on the filter fabric at the bottom of the trench, at the desired grade. Use a maximum of 1 inch of granular material to adjust the pipe to grade. Overlap the filter fabric a minimum of 12 inches.

Apply solvent and cement to the PVC joints in accordance with the manufacturer's recommendations.

Use ordinary backfill above the granular fill material as specified in Section 210.03 A, "Ordinary Backfill" and 210.04 B.2, "Ordinary Backfill".

E. Bridge Approach Drains.
Place and compact backfill using the same density requirements as the adjacent embankment.

F. Edgedrains.
Install edgedrain outlets at intervals of 250 feet. Install double outlets at intervals of 500 feet and at low points in the edgedrain flow line.

Place the edgedrain with a machine trencher capable of cutting the trench, lining the trench with a geotextile fabric, and laying the pipe in a continuous operation. Use machine trencher designed and operated so the excavated material does not fall back into the trench. Place the edgedrain at a minimum grade of 0.2 percent. Use laser grade control on the trenching machine whenever the pipe grades do not follow the pavement grades at a constant depth.

Compact the trench backfill with a hand-held air-operated, mechanical tampers.

If edgedrain is installed adjacent to non-permeable base material, enclose the edgedrain in a geotextile fabric sock. Use Type D3 or Type D4 geotextile drain fabric as specified in Section 858, "Geosynthetics."

Install edgedrain outlets concurrently with the longitudinal edgedrain. Place the discharge pipe at a minimum grade of 2 percent. Install headwalls a minimum of 6 inches above the ditch grade. Use grout to secure the discharge pipe to the headwall. Shape the inslope to conform to the sides and toe of the headwall.

Install the headwall and rodent screen at the same time as installing the outlet pipe. Install the rodent screens to be removable. Do not grout the rodent screens into place.

Connect edgedrain outlets to a storm sewer system using grout, rubber or plastic gaskets, or a gasket joint inserted into a thermoplastic coupling cast into the inlet, manholes, or pipe. Make the connections to the storm sewer concurrently with the installation of the drain.

Cap the ends of the drainage line with a manufactured pipe cap where outlets are not required.

Connect all joints securely according to the manufacturer's recommendations.

G. Structural Plate Pipe.
Place the backfill in lifts not to exceed 6 inches of loose material. During placement and compaction, ensure that each side is brought up within 6 inches of the other at all times. Compact bedding according to Section 714.04 A.10 "Compaction Control for Aggregate". Compact the backfill as specified in Section 203.04 G.2.a "ND T 180".

714.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and as follows:

A. Culverts and Storm Drains.
The Engineer will measure pipe along the top of the pipe and round the measurement to the nearest foot.

The Engineer will include branch connections and elbows in the length measured for pipe.

B. Edgedrains.
The Engineer will measure edgedrains parallel to the roadway and make no deduction for outlet structures installed along the drain.

714.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Pipe Conduit__inch	Linear Foot
Pipe Conduit__inch Storm Drain	Linear Foot
Pipe Conduit__inch Approach	Linear Foot
__ IN Grates for Reinf Conc End Section	Each
Relaying Pipe (Type and Size)	Linear Foot
Relaying End Section (Type and Size)	Each
Bridge Approach Drains	Each
Edge Drain Non-Permeable Base	Linear Foot
Headwalls, Precast Concrete, __ In.	Each

Include the cost of end sections in the price bid for pipe conduit.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 720
MONUMENTS AND RIGHT OF WAY MARKERS

720.01 DESCRIPTION
This work consists of furnishing and installing Alignment Monuments, Iron Pin R/W Monuments, Iron Pin Reference Monuments, and Right of Way Markers.

720.02 EQUIPMENT
Reserved.

720.03 MATERIALS

A. General.

Item	Section
Portland Cement Concrete Class AE	802
Epoxy Resin Adhesives	806.02
Deformed and Plain Steel Bars for Concrete Reinforcement	836.02 A

B. Right of Way Markers.
Right of way markers constructed of recycled plastic.

720.04 CONSTRUCTION REQUIREMENTS
Provide a Professional Land Surveyor (PLS) licensed in the State of North Dakota to oversee monument placement. The PLS shall record all section corner and quarter corner monuments placed, in accordance with North Dakota Century Code. Submit a copy of the recordation.

A PLS is not required for the installation of right of way markers.

720.05 METHOD OF MEASUREMENT
The Engineer will measure as specified in Section 109.01, “Measurement of Quantities”.

720.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Alignment Monuments	Each
Iron Pin R/W Monuments	Each
Iron Pin Reference Monuments	Each
Right of Way Markers	Each

Include cost for removals of designated monuments or markers in the price bid for other items.

Include the cost of materials, installation and the Professional Land Surveyor in the price bid for “_____ Monuments”.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 722
MANHOLES, CATCH BASINS, AND INLETS

722.01 DESCRIPTION
This work consists of constructing and adjusting manholes, catch basins, and inlets, including the furnishing or resetting of necessary metal frames, covers or gratings, valve boxes, or other accessories to new lines and grades.

722.02 EQUIPMENT
Reserved.

722.03 MATERIALS

Item	Section
Concrete Class AE	802
Precast Reinforced Concrete Pipe Manholes	830.01 A or B
Adjustment Rings	830.04
Frames, Tops, Covers, Fittings, and Gratings	834.02 A or B
Reinforcing Steel	836.02 A

Compose mortar of one part cement to two parts of sand by volume. Lime may be added not to exceed 10 percent of the cement by weight.

722.04 CONSTRUCTION REQUIREMENTS

A. Precast Reinforced Concrete Manholes, Inlets, and Catch Basins.
Construct the joints by one of the following methods:
- Mortar;
- Rubber Gaskets; or
- Cold applied preformed plastic gaskets.

B. Concrete Base.
Place the base on firm unyielding ground. Construct the bottom edge of the barrel for manholes, catch basins, and inlets to fit flush on the base. Place mortar in the joint between the base and the barrel. Place mortar to fill the base to the elevation of the outlet invert and slope to drain.

C. Pipe Connections.
Place pipe so that the inside end protrudes through the inside wall a minimum of 2 inches. Place mortar around the pipe.

D. Placing Castings.

1. General.
Set castings in full mortar beds when using precast concrete adjustment rings.

Construct manholes, catch basins, and inlets so that a maximum of 6 inches of adjustment rings are needed to set the casting to grade.

2. **Manholes.**
   Perform surface preparation and installation according to manufacturer's recommendations when using high density polyethylene or expanded polypropylene adjustment rings.

3. **Catch Basins and Inlets.**
   Use only precast concrete adjustment rings for catch basins and inlets.

E. Backfill.
Place backfill in lifts not exceeding 6 inches of compacted material. Compact the material as specified in Section 714.04 A.10, "Compaction Control for Aggregate".

F. Cleaning.
Remove silt and deleterious material from manholes, catch basins, and inlets.

G. Adjustments to Existing Units.

1. **General.**
   Make adjustments to the structure walls through the use of an adjustment ring or Class AE concrete so that a seat of proper dimensions may be reconstructed to receive the casting, grating, or cover. If the top of the existing structure is weak and faulty, replace it as directed, and complete the extension.

2. **Manholes.**
   Perform surface preparation and installation according to manufacturer's recommendations when using high density polyethylene or expanded polypropylene adjustment rings.

3. **Catch Basins and Inlets.**
   Use only precast concrete adjustment rings for catch basins and inlets.

H. Maintenance of Drainage.
If the existing drainage facilities become inoperable before the new drainage system is functioning, provide sufficient temporary pumping and drainage facilities to maintain existing drainage.

722.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01 "Measurement of Quantities" and as follows:

A. Catch Basins and Inlets.
The Engineer will measure the base, riser, adjustment rings, casting, cover, and grate as part of the catch basin and inlet.

B. Manholes.
The Engineer will measure the base, casting, cover, adjustment rings, and grate as part of the manhole.

C. Manhole Risers.
The Engineer will measure manhole risers from the base to the bottom of the precast cover or the casting.

722.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Manhole___ IN	Each
Manhole Tee ___IN × IN	Each
Manhole Sanitary	Each
Manhole Riser __ IN	Linear Foot
Inlet – Type __	Each
Adjust Manhole	Each
Adjust Inlet	Each
Adjust Utility Appurtenance	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 724
WATER MAINS, WATER LINES, AND SEWER LINES

724.01 DESCRIPTION
This work consists of furnishing and installing water, lines, sewer lines, and appurtenances.

724.02 EQUIPMENT
Reserved.

724.03 MATERIALS

Item	Section
Reinforced Concrete Sewer Pipe	830.01 A
Ductile Iron Sewer Pipe	830.02 A
Plastic Pipe	830.03
Copper Pipe	ASTM B 88 Type K
Rubber Gaskets	ASTM C 443
Gate Valves	AWWA C 500
Butterfly Valves	AWWA C 504
Concrete – Class AE	802

Use SDR-18, Class 150 PVC pipe that meets the requirements of AWWA C 900.

Use joints and fittings that meet the requirements of AWWA. Construct copper services with flared or compression fittings

Use gate valves with:
- Non-rising stems;
- O-ring seals; and
- 2 inch operating nuts that open counter-clockwise.

Use granular material with 100 percent passing a 2 inch sieve and no more than 35 percent passing a No. 200 sieve for bedding and encasement.

724.04 CONSTRUCTION REQUIREMENTS

A. General.
Comply with the requirements of the North Dakota Plumbing Installation Standards, the NDDEQ, and city ordinances.

Do not construct water mains in the same excavated trench as sanitary sewer pipes. Provide at least 10 feet of horizontal clearance between water mains and sewer pipes. If it is not possible to maintain the 10 feet of horizontal clearance or if it is necessary for the water main and sewer pipe cross, provide a minimum vertical separation of 18 inches.

B. Excavation and Trenching.
Excavate trenches to a minimum width of 30 inches or a width of 24 inches wider than the outside diameter of the pipe, whichever is greater. Provide sheathing and bracing to support the trench.

1. **Excavation.**
   Remove rock, shale, or hard pan to a depth 1 foot below the bedding elevation and replace with bedding material. The Department will pay for excavation required in excess of 1 foot below the specified bedding elevation as “Common Excavation.”

2. **Bedding and Encasement.**
   Tamp the bedding to provide uniform bearing along the entire length of the pipe. Shape the bedding material so that after placing the pipe, the bedding extends up the sides of the pipe a distance of 1/3 the pipe diameter. Tamp the encasement without displacement of the pipe.

3. **Backfilling.**
   Backfill above the encasement with suitable material excavated from the trench. Place backfill in lifts not exceeding 6 inches of loose material. Compact the material as specified in Section 203.04 G.2.a, “ND T 180”.

C. Water Main.

1. **Temporary Services.**
   Coordinate with the utility owner for service interruptions in advance of the actual scheduled interruptions occurring.

   Provide temporary service to properties whose services will be interrupted for more than 8 hours.

   If the service will be interrupted for less than 8 hours and if performing the work without providing temporary services, notify all affected property occupants, in writing, at least 24 hours in advance of the service interruption. Include the following information in the notice:
   a. Contractor contact information;
   b. Engineer contact information;
   c. When the service will be interrupted;
   d. Approximately when the service will be restored; and
   e. A general description of the work being performed.

   Before distribution, provide the notice to the Engineer for approval of the form and language of the notice. At the same time the property occupants are notified, provide a copy of the final version to the Engineer.

   If service is interrupted for more than 8 hours and temporary service has not been provided, provide all necessary temporary services before continuing any other work.

2. **Placement.**
   Clean the interior of each joint or fixture before lowering into the trench. Prevent deleterious material from entering the pipe during installation. Drain or pump water encountered during laying operations so no water enters the pipe.

   Join pipe according to manufacturer’s recommended practices.

Where connections to existing lines are required, notify the line owners at least 24 hours in advance, so arrangements for temporary service can be made, or agreement reached regarding when the service can be interrupted.

3. **Testing and Disinfecting Lines.**
   After the pipe trench has been partially backfilled, perform a hydrostatic pressure test on all new pipe or valve sections. The city will provide the necessary taps without charge. Furnish all other equipment and material necessary to make the pressure test.

   Fill the test section with water and gradually increase the pressure. Conduct the final hydrostatic pressure test at 150 psi and hold for one hour. If defects are found, repair the defects and repeat the hydrostatic pressure test.

   After the hydrostatic pressure test is successfully completed, disinfect water lines by completely filling lines with a water solution containing a residual chlorine level of at least 100 parts per million. Allow the solution to stand for a minimum of one hour. After the disinfecting period, drain or flush the solution from the line.

4. **Thrust Blocks.**
   Use a cast-in-place concrete thrust block to brace fixtures that could separate from the line under pressure. Cast the block between the fixture and the undisturbed vertical trench wall with a minimum bearing surface of 2 square feet against the vertical wall.

5. **Marking Tape.**
   During backfilling, install marking tape 2 feet above the water main. Use non-detectable tape with a minimum width of 5 inches. Use blue tape with the words “CAUTION, WATER LINE BELOW” imprinted on the tape in black capital letters.

D. Water Service Lines.

1. **General.**
   Make all connections to water mains with a corporation stop.

2. **Placing Water Line.**
   Lay copper pipe in a wavy line in the trench. From the corporation stop to the curb stop, install a length of copper pipe a minimum 2 feet longer than the measured distance between the stops. Place the pipe at least 7.5 feet below the grade of the finished street.

   Bench the water service and offset on solid ground and take precautions to ensure stability. Loop the water service line at a 45 degree angle at the main into a gooseneck. Support the gooseneck to prevent displacement, settlement, and strain on the corporation or connection.

3. **Testing.**
   Test water line and connections in place using normal operating water pressure as soon as the water connection is completed and before placing backfill, open the corporation stop and examine the connection for defects. Repair defects and repeat the pressure test.

E. Sanitary Sewer Pipe.

Lay the sewer pipe from the lower end with the spigot ends pointing in the direction of flow. Place the lower segment of the pipe in contact with the shaped bedding throughout its full

length and check for line and grade before placing the next segment. Remove all deleterious material from the pipe and bell before placing the pipe.

Make joints tight and secure. Completely seat sewer pipe with pre-molded gaskets and check the gasket for proper positioning.

Where connections to existing lines are required, notify the line owners at least 24 hours in advance.

724.05 METHOD OF MEASUREMENT

The Engineer will measure completed and in place as specified in Section 109.01, “Measurement of Quantities” and as follows:

A. Water Mains.
Water main installed length will be measured from center of connected pipe to center of connected pipe or end cap.

B. Sewer Lines.
Sewer line installed length will be measured through fittings and from centerline of pipe to centerline of pipe and with no deduction for lengths through manholes. Where two different sizes enter or leave a manhole, the Engineer will measure each size to the center of the manhole.

C. Water Service Lines.
Water service lines will be measured horizontally from the centerline of the water main to the end of the service.

724.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Butterfly Valve & Box __ IN	Each
Butterfly Valve __IN	Each
Fittings – Ductile Iron	Pounds
Remove Gate Valve & Box	Each
Gate Valve & Box __IN	Each
Sleeve __IN	Each
Water Service Line __IN	Linear Foot
Temporary Service	Lump Sum
Watermain __IN	Linear Foot
__ IN Watermain	Linear Foot
__ IN Sanitary Sewer Pipe	Linear Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 744
POLYSTYRENE INSULATION BOARD

744.01 DESCRIPTION
This work consists of furnishing and installing extruded expanded polystyrene insulation board.

744.02 EQUIPMENT

Equipment	Section
Self-Propelled Pneumatic-Tired Rollers	151.01 C

744.03 MATERIALS
Use polystyrene insulation board that meets the requirements of AASHTO M 230.

744.04 CONSTRUCTION REQUIREMENTS

A. Base Preparation.
Compact and level the base material. Place the board on base that is smooth and level and without point loadings. Do not operate construction equipment on the insulation board. The Engineer will allow placing a layer of sand as a base.

B. Installation.
Stagger the insulation boards so the transverse joints are not continuous and are at least 4 feet apart.

If multiple layers of insulation are used, place vertical joints in a successive layer a minimum of 6 inches from the joint in the preceding layer.

Place boards so that the gap between two boards is less than 1/4 inch.

Take any necessary steps to prevent the boards from moving during backfill placement.

C. Cover Material.
Place a first lift of 12 inches of loose material on the insulation board. Compact the cover material with pneumatic-tired rollers or hand operated mechanical tamper. Do not drive equipment, other than the compaction equipment, over the insulation board until the first lift of material has been placed and compacted.

744.05 METHOD OF MEASUREMENT
The Engineer will measure completed and in place as specified in Section 109.01, “Measurement of Quantities.”

744.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Insulation Board	Cubic Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 748
CURB AND GUTTER

748.01 DESCRIPTION
This work consists of constructing curb, gutter, or combination curb and gutter.

748.02 EQUIPMENT

Equipment	Section
Concrete Equipment	155

748.03 MATERIALS

Item	Section
Concrete Class AE	802
Impervious Membrane Cure	810.01 B.1 or 810.02 B.2
Joint Materials	826
Expansion Joint Material	826.02 C or F
Reinforcing Steel, Dowel Bars, and Tie Bars	836

748.04 CONSTRUCTION REQUIREMENTS

A. General.
Construct curb and gutter using a slip-form machine or full depth fixed forms.

Do not allow traffic or equipment on newly placed concrete until it has attained a flexural strength of 450 psi or a compressive strength of 3,000 psi.

B. Excavation.
Eliminate deviations greater than 1/2 inch when measured with a 10 foot straightedge. Compact the subgrade as specified in Section 203.04 G.4, “Compaction Control, Type C”.

Remove all soft and yielding materials and replace the volume with aggregate base.

C. Mixing, Placing, and Finishing.
Place curb and gutter concrete on a damp base. Consolidate the concrete by vibration. Check the top and face of curbs with a 10 foot straightedge and correct all variations greater than 1/4 inch in 10 feet before the final finish. Finish the exposed surfaces with a moistened wood float and a stiff bristled broom.

Do not place concrete on or against frozen ground.

If honeycombed areas are exposed when the forms are removed, the Engineer will determine if replacement is required. If replacement is not required, repair the honeycombed areas. When repairing the honeycombed areas, use mortar composed of one part cement and two parts sand, mixed with water.

Do not use water to facilitate finishing.

D. Curing.

Apply the final cure within 30 minutes of placing the concrete. Cover the entire concrete surface with an impervious membrane cure.

Immediately cover the exposed sides of the concrete pavement with curing compound if removing forms exposes curing concrete before the expiration of the curing period.

Allow concrete to cure for a period of at least 72 hours before performing work adjacent to the concrete.

If weather conditions cause rapid drying of the curb and gutter surface, apply a fine mist or fog spray to the surface. Do not apply water with brushes.

If the ambient temperature falls below 40°F, maintain the concrete surface temperature between 40°F and 90°F for the duration of the curing period.

If Class ASE concrete is used, maintain the surface temperature between 50°F and 90°F.

Conduct heating operations to avoid sudden temperature changes in the concrete. Before removing any enclosures, reduce the heat in a manner that will allow the concrete's surface temperature to decrease to the air temperature at a rate not to exceed 15°F per hour.

The Engineer will suspend the paving operations if the cure is not properly applied.

Maintain the surface temperature of newly placed concrete above 40°F for 5 days.

Submit a detailed temperature maintenance plan before placing concrete, if the ambient temperature is expected to drop below 40°F.

748.05 METHOD OF MEASUREMENT

The Engineer will measure completed and in place as specified in Section 109.01, "Measurement of Quantities" and as follows:

The Engineer will measure the flow line of curb and gutter and continuously through drainage structures and areas of dropped curb for driveways.

748.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Curb and Gutter Type __	Linear Foot
Curb Type __	Linear Foot
Valley Gutter	Linear Foot or Square Yard

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 750
DETECTABLE WARNING PANELS, SIDEWALKS, DRIVEWAYS, AND MEDIANS

750.01 DESCRIPTION
This work consists of constructing detectable warning panels, sidewalks, driveways, and medians.

750.02 EQUIPMENT

Equipment	Section
Concrete Equipment	155

750.03 MATERIALS

Item	Section
Concrete Class AE	802
Impervious Membrane Cure	810.01 B
Preformed Expansion Joint Material for Structural Construction	826.02 C or F
Reinforcing Steel, Dowel Bars, and Tie Bars	836
Detectable Warning Panels	885

For imprinted concrete use any size coarse aggregate specified in Section 802.01 C.2, "Coarse Aggregate". Produce a mix that consists of 60 percent fine aggregate and 40 percent coarse aggregate.

750.04 CONSTRUCTION REQUIREMENTS

A. Forms.
Use fixed forms or slip forms. If using fixed forms, construct straight forms so that the top face and the contact surface do not vary from true by more than 1/4 inch when measured using a 10 foot straightedge. On curves, install forms to within 1/2 inch of the specified radius.

B. Excavation.
Eliminate deviations greater than 1/2 inch when measured with a 10 foot straightedge. Compact the subgrade as specified in Section 203.04 G.4, "Compaction Control, Type C".

Remove all soft and yielding materials and replace the volume with aggregate base.

C. Mixing Pigmented Concrete.
While the mixer is operating at mixing speed, add pigment to the concrete at a ratio recommended by the manufacturer. Uniformly blend the pigment into the concrete.

D. Placing Concrete.
Place concrete on a damp surface. Uniformly consolidate concrete by vibration.

Repair or replace concrete if honeycombed areas are exposed when the forms are removed. The Engineer will determine if replacement is required. When repairing honeycombed areas,

use mortar composed of one part cement and two parts sand, mixed with water to proper consistency.

E. Finishing.

Do not use water to facilitate finishing.

Finish the exposed surfaces with a wood float. Roughen the surface by passing a stiff bristled broom transversely across the surface.

To finish imprinted concrete, initially use a wood float, and then place a sheet of plastic over the concrete before imprinting. Imprint the concrete with the specified pattern to a depth between 1/2 inch and 3/4 inch.

Finish edges with a 1/4 inch radius edging tool.

F. Joints.

1. General.

Place 3/4 inch isolation joints at 150 foot maximum spacing and between the sidewalk and any abutting curb, pavement, driveway, or other structure. Use a 1/4 inch radius edging tool on isolation joints. Saw or use a 1/4 inch radius edging tool on all other joints.

Saw joints in a timely manner to prevent uncontrolled cracking.

2. Medians.

When placing joints in median concrete, place 3/4 inch isolation joints at 150 foot intervals. Saw contraction joints.

G. Curing.

Apply the final cure within 30 minutes of placing the concrete. Cover the entire concrete surface with an impervious membrane cure.

Immediately cover the exposed sides of the concrete pavement with curing compound if removing forms exposes curing concrete before the expiration of the curing period.

If weather conditions cause rapid drying of the concrete surface, apply a fine mist or fog spray to the concrete surface for interim curing. Do not apply water with brushes.

For curing pigmented concrete, use a clear, all resin based curing compound.

If the ambient temperature falls below 40°F, maintain the concrete surface temperature between 40°F and 90°F for the duration of the curing period.

If Class ASE concrete is used, maintain the surface temperature between 50°F and 90°F.

Conduct heating operations to avoid sudden temperature changes in the concrete. Before removing any enclosures, decrease the concrete's surface temperature to the air temperature at a rate not to exceed 15°F per hour.

The Engineer will suspend the paving operations if the cure is not properly applied.

Maintain the surface temperature of newly placed concrete above 40°F for 5 days.

Submit a detailed temperature maintenance plan before placing concrete, if the ambient temperature is expected to drop below 40°F.

H. Detectable Warning Panels.

1. General.
Install the panels by wet setting in concrete according to the manufacturer's recommendations.

2. Dome Alignment.
Align the rows of truncated domes in a detectable warning surface perpendicular to the grade break of the curb ramp.

3. Rail Crossings.
Place the detectable warning surface so that the edge nearest the rail crossing is 6 feet minimum and 15 feet maximum from the centerline of the nearest rail. Align the rows of the truncated domes in the detectable warning surface with the direction of travel.

750.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities".

750.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Sidewalk Concrete	Square Yard
Imprinted Concrete	Square Yard
Pigmented Concrete	Square Yard
Pigmented Imprinted Concrete	Square Yard
Driveway Concrete	Square Yard
Detectable Warning Panel	Square Foot

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 752
FENCING

752.01 DESCRIPTION
This work consists of constructing fences, removal of fences, and resetting fences.

752.02 EQUIPMENT
Reserved.

752.03 MATERIALS

Item	Section
Concrete Class AE	802
Grouts and Epoxy	806
Fence	860
Chain Link Fence	860.01
Barbed Wire Fence	860.02 A
Woven Wire Fence	860.02 B

752.04 CONSTRUCTION REQUIREMENTS

A. Installing Line Posts.

1. **General.**
   Place all posts as close to the plan specified intervals as conditions allow. At sharp changes in grade, install extra posts to maintain the wire or chain link the proper distance from the ground.

   Align and plumb all posts. Where the slope of the terrain makes it impractical to set the posts plumb, set the posts as directed by the Engineer.

   Drive posts for barbed wire fence and woven wire fence, or set the posts in holes. If rock is encountered and the Engineer determines the post cannot be relocated, drill holes a minimum depth of 12 inches into the rock or to the required embedment depth of the post, whichever is less. Cut the post to provide the required height above the ground. Grout the post into the rock.

2. **Driven posts.**
   If soil conditions prevent proper driving of posts, drill a pilot hole no larger than the diameter of the post minus one inch.

3. **Set posts.**
   When posts are set in holes, drill the holes large enough to allow proper tamping. Set wood posts with the large end down. Place and compact the backfill in lifts not exceeding 6 inches of compacted material. Use all the excavated earth and slightly crown the backfill.

For wood posts, provide a ground at every tenth post using a nine-gauge wire the full length of the post. Staple the wire to the post before driving and staple each line wire to make contact with the ground.

B. Corner and Brace Assemblies.

Install corner assemblies at all horizontal angles greater than 15 degrees.

Install wood corner and brace posts in the same manner as wood line posts.

C. Installing Fence Wire.

1. General.

Use double block or lever type hand stretchers to pull tight all fence wire.

2. Barbed Wire and Woven Wire.

Cut the wire and tie it securely to each corner or brace post.

During installation, install no more than 3 splices, factory and field combined, in a single spool of wire.

If a wire breaks after installation, do not splice more than two times per strand between brace assemblies.

Place wires on the side of the post away from the highway, except on the inside of curves.

Drive staples diagonally to the grain of the wood and to 3/4 of their length into the wood leaving room for the wire to move.

3. Chain Link Fence.

Place fabric on one side of the posts for a continuous run of fence. Attach fence fabric to each brace, gate, and corner post using stretcher bars threaded through the loops of the fabric and fastened to the posts with bands.

Splice the fabric by weaving in a pre-bent wire of the same kind as that in the fabric.

D. Resetting Fences.

Replace materials damaged by negligence or lost from storage.

Stockpile excess fence material at designated locations within the project limits.

Use new staples or other fasteners for resetting the fence. The Engineer will determine if any new posts, braces, or wire are required.

E. Temporary Safety Fence.

Install a temporary safety fence four feet high and colored bright orange. Use a UV treated polyethylene web. Support the fence, at minimum, with 7-foot, 1.2 pound/foot channel steel posts spaced at 6 feet. Support fencing placed across asphalt or concrete using barricades, delineator drums, or other means approved by the Engineer. Securely attach the fence to the supports.

Maintain the temporary safety fence for the duration of the project. Remove the temporary safety fence when it is no longer needed.

752.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will measure new fence, reset fence, and temporary safety fence along the top of the fence from outside to outside of end posts. The Engineer will measure additional wire or fabric at depressions and add it to the quantity.

752.06 BASIS OF PAYMENT

If resetting fence and the Engineer determines the existing posts, braces, or wire are inadequate, the Department will pay invoice cost of the new material, plus tax, plus the transportation charges and add 25 percent to cover all other costs. The Department will make this payment in addition to the price bid for “Fence Remove & Reset.”

Pay Item	**Pay Unit**
Fence Barbed Wire ___Strand _____	Linear Foot
Fence Chain Link	Linear Foot
Fence Woven Wire	Linear Foot
Fence Chain Link Remove & Reset	Linear Foot
Temporary Safety Fence	Linear Foot
Fence Remove & Reset	Linear Foot
Fence Terminal	Each
Gate – Vehicle	Each
Corner Assembly _____	Each
Double Brace Assembly _____	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 754
HIGHWAY SIGNS

754.01 DESCRIPTION
This work item consists of furnishing, fabricating, and installing highway signs, delineators, and supporting structures.

754.02 EQUIPMENT
Reserved.

754.03 MATERIALS

Item	Section
Concrete, Class AE	802
Reinforcing Steel	836
Highway Signs and Posts	894

Fabricate sign faces according to the detail drawings and the alphabets shown in the plans, MUTCD, the Standard Highway Signs published by FHWA, and the Standard Highway Signs Supplemental Manual published by the NDDOT. The last number shown as part of the sign number in the plans indicates the required width of the sign.

Use screening inks that are compatible with the sheeting backgrounds.

754.04 CONSTRUCTION REQUIREMENTS

A. Locating and Positioning Signs and Sign Structures.
Erect signs located less than 30 feet from the pavement edge with the sign face truly vertical and turned 93 degrees away from the center and direction of travel of the lane which the facility serves. Erect signs located 30 feet or more from the edge of the pavement edge with the sign face truly vertical and aligned 90 degrees from the center and direction of travel of the lane which the offset sign serves. Position signs and delineators located at the point where lanes divide or on curves to minimize specular reflection directed toward traffic.

B. Sign Fabrication.

1. General.
Use directly applied sheeting, cut to the specified shapes for the messages, symbols, and borders on variable message signs. Apply the message, symbols and border as specified by the sheeting manufacturer.

2. Fabrication of Sign Backing.
Cut sign backing to size and shape and fabricate to be free of defects. Fabricate sign backings that are larger than manufacturer's material in sections with vertical butt joints. Use a minimum of 24 inch wide sections. If more than two sections of backing are required, place the wide sections on the outside positions and the narrower one between. Use the widest manufacturer's sections of sheeting before narrower sections are used. The surface of all signs shall be plane surfaces.

Complete all cutting, shearing, and drilling or punching of holes before degreasing metal and applying sheeting.

3. **Fabrication of Flat Sheet Signs.**
Apply sheeting to the background of flat sheet signs according to the sheeting manufacturer's recommendations.

Apply messages, symbols, film, and borders by directly applying sheeting or by screening. Apply directly applied sheeting according to the manufacturer's recommendations.

Place sheeting with no splices when sign backing is smaller than manufactured material. Use sheeting from the same manufacturer's lot on each individual sign.

Process and finish the sign face with material according to the sheeting manufacturer's recommendations.

Finish the signs to have a smooth, uniform surface with clear cut and sharp messages, symbols, and borders.

4. **Fabrication of Panel Signs.**
Apply sheeting to the background of panels according to the sheeting manufacturer's recommendations.

If splicing the sheeting, overlap the splice a minimum of 3/16 inch. Splice at a 90 degree angle to the length of the panel. Make the splices uniform and neat throughout the entire length. Do not splice any individual panel more than 2 times, and leave at least 8 feet between adjacent splices.

Extend the sheeting over the edges and down the side legs a minimum of 1/16 inch.

Attach motorist service, cultural and recreational area symbols using rivets. Place rivets in each corner and at 12 inch intervals around the outer edge of the panel, spaced 1 inch from the outer edges.

5. **Date of Fabrication.**

   a. **General.**
   Use 1/4 inch high numbers on a 2-1/4 inch long by 1-3/4 inch pressure sensitive label. Imprint the numbers 1 through 12 on the upper part of the label, with the last two digits of four consecutive years printed across the bottom. Punch out the number of the month and the year of fabrication.

   b. **New Signs.**
   Date all new signs with the month and year fabricated. Affix the date label to the metal sign backing on the lower corner of the sign near the edge closest to traffic. The label should be visible from the ground.

   c. **Overlays.**
   Date all sign overlays with the month and year the overlay was attached to the sign. Affix the date label to the right of the original date label on the existing sign panel. If no label is present, affix the label according to Section 754.04 B.5.b "New Signs".

C. Shipping and Storage.

Before shipping or storage, ensure that all signs are free of moisture and that all inks are thoroughly dry. Keep all packaged signs dry. Store and ship signs off the ground in an upright position.

D. Erection of Sign Supports and Delineators.

1. General.

Confirm the support lengths with the Engineer before ordering sign support posts.

Use a driving cap when driving supports.

Firmly set all supports and plumb after erection.

Construct all concrete foundations with the top sloped enough to drain away from the sign support. Give all exposed concrete above ground surface a rubbed finish.

Use the same breakaway coupler system throughout the contract.

2. Anchor for Telescoping Perforated Tubes Supports.

Drive anchors for telescoping perforated tubes supports a maximum of 4 inches above the ground or surfacing.

Install the specified length of anchor unless the Engineer determines a shorter length is sufficient due to good soil bearing developed when driving the anchor. The Engineer may reduce anchor lengths to a minimum of 3 feet.

If installation is in either concrete or bituminous material, omit the soil plate or use a surface mount anchor base.

Core concrete and bituminous surfacing before installing the anchor unit and fill the cored area with like material that matches the surrounding surfacing.

3. Single Tubular Sign Supports.

Set tubular sign supports in a concrete foundation. Place plates so the tapered bolt slot tapers toward approaching traffic.

4. W-Shaped Sign Supports.

a. Breakaway Base Plates.

Assemble breakaway base plates with the bolt torqued to plan requirements. Place the plates so the tapered bolt slot tapers toward approaching traffic.

b. Flame Cutting of W-Shape Posts.

The Engineer will allow the use of a gas cutting torch for cutting metals or preparing joints. Do not flame cut carbon steel above 0.30 percent carbon, high alloy steels, heat treated steel, and plated metals unless subsequent corrective treatment is provided as approved by the Engineer.

Perform flame cutting using the oxyacetylene gas method. Do not deviate from true lines more than 1/16 inch. Repair edge defects according to Section 3.2 of AWS Structural Welding Code, as amended by AASHTO Specifications for Welding of Structural Steel Highway Bridges. The roughness of flame cut surfaces shall be less than an ANSI roughness value of 1,000 microinches. Completely remove slag produced during flame cutting.

If flange plates or other members are cut to a curve, make cuts uniform to the required radius. Do not make a series of straight cuts tangent to the curve.

If cutting the ends of members that are to take bearing with a torch, make a suitable allowance in their length to permit proper milling or planing.

Prepare joints for welding using flame cutting or flame gouging methods. Remove slag and oxidized metals.

c. Edge Finishing.
If using the shearing method to form field splice plates and stiffeners that have a thickness less than 1/2 inch, leave a minimum of 1/8 inch of extra material beyond the specified dimensions. Remove the extra material by machining or planing.

If using the shearing method to form structural steel plates that have a thickness of 1/2 inch or greater, leave a minimum of 1/4 inch of extra material beyond the specified dimensions. Remove the extra material by machining or planing.

5. Overhead Sign Structures.

a. General.
Fabricate all overhead sign structures so that only bolted assembly is required in the field. The Engineer will allow drilling to fasten an overhead sign to a bridge.

Do not field weld.

b. Anchor Bolt Installation.
Use a steel template to accurately locate and hold the anchor bolts plumb and in proper alignment. Put this template in place during placement of the concrete base and leave it in place a minimum of 24 hours after the concrete placement is complete. Leave the support cage used to position the anchor bolts in the concrete foundation. The Engineer will reject the base if anchor bolts are out of position or if the anchor bolts are greater than 1:20 out of plumb. Do not alter the base or bend the anchor bolts to straighten them or move them into position.

c. Anchor Bolt Tightening.
Tighten top and leveling nuts of the anchor bolts according to the following steps:

(1) Bring all leveling nuts to full bearing on the bottom of the base plate. Keep the bottom of the leveling nut as close to the concrete base as practicable, and not more than one inch above the top of the concrete base. Thread leveling nuts onto the anchor bolt to provide at least a 1/4 inch projection of the bolt above the top nut when in its tightened position.

(2) Generously add beeswax or equivalent to the top nut bearing face and top nut internal threads prior to placement on the anchor bolt. Tighten all nuts to a “snug” condition. The Department defines "snug" as the tightness attained by the full effort of a person using a wrench with a length equal to 14 times the diameter of the anchor bolt (minimum wrench length shall be 18 inches). Apply the full effort required to achieve a “snug” tight condition as close to the end of the wrench as possible, and continue until the nut stops rotating. Tighten by leaning back, pulling firmly, and using one’s entire body weight on the end of the wrench (with feet braced to prevent slipping). Accomplish snug tightening in a minimum of two separate passes of tightening. Sequence tightening by tightening in each pass the opposite side nut, to the extent possible, until all the nuts in that pass have been snugged.

(3) Check the “snug” tightness of the nut in the presence of the Engineer after completing nut snugging as described above but prior to commencing step (4) below. Check the “snug” tightness of the nuts (top and leveling) by applying a torque to the nut according Table 754-01.

Table 754-01

Bolt Diameter (inches)	Torque (foot-pounds)
1	100
1-1/4	200
1-1/2	300
1-3/4	400
2	500
2-1/4	700
2-1/2	800

(4) After step (2), ensure that the top nut and leveling nuts are in full bearing on the base plate. If any gap exists between the nut and the base plate, insert a beveled washer between the nut washer and the base plate to eliminate the gap. Use a stainless steel Type 304 washer of the same diameter as the hardened washer, which is beveled so that the gap between the nut and the base plate is eliminated. Retighten all nuts according to step (1) and (2) above if beveled washers are added.

(5) Tighten all top nuts an additional 1/3 turn using a hydraulic wrench. Tighten all of the nuts in two separate passes of equal increment turns. Use a sequence of tightening in each pass so that the opposite side nut, if possible, shall subsequently tightened until all the nuts in that pass have been turned. Do not allow the leveling nut to rotate during top nut tightening.

(6) Check the tightness of the nuts in the presence of the Engineer a minimum of 48 hours after completing step (4). Apply torque to the nut in accordance with Table 754-02.

Table 754-02

Bolt Diameter (inches)	Torque (foot-pounds)
1	300
1-1/4	630
1-1/2	1,120
1-3/4	1,820
2	2,770
2-1/4	4,010
2-1/2	5,550

After the anchor bolt nuts have been checked for tightness, the Engineer will perform ultrasonic testing and calibration procedures for final acceptance. The Engineer will perform these tests to ensure that no flaws in the bolts have been introduced during the construction process and no loose nuts or washers exist.

The Engineer will tap each nut (top and leveling) with a 24 ounce ball peen hammer to check for looseness. A tight nut produces a sharp ringing sound, and a loose nut produces a dull sound. The Engineer will tap each washer on one side while placing one hand on the other side of the washer. If the washer moves, the nut is not properly tightened. The Engineer will use a wrench with a length equal to 14 times the diameter of the anchor bolt (minimum 18 inches) to check the tightness of each nut. If the Engineer is able to rotate a nut as a result of the application of a person's full effort on the end of the wrench, the nut is not properly tightened. If the Engineer finds any nut or washer to be loose as a result of the above acceptance procedure, tighten such loose nuts according to Steps (1) through (5) above. If any nuts require tightening after the initial installation, remove and reinstall nuts and washers and, if necessary, remove and re-erect the entire structure at no cost to the Department.

Test to verify the absence of flaws prior to the erection stage. The Engineer will reject the entire base installation because of reflectors found with an indication rating less than 15 decibels.

d. Erection Procedures.

Erect the overhead sign supports according to the following steps:

(1) Place the column, without the truss or arm brackets attached, on the leveled bottom nuts and washers.

(2) Place the two perpendicular top nuts and the two parallel top nuts to the sign face (in its final position) on the anchor bolts, along with their corresponding washers, and snug tighten them.

(3) Level the column base plate by adjusting only the nuts perpendicular and parallel to the sign face in its final position.

(4) Place the remaining top nuts and washers on the anchor bolts and loosely snug tighten them.

(5) Tighten all bottom and top nuts as specified steps (1) through (4) of Section 754.04 D.5.c, "Anchor Bolt Tightening".

(6) Place the assembled arm bracket or truss, without the sign, on the erected column. Tighten all bolts by the turn-of-nut method specified in Section 616.04 G.2.c(1), "Turn-of-Nut Tightening". Do not reuse any nuts and bolts loosened or removed after being fully tightened. The Engineer will not consider previously tightened bolts that have been loosened by the tightening of adjacent bolts as reused and they may be retightened.

(7) Place the sign panel on the erected arm bracket or truss.

(8) Check the anchor bolt nuts connecting the column base to the concrete foundation for tightness according to step (5) of Section 754.04 D.5.c, "Anchor Bolt Tightening".

E. Mounting Flat Sheet Signs.

If washing signs is necessary, use water and a soft bristled brush or a sponge.

Bolt flat sheet signs to the supports and place a nylon washer between the flat washer and the sign face.

F. Removing and Resetting Signs and Supports.

1. General.

Remove and reset existing signs and supports as specified. Stockpile all signs and supports not to be reset at designated locations within the project limits. The Engineer will arrange to have stockpiled signs removed from the project limits and delivered to the Department's facility.

Replace removed or reset signs and supports that are damaged during removing, resetting, or stockpiling at no additional cost to the Department.

Remove existing signs and supports as construction progresses, and immediately reset or install new signs.

The Engineer will allow the temporary reset of existing signs, or the temporary installation of new signs. Include the cost of installing and resetting signs temporarily in the price bid for other items.

2. Reset Sign Panel.

Remove sign panels from existing supports. Reinstall sign panels, angles, stringers, and steel channels on new supports.

Provide all necessary brackets and hardware to attach sign panels, angles, stringers, and steel channels on new supports.

3. Reset Sign Support.

Remove sign panels from existing supports. Reinstall support and install new sign panels, angles, stringers, and steel channels.

Provide all necessary brackets and hardware to attach sign panels, angles, stringers, and steel channels on supports.

G. Remove Sign Foundations.
Remove steel supports, foundations, and pile footings and restore the surface to match the surrounding area. Remove foundations and pile footings to a depth of 2 feet below the ground line.

H. Remove Overhead Sign Structure.
Remove the overhead sign structure, sign, sign lighting, and concrete foundations.

I. Overlay Panel Sign Refacing.
Provide overlay panels from 0.063 inch aluminum as specified in Section 894.01 A, "Flat Sheet Aluminum".

Remove the legend, border, and symbol on those signs that have demountable copy and remove any existing sign overlays and place overlay panels on the signs. Do not remove direct applied sheeting legends, borders, and symbols. Direct apply the new legends, borders, and symbols to the overlay panels and install on the existing signs.

Install overlay panels on the existing signs with 5/32 inch diameter aluminum blind fasteners. Attach the fasteners so that 1/8 inch of the fastener length protrudes through the existing sign backing. Abut the panels together. Cut the legends, numerals, symbols, and borders where they cross joints.

If the sign to be overlaid is larger than manufactured overlay panels, use individual panels that meet the following requirements:

- Use overlay panels between 1-1/2 and 4 feet wide; and
- Use panels with a minimum length of 8 feet.

If the overlay panels do not cover the full height of the sign, place the overlay panels on the lower portion of the sign first so the longer side of the panel is vertical. Place the remaining panels above these panels with their long side placed horizontally.

Place rivets at 12 inch intervals around the outer edge of the overlay panel and spaced 1 inch from the outer edges. For overlay panels greater than 24 inches wide, in addition to the outer edger rivets, place rivets down the center of the length of the overlay panel at 12 inch intervals.

J. Auxiliary Signs.
Install auxiliary signs used with route markers with the same background color as the route markers:

- Interstate, Blue;
- Interstate Business Loop, Green;
- State, White;
- US, White; and
- County, Blue.

754.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities" and as follows:

A. Flat Sheets, Panels, and Extruded Aluminum Panels.
The Engineer will measure flat sheets, panels, and extruded aluminum panels for signs to the closest 1/10 square foot.

B. Galvanized Steel Posts - W-Shaped Posts.
The Engineer will measure the post length and the pile length when determining the length of W-shaped posts.

C. Sign Foundations.
The plan quantity of concrete will be used for measurement and payment.

D. Reset Sign Panel.
The Engineer will measure the item “Reset Sign Panel” by the number of locations a sign or sign assembly has been reset.

E. Reset Sign Support.
The Engineer will measure the item “Reset Sign Support” by each leg of a sign support that has been reset.

F. Reference and Object Markers.
The Engineer will measure the items “Reference Marker – Type __”, “Object Markers – Type __”, and “Object Markers – Culverts” by each location.

754.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Flat Sheet for signs – Type __Reflective Sheeting	Square Foot
Delineators – Type __	Each
Remove and Reset Delineators	Each
Diamond Grade Delineators – Type __	Each
Steel Galvanized Posts – Telescoping Perforated Tube	Linear Foot
Galvanized Steel Post – Standard Pipe	Linear Foot
Galvanized Steel Post – W-Shape Posts (Two or More)	Linear Foot
Stub Post __IN	Each
Panel for Signs – Type __ Reflective Sheeting	Square Foot
Overlay Panel – Type __ Reflective Sheeting	Square Foot
Extruded Aluminum Sign Panel – Type __ Reflective Sheeting	Square Foot
Interstate Mile Post – Type __	Each
Reference Marker – Type __	Each
Reset Sign Panel	Each
Reset Sign Support	Each
Reset Mile Post	Each
Object Markers – Type __	Each
Object Markers – Culverts	Each
Class AE Concrete – Sign Foundations	Cubic Yard
Remove Sign Foundation	Each
Overhead Sign Structure Bridge Mounted	Each
Overhead Sign Structure __FT Cantilever	Each
Overhead Sign Structure __FT Truss	Each
Remove Overhead Sign Structure	Each

Pay Item	Pay Unit
Remove Overhead Sign Structure Bridge Mounted	Each
Remove Overhead Sign Structure Cantilever	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 760
RUMBLE STRIPS

760.01 DESCRIPTION
This work consists of installing centerline, shoulder, and intersection rumble strips.

760.02 EQUIPMENT
Reserved.

760.03 MATERIALS
Use one of the following materials when applying a fog coat to rumple strips:

- SS-1h, Section 818.02 F, "Anionic Emulsified Asphalt";
- MS-1 Section 818.02 F, "Anionic Emulsified Asphalt"; or
- CSS-1h Section 818.02 E.1 "Cationic Emulsified Asphalt".

When MS-1 is used it may be diluted by the supplier or the Contractor.

760.04 CONSTRUCTION REQUIREMENTS

A. Shoulder and Centerline Rumble Strips.
Mill the shoulder and centerline rumble strips.

B. Intersection Rumble Strips.
Saw cut intersection rumble strips at all STOP conditions of state highways.

Do not install intersection rumble strips on bridge decks or approach slabs. The Engineer will relocate the intersection rumble strips to a location off the bridge deck and approach slabs.

C. Exclusion Areas.
Do not install rumble strips in the areas shown in Table 760-01.

Table 760-01

Type of Rumble Strip	Exclusion Areas
Shoulder and Centerline	Posted speeds of 45 mph or less, urban areas, and curb and gutter sections and 1/2 mile on each end of these areas
Shoulder and Centerline	Across bridge decks and approach slabs.
Shoulder and Centerline	300 feet before and after Automated Traffic Recorders, Environmental Sensor Stations, and Weigh in Motion equipment
Shoulder	Adjacent to guardrail.
Intersection	Posted speeds 45 mph or less, urban areas, or areas with curb and gutter

D. Sweeping.
Immediately after installing the rumble strips sweep and remove the millings from the pavement surface.

E. Fog Coat.
On bituminous surfaces, uniformly apply a fog coat across the rumble strips within 48 hours of sweeping. Apply emulsified asphalt at a rate of 0.10 gallons per square yard. Dilute emulsified asphalts with a maximum 50 percent water.

For centerline rumble strips, apply fog coat in both directions of travel.

F. Traffic Control.

1. General.
Use a TMA as specified in Section 704.04 M, "Protection Vehicle with Truck Mounted Attenuation Device (TMA)".

2. Centerline Rumble Strip Installation.
If the rumble strip operation encroaches in the opposing lane, provide flaggers and 2 sets of the required flagger signing for each direction of travel. Ensure that at least one set of the required flagger signing is in place in each direction of travel whenever work centerline installation is performed. Limit the work area to a maximum of 3 miles.

760.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and as follows:

The Engineer will make no deduction in length for exclusion areas with the exception of areas specified in the first line of Table 760-01 in Section 760.04 C, "Exclusion Areas".

The Engineer will measure flagging and traffic control signs as specified in Section 704.05, "Method of Measurement".

The Engineer will count each leg of an intersection receiving rumbles strips as one "Set".

760.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Rumble Strips – Concrete Shoulder	Mile
Rumble Strips – Concrete Centerline	Mile
Rumble Strips – Asphalt Shoulder	Mile
Rumble Strips – Asphalt Centerline	Mile
Rumble Strips – Intersection	Set

Flagging and traffic control signs will be paid for as specified in Section 704.06, "Basis of Payment".

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 762
PAVEMENT MARKING

762.01 DESCRIPTION
This work consists of furnishing and installing pavement markings.

762.02 EQUIPMENT

A. Paint Application.

To apply pavement marking paint and glass beads, use a self-propelled, pneumatic spraying machine with atomizing nozzles or airless nozzles capable of applying two 4 inch to 8 inch wide lines at one time. Equip the spray mechanism with quick opening and closing valves. Use equipment capable of applying the materials at the specified rate and in an even and uniform thickness with clearly defined edges.

Use an applicator with reservoirs equipped with agitators that keep the material in a smooth, even mixture. Equip the applicator with an automatic skip control device that applies a stripe of specified length with a linear tolerance of 3 inches. Equip the applicator with a guide boom and make the applicator capable of retracing and applying materials to traffic markings in place.

Equip the machine with a dispenser adjusted and synchronized with the paint applicator to distribute the glass beads uniformly on the painted lines using air pressure. Equip the bead dispenser with an automatic cutoff control, synchronized with the cutoff of the striping material.

Use hand-operated equipment to place the pavement markings and reflectorized spheres on areas not accessible to the pavement marking applicator.

B. Grooving Equipment.

Use grooving equipment that has the following characteristics:

- Equipped with diamond blades mounted on a self propelled machine designed for grinding a recess into the pavement surface;
- Equipped with a dust collection system capable of removing and containing airborne emissions incurred during grooving operations;
- Uses mounted diamond blades on a floating head with controls capable of providing uniform depth and alignment; and
- Capable of grooving a total width sufficient to install 4 inch wide pavement marking in a single pass.

Do not use equipment that causes strain or damage to the underlying surface of the pavement.

C. Data Logging System (DLS).

Use a computerized DLS capable of documenting a minimum length of 300 linear feet.

Use a DLS capable of generating an electronic record. The electronic record shall consist of a comma or space delimited text file capable of being opened using electronic spreadsheet software.

762.03 MATERIALS

Item	Section
Water Based Pavement Marking Paint	880.01
Epoxy Pavement Marking Paint	880.02
Preformed Patterned Pavement Marking Film	880.03
Short Term Pavement Marking - Type NR (Non-Removable)	880.04 A
Short Term Pavement Marking - Type R (Removable)	880.04 B
Raised Pavement Markers	880.05

762.04 CONSTRUCTION REQUIREMENTS

A. Pavement Surface Preparation.

1. General.
Install pavement markings on clean and dry surface. Air blast the pavement immediately before the paint application using an air compressor that supplies air free of oil and water.

The Engineer will locate the beginning and ending points of “no-passing zone” markings.

The Engineer will not mark broken line intervals.

2. Preformed Patterned Pavement Marking Film.
Primer may be used to precondition the pavement surface.

3. Epoxy.
Prepare pavement surfaces as specified by the epoxy paint manufacturer. Shotblast or grind existing epoxy pavement markings to remove a sufficient amount of the existing epoxy marking to provide a clean, rough surface for the application of new epoxy markings.

4. Grooved Pavement Markings.

a. General.
For messages, groove the same area as the messages. Do not groove a rectangular area to contain the message.

After grinding, blow the grooved slot clean to remove any residue and loose material before the installation of the pavement marking. When wet-grinding, immediately pressure wash the grooved slot to remove residue.

b. Grooves for Preformed Patterned Pavement Marking Film.
If specified in the plans, groove a recess into the pavement surface for each stripe that meets the tolerances specified in Table 762-01.

Table 762-01
Preformed Patterned Pavement Marking Film Grooves

Parameter	Tolerance
Depth	90 to 110 mils
Smoothness	Ridges, within the groove, shall be no more than 6 mils higher than either adjacent valley
Width	line width plus 1/2 inch
Length	line length plus 3 inches per end of line
Line End Tapers	3 inches

If pavement marking installation does not occur within 24 hours of grinding, sandblast the groove and install the pavement markings the same day the sandblasting occurs.

c. Grooves for Epoxy Paint.
If specified in the plans, groove a recess into the pavement surface for each stripe that meets the tolerances specified in Table 762-02.

Table 762-02
Epoxy Paint Grooves

Parameter	Tolerance
Depth	45 to 55 mils
Smoothness	Ridges, within the groove, shall be no more than 6 mils higher than either adjacent valley
Width	line width plus 1 inch
Length (skips)	line length plus 3 inches per end of line
Line End Tapers	3 inches

After creating the groove, prepare the surface in accordance with the manufacturer's instruction

B. Traffic Control.

1. General.
Properly place necessary traffic control devices and ensure they are in operation before starting construction. Keep the devices current and placed only in the areas of actual work activities. Keep traffic control devices in place until the pavement marking has dried and the Engineer approves their removal.

Do not perform equipment preparation, testing, filling, and cleaning on the roadway.

2. Traffic Movement.
Maintain traffic through the work area at all times according to the traffic control plan and Section 704 "Temporary Traffic Control". Furnish flag persons when needed.

Maintain two-way traffic on two-lane roadways and keep 1/2 of the roadway open to traffic on multi-lane roadways at all times. Include the cost to furnish, erect, and maintain cones, signs, and barricades including the cost for flagging and shadow vehicles, in the cost of pavement marking.

3. Protection Vehicles.
Provide protection vehicles as specified in Section 704.04 M, "Protection Vehicle with Truck Mounted Attenuation Device (TMA)".

C. Permanent Pavement Marking.

1. General.

a. Application.
Apply pavement marking paint during daylight and in a manner to prevent overspray.

b. Data Logging System (DLS).
The use of a computerized DLS is required for monitoring the application of water based paint and epoxy pavement markings when the plan quantity of long lines for liquid pavement marking is 30,000 linear feet or greater.

Before beginning striping operations, submit the DLS manufacture's recommendations for equipment calibration and provide certification that the DLS equipment meets these recommendations.

At the beginning of striping operations each day, verify the DLS measurement by traveling a distance of 100 feet and compare the DLS measurement with a physical measurement.

Submit an electronic or printed record from the DLS each day for all longitudinal areas where striping material was machine placed. The Engineer may require more frequent submittals. Produce the record in its final format directly from the DLS, before the records are removed from the DLS.

Include the following data in the report:

1. Application vehicle speed to nearest 0.1 MPH.
2. Weight (LBS) and/or volume (GAL as measured through a piston displacement pump mechanism) of paint material used by color.
3. Weight (LBS) of reflective material used.
4. Pavement surface temperature (°F).
5. Air temperature (°F).
6. Dew point (°F).
7. Humidity (%).
8. The system shall record the average material application rates and film thickness calculated over the section painted.

9. For every highway marked, the highway number with beginning and ending reference points rounded to the nearest thousandths of a mile and all information listed above.

c. Acceptance.

Upon initial inspection pavement markings must demonstrate satisfactory retroreflectivity and proper daytime and nighttime colors.

Where material yield computations show a deficiency in material usage of less than 20 percent, the Engineer may accept the work and process a contract price adjustment in direct proportion to the percent of the deficiency. The Engineer will reject the work if the deficiency in material usage is 20 percent or more.

Where retroreflectivity is less than 20 percent below the minimum levels, the Engineer may accept the work and process a contract price adjustment in direct proportion to the percent of the deficiency. The Engineer will reject the work if the deficiency in retroreflectivity is 20 percent or more.

Remove and replace material if the yield computations show that the amount of material applied is below the specified requirements. Remove and replace material that has measured retroreflectivity below the specified requirements. Use suitable blasting or grinding equipment to removed deficient material.

If the Engineer requires removal and replacement, remove at least 90 percent of the deficient line, with no excessive scarring of the existing pavement. Perform removal actions to a width of 1 inch wider all around the nominal width of the pavement marking to be removed.

2. Water Based Paint.

a. Method of Application.

Allow new bituminous treatment to cool to a temperature below 125°F and cure for a period of 72 hours before applying permanent pavement marking.

Apply pavement marking paint and glass beads separately by machine. Use hand application where machine application is not feasible.

Apply water based paint when the air and pavement surface temperatures are 45°F or warmer. Do not apply paint when the air or pavement surface temperatures are forecasted to be colder than the minimum application temperature during the curing period of the paint. Apply pavement marking paint and beads only during daylight hours.

b. Rate of Application.

Apply paint at a rate so that 1 gallon of paint will cover a 4 inch wide stripe for a length of 260 to 300 feet. Do not dilute paint, but the Engineer will allow a small quantity of naphtha thinner to flush out paint containers.

Uniformly distribute glass beads over the wet paint stripe at a rate of at least 6 pounds per gallon of paint. Apply beads using an automatic pressure dispenser.

If the application rates are not within the requirements, stop the marking application until corrections are made.

c. Tolerances.

(1) Surface Applied.

Place surface applied markings within the following tolerances:

- 3 inches of the specified length.
- 1/4 inch of the specified width.
- 6 inches in a 40 foot cycle.
- 2 inches from the proper alignment.
- Begin dashed lines placed over existing dashed lines within 6 inches of the beginning of the existing line.

(2) Grooved.

Apply the grooved markings in the groove and within the following tolerances:

- 2 inches of the specified length and
- 1/4 inch of the specitied width.

3. Epoxy Paint Pavement Markings.

a. General.

Apply pavement marking paint and glass beads separately by machine. Use hand application where machine application is not feasible.

Apply the epoxy pavement marking material at a thickness of 20 mils. Calculate thickness without drop on glass beads.

Apply glass beads immediately after the placement of the epoxy. Use a dispenser system that delivers at least 25 pounds of beads per gallon of epoxy material.

If the application rates are not within the requirements, stop the marking application until corrections are made.

Do not apply material over a longitudinal joint.

Do not apply markings if the wind or other conditions cause a film of dust to be deposited on the pavement surface before the material can be applied.

If short term paint was applied, epoxy pavement markings may be placed directly over the short term paint.

Place epoxy materials only when air and pavement temperatures are at least 50°F. The Engineer will allow lower temperature if the manufacturer, in writing, approves a lower temperature and warranties the adhesion of the epoxy to the pavement for a minimum of one year.

Place epoxy material after bituminous material has been in place for a minimum of 14 days.

b. Tolerances.
Place epoxy paint within the tolerances specified in Section 762.04 C.2.c, "Tolerances".

c. Retroreflectivity.
Place epoxy pavement markings so that the initial retroreflectivity values of the markings are at or above those shown in Table 762-03. The initial retroreflectivity values are those obtained at least 2 weeks after the placement of markings.

Table 762-03
Retroreflectivity Values (mcd/m^2/lux)

White	Yellow
275	180

4. Preformed Patterned Pavement Marking Film.
Install the permanent marking film in accordance to the manufacturer's temperature recommendations. Do not place the permanent marking film over painted markings. Prepare the pavement surface for installation as required by the manufacturer. Cut the film at open joints or cracks in the pavement. Tamp the cut ends firmly into place.

D. Short-Term Pavement Marking.

1. General.

a. Short Term Pavement Marking Condition Classifications.
The Engineer will rate short term pavement markings as "acceptable", "marginal", or "unacceptable" in accordance with *Quality Guidelines for Temporary Traffic Control Devices and Features*, published by ATSSA.

Install short-term pavement markings that are classified as acceptable.

The Engineer will allow markings that degrade into the "marginal" category during the course of the work to remain in place. Replace markings that fall into the "unacceptable" range no more than 24 hours after being notified of the marking's condition.

b. Maintenance and Duration.
As necessary, remove material from raised pavement markers that reduces the brightness of reflectorized sheeting.

Immediately remove all markings that are no longer required.

c. Installation Requirements.
Use the same method of surface preparation as specified for permanent installation.

Apply short-term pavement marking to the center line to the full length of the surface treatment and milled surface before sunset on the same day the work is performed. Do not resume paving or milling operations if the short-term pavement marking has not been replaced as required.

On the final lift, allow new asphalt pavements to cool to 125°F before applying short-term pavement marking paint.

Place short-term pavement marking on the final lift of new pavement with alignment and spacing so that the permanent striping matches when applied. Correct errors in alignment and spacing or remove the short-term markings just before the installation of the permanent striping.

2. **Short-Term Pavement Marking – Type NR (Non-Removable).**
Allow the final lift of asphalt pavements to cool to 125°F before Type NR markings.

Place the short term pavement markings at the rate specified in Section 762.04 C.2.b, "Rate of Application" with the following exception:

Exception: When the permanent pavement marking is specified as epoxy paint, apply the short term pavement marking at a thickness of 10 mils.

3. **Short-Term Pavement Marking – Type R (Removable).**
Install Type R markings when the air and pavement temperatures are at a minimum of 50°F and expected to remain above 50°F.

If the air or pavement temperature falls below 50°F during installation, Type NR markings may be installed as specified in Section 762.04 D.2, "Short-Term Pavement Markings – Type NR (Non-Removable)". Install Type R markings once the specified temperatures exist.

Remove Type R markings once they are no longer necessary for traffic control operations. If Type NR markings were substituted for Type R markings, remove the Type NR markings using a method that does not leave a scar on the pavement.

4. **Short-Term Pavement Marking - Seal Coat Projects.**
Use pavement marking paint and beads for short-term pavement marking for seal coat projects.

Broom the areas to receive the striping before applying the paint and beads, without dislodging the chips.

If the in-place short-term pavement marking has become obscured and has lost its required visibility due to being covered, or partially covered, by cover coat or blotter material, remove the material from the striped areas by light brooming or compressed air before sunset. Correct damage to the cover coat material and striping resulting from the removal operation at no additional cost to the Department.

Apply paint at a rate such that 1 gallon of paint will cover a 4-inch wide stripe for a length of 200 to 240 feet. Evenly distribute glass beads over the wet paint stripe at a rate of at least 6 pounds per gallon of paint.

5. **Raised Pavement Markers.**
Install broken lane lines on two-lane two-way roadways using four markers spaced at 3.33 foot centers with a 30 foot gap. Space markers used for solid lines on 5 foot centers. In

no-passing zones, place the double rows of markers 4 inches apart. Place raised pavement markers used in double solid lines side by side.

Remove raised pavement markers once they are no longer necessary for traffic control operations.

762.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01 “Measurement of Quantities” and as follows:

The Engineer will only measure the painted or installed portion of broken lines.

If substituting raised pavement markers for paint, the Engineer will measure the lengths of a pavement line that would exist if paint had been installed.

The Engineer will measure pavement marking-painted messages by the square footage shown on the Plans, in place, and accepted by the Engineer.

762.06 BASIS OF PAYMENT

Pay Item	**Pay Unit**
Pavement Mark Painted – Message	Square Foot
Pavement Mark Installation	Mile
Epoxy Pavement Mark Message	Square Foot
Epoxy Pavement Mark Message – Grooved	Square Foot
Epoxy Pavement Mark __IN Line	Linear Foot
Epoxy Pavement Mark __ IN Line – Grooved	Linear Foot
Epoxy Pavement Mark __ IN Line – Wet Reflective	Linear Foot
Preformed Patterned Pavement Mark – Message	Square Foot
Preformed Patterned Pavement Mark – Message (Grooved)	Square Foot
Raised Pavement Markers	Each
Short Term __IN Line – Type R	Linear Foot
Short Term __IN Line – Type R – Wet Reflective	Linear Foot
Short Term __IN Line – Type NR	Linear Foot
Short Term Message – Type R	Square Foot
Short Term Message – Type R – Wet Reflective	Square Foot
Short Term Message – Type NR	Square Foot
Short Term Painted Line – Seal Jobs	Linear Foot
Pavement Mark Painted __IN Line – Wet Reflective	Linear Foot or Mile
Pavement Mark Painted __IN Line	Linear Foot
Pavement Mark Painted Curb Top & Face	Linear Foot
Plastic Pavement Mark Film __IN Line	Linear Foot
Plastic Pavement Mark Film __IN Line – Grooved	Linear Foot
Preformed Patterned Pavement Mark __IN Line	Linear Foot
Preformed Patterned Pavement Mark __IN Line - Grooved	Linear Foot
Pavement Marking ____ - Masking	Square Foot or Linear Foot

Include the cost of installation and removal in the price bid for Type R marking film. If Type NR markings are substituted for Type R markings due to temperature requirements, the markings will be paid for at the contract unit price for Type R markings.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 764
GUARDRAIL AND ATTENUATION DEVICES

764.01 DESCRIPTION
This work consists of installing, removing, and resetting guardrail and attenuation devices.

764.02 EQUIPMENT
Reserved.

764.03 MATERIALS

Item	Section
Concrete, Class AE	802
Deformed and Plain Steel Bars for Concrete Reinforcement	836.02 A
Guardrail and Posts	862

764.04 CONSTRUCTION REQUIREMENTS

A. General.

1. Installation Requirements.
Before guardrail removal, installation, and extension, develop a written construction schedule for work at the guardrail location, and have the schedule reviewed by the Engineer. Include a sequence of controlling items and the timing of each in the schedule of work. Do not stop work between controlling items for more than four working days at any individual run.

Install the guardrail to produce a smooth continuous line with uniform height.

Set posts plumb with the front faces uniformly aligned.

Backfill posts with approved material placed and compacted in 6 inch layers, using a mechanical tamper.

Place hot bituminous pavement before guardrail post installation. Drill post holes for the new or reset guardrail through the hot bituminous pavement. Install the post in the remaining material by augured holes or driving.

When posts are installed in augured holes, backfill the holes with approved material without displacing the post alignment. Remove surplus excavated material.

When posts are driven, make the diameter of the hole in the bituminous pavement sufficient so when the soil around a post heaves up while the post is driven, the remaining asphalt will not move. If driving causes damage to posts, replace the post and install the replacement post by auguring the hole. Use a post cap if making minor vertical adjustments with a sledgehammer or maul.

Place a maximum thickness of 2 inches of bituminous material around each post to blend the post hole into the surrounding bituminous material.

Do not burn or weld after the material has been galvanized. All holes shall be machined drilled.

Repair areas exposed by cutting or drilling and any damaged galvanized coating according to Section 854.02, "Damaged Galvanized Coatings".

Hang guardrail and end terminals for individual runs in a single day.

2. Installation on Roadways Open to Public Traffic.
At locations of guardrail installation where the roadway is open to traffic, complete the installation of each individual run within 10 working days from the date all controlling items allow guardrail installation to begin.

Install delineator drums, as specified in Section 704, "Temporary Traffic Control", at 25-foot intervals adjacent to areas meeting one of the following conditions:

- Existing guardrail was removed and new guardrail will be installed;
- Where no guardrail previously existed but will be installed; or
- At guardrail extensions.

Leave the drums in place until guardrail installation at that location is complete and accepted by the Engineer.

3. Failure to Comply with Installation Requirements.
Provide temporary protection according to the plans at an object if unable to complete the required work in the specified time. Do not use material installed for this purpose in the final guardrail installation. The Department will not make separate payment for attenuation provided due to the Contractor's inability to complete the work in the specified time.

If the Contractor fails to comply with all requirements of Section 764.04 A.2, "Installation on Roadways Open to Public Traffic", the Engineer will perform one or both of the following:

1. The Engineer will apply a contract price reduction of $1000 per day if the deficiency is not remedied within 24 hours of notification to correct the item.

2. The Engineer will have the temporary protection installed by other forces and deduct the costs from monies due or that become due to the Contractor.

If the Engineer uses other forces to install temporary protections, remove and dispose of the materials installed by the other forces at no additional cost to the Department.

B. Cable Guardrail.
Eliminate cable slack by over-tensioning the cable and then backing off to the required tension.

Measure the required tension by achieving a 5 inch deflection by weighting a 12.5 foot span with a central load of:

200 pounds when the temperature is 100°F
220 pounds when the temperature is 80°F

240 pounds when the temperature is 60°F
260 pounds when the temperature is 40°F

Ensure the tension of all the cables is to the same deflection throughout the length of the rail.

Cast concrete anchors in place and do not disturb the earth surrounding the anchor.

At locations where cable is connected to a cable socket with a wedge-type connection, crimp one wire of the wire rope over the base of the wedge to hold it firmly in place.

C. W-Beam Guardrail.

Join the rail sections so the splices are lapped to flow in the direction of the traffic nearest the guardrail. Construct the lap splices so the plate ends make contact throughout the entire area of the splice.

Submit a copy of the installation instructions and drawings of the guardrail end terminals. Ensure the drawings contain all components of the end treatment assembly.

D. Removal of Guardrail.

1. General.

If the Engineer determines that the concrete anchors do not interfere with other construction, cut off concrete anchors one foot below ground level. When concrete anchors are removed, backfill the holes with approved material in 6 inch layers. Thoroughly tamp each layer using a mechanical tamper. If concrete anchors are cut off or removed, shape the surface to match the surrounding area and dispose of the removed concrete.

When removing guardrail posts and not replacing the posts in the same hole, backfill the hole with approved material. When the existing surrounding surface is bituminous, place 2 inches of bituminous material at the top of the hole to match existing surrounding surface.

2. Removed Guardrail in Locations Where There will be no permanent guardrail.

At locations where guardrail is to be removed and no guardrail will exist upon completion of the work, leave the guardrail in place until the hazard associated with the guardrail is no longer present and all work is complete except for that which requires the guardrail to be removed.

E. Salvaged Guardrail Materials.

Disassemble rail and end treatments to be salvaged at each joint or splice.

1. Cable Guardrail.

Stockpile salvaged cable in rolls.

2. Miscellaneous Hardware.

Place miscellaneous hardware from the removed guardrail in containers at the stockpile site.

3. **Disposal of Unsalvageable Materials.**
   Remove and dispose of all damaged posts, rail, and hardware.

F. Reset Guardrail.
When resetting guardrail, install the guardrail material as specified for the type of guardrail being reset.

Stockpile the box beam rail removed in lengths not to exceed 36 feet.

Stockpile the W-beam rail removed for reset in lengths not to exceed 50 feet.

G. Attenuation Devices.
Install attenuating devices that meet the appropriate MASH testing Requirements and have an eligibility letter from FHWA.

Install attenuating devices as specified by the manufacturer.

Furnish the Engineer work drawings for crash cushions. Include manufacturer's specifications, erection instructions, maintenance instructions and the FHWA approval letter in the shop drawing submittal.

764.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, "Measurement of Quantities".

764.06 BASIS OF PAYMENT

Pay Item	Pay Unit
_____ Guardrail	Linear Foot
W-Beam Guardrail End Terminal	Each
Remove & Reset Guardrail	Linear Foot
Remove W-Beam Guardrail & Posts	Linear Foot
Reset W-Beam Guardrail	Linear Foot
Reset W-Beam Guardrail End Terminal	Each
Reset Box Beam Guardrail	Linear Foot
Remove Concrete Safety Shape Transition	Each
Remove 3-Cable Guardrail & Posts	Linear Foot
Remove Box Beam Guardrail	Linear Foot
Remove Box Beam Guardrail End Section	Each
Barrel Attenuation Device – Type B-__	Each
Attenuating Crash Cushion Test Level -__	Each

The department will make payment for temporary delineator drums according to Section 704, "Temporary Traffic Control".

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 766
MAILBOX ASSEMBLIES

766.01 DESCRIPTION
This work consists of removing mailbox assemblies, furnishing and installing new support systems, and fastening the removed mailboxes or new mailboxes to the new support systems.

766.02 EQUIPMENT
Reserved.

766.03 MATERIALS
Reserved.

766.04 CONSTRUCTION REQUIREMENTS

A. General.

Obtain the mailbox owner's contact information from the U.S. Postal Service.

The mailbox owner will furnish a postal service approved mailbox. Install the furnished mailbox on the new support system.

Before disturbing the exiting mailboxes and supports, notify the affected mailbox owners in writing 30 days before disturbing the mailbox. Provide copies of the notification to the Engineer.

Before removing the existing mailbox and support, verbally coordinate with the mailbox owner to discuss resetting the existing mailbox on a new support.

B. Temporary Relocation.

If construction activities require the removal of the support system and delayed installation of the new support system, reset the existing support system at a location approved by the Engineer and postal service.

If construction activities require the removal of the support system and delayed installation of the new support system, relocate mailboxes to a location approved by the Engineer and postal service.

If existing mailboxes meet NCHRP 350 or MASH requirements, they may be reset temporarily during construction. If the existing support does not meet NCHRP 350 or MASH, place temporarily located mailboxes on supports that meet MASH requirements. If there is no support that meets MASH requirements, perform one of the following actions:

- Place them outside the clear zone;
- Place them on a 4 × 4 inch wood post; or
- Reset them using assemblies shown in the plans.

After construction has progressed to allow permanent installation, install the mailbox assemblies and mailboxes at the specified locations.

766.05 METHOD OF MEASUREMENT

The Engineer will measure as specified in Section 109.01, “Measurement of Quantities” and as follows:

The Engineer will measure mailbox assemblies on a single support system as one Each.

766.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Mailbox – All Types	Each

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 770
HIGHWAY LIGHTING

770.01 DESCRIPTION
This work consists of furnishing and installing highway lighting.

770.02 EQUIPMENT

Item	Section
Concrete Equipment	155

770.03 MATERIALS

A. General.

Item	Section
Concrete, Class AE	802
Rapid-Hardening Cementitious Materials	806.01
Galvanizing	854
Highway Lighting	895

B. Work Drawings.
Submit work drawings a maximum of 20 days after the date of contract execution.

Provide the dimensions, type of material, and the functional characteristics of the equipment to be installed.

Submit work drawings for the following items:

1. Conductors;
2. Pull Box;
3. Feed Point Equipment including:
   a. Circuit breakers (enclosed in a load center-type panel board);
   b. Enclosed relay (normally open);
   c. Cabinet; and
   d. Photoelectric cell.
4. Light Standard including:
   a. Luminaire;
   b. Fuseholder; and
   c. All necessary calculations and drawings used in the design of the light standard.
5. Sign Lighting Fixture including:
   a. Loadcenter;
   b. Luminaire; and
   c. Ballast (if applicable).

C. Anti-Seize Lubricants.
Use an anti-seize lubricant on all metal screw and bolt connections.

770.04 CONSTRUCTION REQUIREMENTS

A. General.

All electrical installations must be either performed by or supervised by an electrician licensed by the ND State Electrical Board. Perform all work to meet the requirements of the National Electrical Code, the North Dakota State Electrical Board, the local utility company, and the ordinances established by the local municipality.

When installing lighting on a new meter, provide and bear all costs for the electrical service necessary to operate the lighting system until it is accepted as specified in Section 770.04 N.2, "Acceptance".

Padlocks are required on items covered under this specification. Supply all necessary padlocks. Coordinate with the entity responsible for maintenance of the lighting system to verify padlocks match the existing key structure.

B. Cable Trench.

Immediately backfill cable trenches using the excavated material. Compact backfill material using the same density requirements as the adjacent material.

Multiple underground cable for street lighting may be installed via the plowing method.

C. Concrete Foundation.

1. General.

Place concrete foundations to provide the greater minimum horizontal and vertical clearances to power lines required by the NEC or the power line voltages shown in Table 770-01. Do not adjust the plan foundation locations without the approval from the Engineer.

Table 770-01

Power Line Voltage (kV)	Horizontal Clearance	Vertical Clearance
0 - 22	5 ft	6 ft
Greater than 22	5 ft + 0.033 ft per kV greater than 22 kV	6 ft + 0.033 ft per kV greater than 22 kV

Cast concrete foundations in place. Place the concrete in one continuous operation with no construction joints.

Consolidate the concrete using an internal or external vibrator. Ensure the vibration does not displace reinforcing steel or forms. Vibrate for a sufficient duration and intensity to thoroughly consolidate the concrete without causing segregation.

Use vibrators capable of visibly affecting the concrete mixture a distance of at least 18 inches from the vibrator.

Do not apply vibration directly to reinforcement that extends into non-plastic sections or layers of concrete. Do not use vibrators for moving concrete in the forms.

Allow the concrete foundation to cure for 7 days before placing poles on the foundation. Poles may be placed prior to the expiration of the 7 day cure period if cylinders cast from the same batch of concrete reach the concrete design strength.

Do not grout between the foundation and the pole base.

2. Anchor Bolt Installation

Use a steel template to accurately locate and hold the anchor bolts plumb and in proper alignment. Put this template in place during placement of the concrete base and leave it in place a minimum of 24 hours after the concrete placement is complete. Leave the support cage used to position the anchor bolts in the concrete foundation. The Engineer will reject the base if anchor bolts are out of position or if the anchor bolts are greater than 1:20 out of plumb. Do not alter the base or bend the anchor bolts to straighten them or move them into position.

D. Conduit.

1. General.

a. Conduit Properties

Provide smooth and rounded inner edges of joints and the extreme ends of conduit. Do not use slip joints or running threads for conduit couplings. If a standard coupling cannot be used, use an approved threaded union. Rotate coupling components until ends of conduit are brought together.

Use a single type of material throughout a conduit run.

b. Conduit Placement.

Install conduit a minimum of 24 inches below the surface.

Bore or jack conduit under the roadway. Install conduit in other areas via trenching, plowing, boring, or jacking. Do not jack non-metallic conduit. Fill abandoned bore areas and conduit tunnels within the roadbed using grout.

When field bending conduit, produce bends without crimping or flattening the conduit and construct the inside radius of the bend equal to at least six times the nominal diameter of the conduit.

Seal conduit ends with steel wool immediately after installation and reinstall after each phase of construction.

Immediately backfill using the excavated material. Compact backfill material to the same density as the adjacent material.

c. Conduit Termination.

Install conduit runs terminating in concrete foundations a minimum of 2 inches above the finished grade of the foundation. Install conduit runs terminating in concrete pull boxes 2 inches beyond the inside wall of the box and a minimum of 2 inches above the bottom.

Install conduit into foundations and pull boxes on the face of the object nearest to the conduit run.

If light standard foundations are installed and there is not a continuous run of conduit, install conduit in the concrete foundation that is a minimum of 2-inch diameter and use rigid conduit elbows.

d. Conduit Seals.
Until wiring is in place and finalized, install, and maintain conduit plugs in each conduit end after the conductor is installed. Provide conduit plugs that create an air and watertight seal, are removable, and reusable. Provide plugs that can be split to permit installation or removal of the plugs without removing the conductor. Provide conduit plugs that seal using an adjustable filler of neoprene or silicone rubber compressed with stainless steel hardware.

Upon completion of wiring, install duct seal on all conduits containing cables at controller cabinets, light bases, and pull boxes. Install expandable conduit plugs in open or unused conduit runs.

2. Metallic Conduit.
Fit the terminal ends of metallic conduit with a grounding bushing before installing the conductor. When constructing joints, paint metallic conduit end threads with pipe joint compound and thread them into couplings.

Apply rust-preventative paint matching the conduit color to bushings, exposed threads, and scuffed areas.

3. Nonmetallic Conduits.
Paint plastic conduit ends with a solvent weld, as recommended by the conduit manufacturer, before inserting them into couplings.

4. HDPE.
Install conduit when the conduit temperature and the ambient temperature is greater than minus 10°F.

E. Conductors.

1. General.

a. Pull all conductors through conduit by hand without causing strain to the conductors or conduit.

b. If splicing, place splices in light standard bases or feed points. Use compression type splices.

c. Install additional conductor length to provide for slack and the wiring of feed points and light standards as follows:

1. Ten feet at the feed point;
2. Four feet at each foundation for each incoming and outgoing circuit;
3. Three feet of slack for each single conductor installed in cable trench at each light standard foundation for each incoming and outgoing circuit. Install this extra

conductor in a series of “S” curves in the trench. This does not apply to multiple conductor cable; and

4. Six feet at pull boxes where connections are made.

d. Connect conductor with sufficient slack to prevent any strain on the conductor or connections.

e. Ground the following items:
   - bases;
   - light standards;
   - control cabinets;
   - feed points; and
   - exposed metal parts

   Install bolted pressure connectors on all ground rods.

f. After the conductor is installed, protect the conductor from moisture until the light standard is installed.

g. Identify the function of each conductor and label each conductor accordingly.

2. Highway Lighting Circuits.
Where one lighting circuit crosses another, place a minimum 4-inch bed of sand between the circuits at the point of crossing. Circuits installed by plowing do not require a sand bed.

Loop the continuous grounding conductor (not a neutral) through each foundation and feed point. Connect the continuous grounding conductor to the light standard and feed point cabinet.

Provide sufficient length of internal light standard conductor so the fuse kit can be withdrawn from the standard through the hand hole.

F. Feed Point.
Install the complete feed point including the cabinet, padlock, conduit, conductor, service entrance heads, meter sockets, and ground rods.

The local utility company will furnish and install the required single phase voltage service connection and any required meter. Coordinate with the local utility company for the service connection. Lock and seal any switch box as required by the utility company or local governmental agency. Include a legible labeling system for the breakers inside the switch box.

G. Light Standards.

1. General.
Install mast arms perpendicular to the roadway centerline.

2. Anchor Bolt Tightening
Plumb the light standard with leveling nuts. Adjust the leveling nuts on assembled light standards before 10:00 am.

Tighten the anchor bolts securely. Install nuts so a minimum of two threads are exposed above the nuts. Torque bolts in a multi-directional slip base as specified by the manufacturer. Tighten top and leveling nuts of the anchor bolts according to the following steps:

(1) Bring all leveling nuts to full bearing on the bottom of the base plate. Keep the bottom of the leveling nut as close to the concrete base as practicable, and not more than one inch above the top of the concrete base. Thread leveling nuts onto the anchor bolt to provide at least a 1/4-inch projection of the bolt above the top nut when in its tightened position.

(2) Generously add beeswax or equivalent to the top nut bearing face and top nut internal threads prior to placement on the anchor bolt. Tighten all nuts to a “snug” condition. The Department defines "snug" as the tightness attained by the full effort of a person using a wrench with a length equal to 14 times the diameter of the anchor bolt (minimum wrench length shall be 18 inches).

Apply the full effort required to achieve a “snug” tight condition as close to the end of the wrench as possible and continue until the nut stops rotating. Tighten by leaning back, pulling firmly, and using one’s entire body weight on the end of the wrench (with feet braced to prevent slipping).

Accomplish snug tightening in a minimum of two separate passes of tightening. Sequence tightening by tightening in each pass the opposite side nut, to the extent possible, until all the nuts in that pass have been snugged.

(3) Check the “snug” tightness of the nut in the presence of the Engineer after completing nut snugging as described above but prior to commencing step (4) below. Check the “snug” tightness of the nuts (top and leveling) by applying a torque to the nut according to Table 770-02.

Table 770-02

Bolt Diameter (inches)	Torque (foot-pounds)
1	100
1-1/4	200
1-1/2	300
1-3/4	400
2	500
2-1/4	700
2-1/2	800

(4) After step (2), ensure that the top nut and leveling nuts are in full bearing on the base plate. If any gap exists between the nut and the base plate, insert a beveled washer between the nut washer and the base plate to eliminate the gap. Use a stainless steel Type 304 washer of the same diameter as the hardened washer, which is beveled so that the gap between the nut and the base plate is eliminated. Retighten all nuts according to step (1) and (2) above if beveled washers are added.

(5) Tighten all top nuts an additional 1/3 turn using a hydraulic wrench. Tighten all of the nuts in two separate passes of equal increment turns. Use a sequence of tightening in each pass so that the opposite side nut, if possible, shall subsequently tightened until all the nuts in that pass have been turned. Do not allow the leveling nut to rotate during top nut tightening.

(6) Check the tightness of the nuts in the presence of the Engineer a minimum of 48 hours after completing step (4). Apply torque to the nut in accordance with Table 770-03.

Table 770-03

Bolt Diameter (inches)	Torque (foot-pounds)
1	300
1-1/4	630
1-1/2	1,120
1-3/4	1,820
2	2,770
2-1/4	4,010
2-1/2	5,550

The Engineer will tap each nut (top and leveling) with a 24-ounce ball peen hammer to check for looseness. A tight nut produces a sharp ringing sound, and a loose nut produces a dull sound.

The Engineer will tap each washer on one side while placing one hand on the other side of the washer. If the washer moves, the nut is not properly tightened.

The Engineer will use a wrench with a length equal to 14 times the diameter of the anchor bolt (minimum 18 inches) to check the tightness of each nut. If the Engineer is able to rotate a nut as a result of the application of a person's full effort on the end of the wrench, the nut is not properly tightened. If the Engineer finds any nut or washer to be loose as a result of the above acceptance procedure, tighten such loose nuts according to Steps (1) through (5) above. If any nuts require tightening after the initial installation, remove and reinstall nuts and washers and, if necessary, remove and re-erect the entire structure at no cost to the Department.

3. Rodent Protection.

Install rodent protection continuously around the inside of the lower plate to prevent rodents from entering the base through the space between the concrete foundation and the lower plate. Protection may consist of wire mesh with opening sized of 1/4 inch or less, Xcluder wrap, Halek Solutions rodent intrusion guard, or an approved equal. If using wire mesh, secure the mesh to the anchor bolts and lower plate.

H. Street and Sign Lighting Luminaires.

Insert a plug of oakum in the luminaire wire entrance.

Place the fuse assembly for each street light luminaire in the light standard base. Use breakaway fuses.

I. Wall-Mounted Luminaire.
Install the mounting bolts using a threaded insert. Attach the wall-mounted luminaire by a minimum of three 1/4-inch diameter bolts.

Install the fuse assembly for each luminaire in the junction box.

J. Underpass Ceiling-Mounted Luminaire.
Insert the mounting bolts using a threaded insert. Attach the ceiling-mounted luminaire by a minimum of four 1/4-inch diameter bolts.

Install the fuse assembly for each luminaire in the junction box.

K. Sign Lighting.
Install ground rods and conductor for sign lighting systems.

L. Remove Existing Lighting Equipment.
Before work begins, contact the local utility company and arrange a time for the power to be disconnected. The local utility company will remove the meter.

Remove existing foundations to a minimum depth of 3 feet below the ground line. Restore the surface to match adjacent areas.

If the plans designate the lighting equipment for salvage:
- disconnect the luminaire receptacle wires at the fuses;
- remove the luminaire from the mast arm before storing the equipment; and
- deliver the switch box and meter trim, along with all other salvaged components, to the designated salvage area.

M. Relocate Light Standard.

1. General.
Disconnect the wires to the luminaire at the fuses. Remove the light standard as specified in Section 770.04 L, “Remove Existing Lighting Equipment”. Install the light standard in the new location as specified in Section 770.04 G, “Light Standards”.

2. Painting Relocated Standards.
Sandblast surfaces that require preparation. Feather and clean existing paint remaining along the edges of blast cleaned areas to ensure a bond of new to old paint.

Apply paint only when the air temperature is at or above 45°F and below 100°F. Do not apply paint when there is precipitation or when the wind will cause accumulation of blown material in the wet paint.

Brush or spray apply paint. If using spraying equipment, use airless spraying equipment and continuously agitate the paint during the spraying operation. Apply paint so the finished surface is smooth and uniform without skips or areas of excessive paint. Allow the previously applied coat of paint to dry before applying the next coat.

Protect adjacent property from drift by using protective shields.

Prevent dust and dirt from accumulating on freshly painted surfaces.

Touch up painted areas that become scratched or marred with matching paint after erection.

N. Tests and Acceptance.

1. Tests.
After the installation is complete and at the time designated by the Engineer, the Engineer will conduct operating tests. Be present during all tests, furnish instruments and personnel required for tests, and record test results. The Engineer may hold nighttime tests and inspections.

2. Acceptance.
Upon completion of the lighting system operating tests, put the lighting system into service.

The lighting system will be accepted after 30 consecutive days of service without malfunction. If a malfunction occurs, submit a written report detailing the malfunction and the measures taken to correct the malfunction. The Engineer will perform the lighting inspection after this period.

770.05 METHOD OF MEASUREMENT

The Engineer will measure, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and as follows:

The Engineer will not measure conduit that is placed in concrete foundations, in feed points, on overhead sign structures, and on bridge sign structures.

The Engineer will include the additional conductor lengths in the measurement of the conductor.

770.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Lighting System	Each
Cable Trench	Linear Foot
Concrete Foundation	Each
Conduit ____ Size	Linear Foot
Multiple Underground Cable ____ Size	Linear Foot
Underground Conductor ____ Size	Linear Foot
Feed Point-Type __ - __ Mounted	Each
Lighting Standard	Each
Lighting Standard Extension	Each
Street Lighting Luminaire	Each
Bridge Sign Lighting	Each
Overhead Sign Lighting	Each
Wall-Mounted Luminaire	Each
Underpass Ceiling-Mounted Luminaire	Each
Relocate Light Standard	Each

Pay Item	Pay Unit
Remove Light Standard	Each
Remove Feed Point	Each
Revise Concrete Foundation	Each

When the “Lighting System” item is included in the Contract, the Contractor may submit a schedule of values for each lighting system detailing the individual component costs. The Engineer will review the schedule of values and if acceptable, will make progressive payments based on the schedule and as the work is completed. The Engineer will not make payment beyond 95 percent of the contract unit price until the lighting system is accepted.

If no schedule of values is submitted, the Engineer will make a determination of overall lighting system construction progress and make progressive payments up to 95 percent of the contract unit price until the lighting system is accepted.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 772
HIGHWAY TRAFFIC SIGNALS

772.01 DESCRIPTION
This work consists of furnishing and installing flashing beacons and traffic signals.

772.02 EQUIPMENT

Item	Section
Sawing	155.09
Air Compressor	156.01

772.03 MATERIALS

A. General.

Item	Section
Concrete, Class AE	802
Rapid-Hardening Cementitious Materials	806.01
Galvanizing	854
Highway Traffic Signals	896

The Department defines words and phrases as defined in Section 1 “Definitions” of the NEMA Standard Publication No. TS 2 Traffic Control Assemblies with NTCIP Requirements and Part 1 “Definitions” of NEMA Standards Publication TS-1 Traffic Control Systems to interpret these Specifications.

B. Work Drawings.
Submit work drawings a maximum of 20 days after the date of contract execution.

Provide the following with the work drawings:
- The dimensions;
- Type of material;
- The functional characteristics of the equipment to be installed; and
- Manufacturer warranties and guarantees listing the Department as the owner.

Submit work drawings for the following items:

1. Conductors;
2. Fiber Optic Cables;
3. Pull Box;
4. Saw Slot Sealant;
5. Feed Point Equipment;
6. Traffic Signal Standards including all necessary calculations and drawings used in designing these poles;
7. Combination Standards including all necessary calculations and drawings used in designing these poles;
8. Traffic Signal Heads;

9. Beacon Heads;
10. Pedestrian Signal Heads;
11. Pedestrian Push Button;
12. Law Enforcement Confirmation Lights;
13. Traffic Signal Controller cabinet with all components;
14. Emergency Vehicle Pre-Emption Equipment; and
15. Painting method and type.

C. Certificate of Compliance.
Submit a certificate of compliance that states all components of the LED signal modules meet ITE standards.

D. Wiring Diagrams.
At the time the cabinet and control equipment are accepted, furnish traffic signal cabinet wiring diagrams showing all circuits and parts in detail. Place the wiring diagram in the signal cabinet and submit one PDF copy to the Engineer.

Provide wiring diagrams that contain all the control equipment and their associated connecting cables and termination points. Identify each wire in each connecting cable on the wiring diagram as to its function and terminal number. At each terminal on the wiring diagram, list the cable designation and connector letter or number of the wire terminated at that point.

Include the location of all control equipment, terminals, etc., within the cabinet as well as an intersection layout showing the location of vehicle signal faces, pedestrian signal indications, loop detectors, pedestrian push buttons, etc., all labeled as shown on the plans.

E. Service Manuals.
At the time the cabinet and control equipment are delivered, a pdf of the service and operating manuals for the traffic signal controller unit and emergency vehicle pre-emption controller.

Furnish service manuals that include the following minimum information:
1. Detailed description of operation and instructions for initial set-up;
2. Recommended servicing and service hints;
3. Complete parts list; and
4. Recommended spare parts list.

F. Anti-Seize Lubricants.
Use an anti-seize lubricant on all metal screw and bolt connections.

772.04 CONSTRUCTION REQUIREMENTS

A. General.
All electrical installations must be either performed by or supervised by an electrician licensed by the ND State Electrical Board. Perform all work to meet the requirements of the National Electrical Code, the North Dakota State Electrical Board, the local utility company, and the ordinances established by the local municipality.

When installing lighting on a new meter, provide and bear all costs for the electrical service necessary to operate the lighting system until it is accepted as specified in Section 770.04 N.2, “Acceptance”.

Padlocks are required on items covered under this specification. Supply all necessary padlocks. Coordinate with the entity responsible for maintenance of the lighting system to verify padlocks match the existing key structure.

B. Concrete Foundations.
Construct concrete foundations as specified in Section 770.04 C, "Concrete Foundations".

C. Conduit.
Install conduit as specified in Section 770.04 D, "Conduit". Install an additional 2-inch conduit in each traffic signal standard foundation and traffic signal cabinet foundation as directed by the Engineer. Place a label on the additional conduits indicating the cardinal direction the conduit runs.

D. Conductors and Cables.

1. General.
Pull all cables through conduit by hand without causing strain to the cable or conduit. Install wire entrance fittings. Use rubber sleeve fittings with clamps to protect the wire through the wire entrances on the signal standards and mast arms.

Install cables with no splices.

Terminate cables at meter box, signal standards, or other equipment. Connect cables with sufficient slack to prevent any strain on the cable or connections. Install additional cable quantities to provide for slack and the wiring of cabinets, feed points, and signal heads as follows:

a. Nine feet at the cabinet;
b. Fifteen feet at post-mounted and pedestal-mounted vehicular signal heads;
c. Twelve feet at post-mounted and pedestal-mounted pedestrian signal heads;
d. Eight feet at each pedestrian push button;
e. Fifteen feet at each flashing beacon sign support;
f. Twenty-three feet at each signal pole with mast arm plus the length of the mast arm;
g. Ten feet at the feed point;
h. Five feet at each foundation for each incoming and outgoing pedestrian and signal head control circuit;
i. Six feet at pull boxes where connections are made; and
j. Three feet at each foundation for each incoming and outgoing circuit which passes through the foundation with no connection being made.

Ground all bases, signal standards, control cabinets, feed points, and any exposed metal parts. Attach bolted pressure connectors to all ground rods.

Protect cable from moisture during installation.

Identify the function of each cable and label each cable accordingly in all bases, signal standards, control cabinets, feed points, and pull boxes.

Make all necessary wiring connections.

Identify the function of each cable and place typed labels as shown in Table 772-01.

Table 772-01

Cable Type	Label	Label Location
Control Cable	Cable number and location (i.e. 1 NW, 2 SW, etc.)	Within 12 inches of conduit
	Conductor phase number (i.e. Ø1 SBL, Ø2 NB, etc.)	Within 6 inches of terminals
Pedestrian Pushbutton	Phase number (i.e. Ped Ø2, Ped Ø4, etc.)	Within 6 inches of terminals
Emergency Vehicle Preemption	Direction of traffic seeing indication (i.e. NB, SB, etc)	Within 6 inches of terminals
Video Detection	Direction of traffic detected (i.e. NB, SB, etc.)	Within 6 inches of terminals
Communication Cable	Location of other end (i.e. 1st St, City Hall, etc.)	Within 6 inches of terminals
Tracer Wire	"Tracer" and location of other end (i.e Tracer NW, Tracer NE, etc)	Within 12 inches of conduit

2. Traffic Signal Control Circuits.

a. General.
Use terminal blocks or lever nuts to terminate conductors in signal bases. Use the same style for all connections in a single base.

Install, No. 16 AWG, two-conductor cable from each pedestrian push button to the controller cabinet.

Install control cables running from the base connection in each traffic signal standard base to each traffic signal head. Install conductor cable according to Table 772-02.

Table 772-02

Traffic Signal Head Type	Conductor Cable
Two-section pedestrian head	No. 14 AWG, 3-conductor cable
Three-section & four-section vehicular head	No. 14 AWG, 5-conductor cable
Five-section vehicular head	No. 14 AWG, 7-conductor cable

b. Terminal Blocks.
When terminal blocks are used in the signal base, terminate conductors on the terminal block and then spray the terminations with dielectric insulating varnish.

When a terminal block is used in a transformer base, either place the terminal block face down or place it inside a PVC pipe that is covered on the top and open on the bottom.

c. Lever Nuts.
When lever nuts are used in the signal base, terminate conductors in the lever nuts and install dielectric insulating grease in all entrances of the lever nuts.

3. **Loop and Loop Lead-In Conductor.**
   For preformed loop detectors, seal the conduit end inside the pull box to prevent water from entering the conduit.

4. **Tracer Wires.**
   Install No. 12 tracer wires in the following conduits:
   - Control cable conduits between the controller cabinet and signal base; and
   - Fiber optic conduits between the controller cabinet and the next fiber termination point.

E. Installation of Loop Detectors.

1. **General.**
   Install the road loop in a manner that will minimize interruptions to the normal flow of traffic.

   Do not begin work until all material, equipment, and personnel are at the site.

2. **Layout.**
   The Engineer will mark the loop detector locations before installation.

3. **Pull Box.**
   Install conduit from the pull box to the gutter or roadway edge. Install a separate conduit for the pull box entry for each loop. Perform excavation from the saw slot at the gutter or roadway edge using a punch or drill type tool, rather than by usual excavating methods. Do not cut the visible portion of the gutter for conduit installation. Install the conduit to directly receive the loop wire in line and not at an angle. Use the same sealant over the conduit as used to close the saw cut.

4. **Saw Cut.**
   Saw the pavement slot with a self-propelled power saw equipped with a depth gauge and alignment guide. Cut clean pavement slots free of uneven and jagged edges.

   Clean slots immediately after the cutting operation. Place wooden strips in the cut or place a durable cover to prevent slot shrinkage or damage before the wire is installed.

5. **Wire Installation.**
   Install wire loops in a clean and dry slot. Clean wire slots using compressed air. Use a constant connection scheme for the color-coded, shielded loop lead-in wire throughout the intersection.

   Coil a minimum of 6 feet of slack for loop wire pairs and leave it in the pull box.

   Use blunt tools to install the wire. Hold the wire in place with short strips of polyethylene foam sealant backing placed over the wire at approximately every 2 feet. Leave these strips in place while the sealant is poured.

6. Initial Testing.
Before installing sealer, perform the following in the presence of the Engineer.

a. Continuity Test.
Perform continuity tests for each loop detector circuit at the following locations:
- The continuity of the lead-in cable must be less than 0.5 ohms at the pull box before splicing; or
- The continuity of the lead-in cable must be between 0.5 and 5.0 ohms at the traffic signal controller cabinet or detector cabinet after splicing in the pull box.

b. Inductance Test.
Perform induction tests for each loop detector and lead-in cable at the traffic signal controller cabinet or detector cabinet. The inductance must be between 50 to 500 microhenries.

c. Insulation Resistance Test.
Perform the insulation resistance test using 500 volts direct current at the traffic signal controller cabinet or at the detector cabinet between one loop detector lead-in conductor and the cabinet ground rod. The insulation resistance must be greater than 100 megaohms.

7. Saw Cut Seal.
Install sealer according to the manufacturer's instructions.

Pour sealer into the slot to 1/2 depth without air bubbles or material pileup. Then fill the slot to roadway level without air bubbles or material pileup.

Do not form a trough or a mound with sealer.

Allow sealer to harden according to the manufacturer's recommendations before allowing traffic to move over the area.

8. Final Testing.
After installing sealer, perform the tests specified in Section 772.04 E.6, "Initial Testing". Record the test results on form SFN 60844 *Traffic Signal Loop Detector Test Report* and submit the form to the Engineer.

9. Loop Detector System.

a. General.
Provide a moisture proof loop detector system.

b. Loop and Lead-In Conductor.
Install the loop lead-in conductor unspliced from the pull box to the cabinet.

Place the splice area at the top of the conductor holding device. Use a wood lath or other nonmetallic material to hold the loop and lead-in conductor in place inside the pull box, so that the conductor does not touch the bottom of the pull box.

c. Splices.
If splicing the detector feeder cable or loop lead-in conductor, use one of the following:
(1) Uraseal;
(2) 3M Underground Splice Kit; or
(3) Approved equal.

F. Feed Point.
The local utility company will furnish and install the required single phase voltage service connection and any required meter.

G. Traffic Signal Standards and Combination Signal and Light Standards.

1. General.
Install the luminaire fuses in the base of combination signal and light standards.

2. Anchor Bolt Tightening.
Conduct anchor bolt tightening as specified in Section 770.04 G.2, "Anchor Bolt Tightening".

3. Rodent Protection.
Install rodent protection as specified in Section 770.04 G.3, "Rodent Protection".

H. Traffic Signal and Pedestrian Heads.

1. General.
Mount pedestrian signals vertically and within 2 inches of the pole.

Provide back plates with a 1-inch yellow retroreflective sheeting border. Use sheeting specified in Section 894.02 E, "Type XI Retroreflective Sheeting".

Cover all heads with a material that allows the signal heads, when lit, to be seen dimly by personnel testing the signals. Leave the hoods in place until the Engineer authorizes operation of the signal. Position the heads to provide the best possible view for the traffic to be controlled.

2. Pole Mounted.
Attach the signal and head to signal poles using brackets having either threaded pole plates or pole clamps that accept the 1-1/2 inch standard steel pipe. Mount the traffic signal and pedestrian head on 1-1/2 inch standard steel pipe and fittings. Attach pole plates to the pole using corrosion resistant banding material.

3. Pedestal Mounted.
Mount pedestal-mounted traffic signals and pedestrian heads mounted on a post top slip fitter that attaches rigidly to the signal pole.

I. Traffic Signal Controller.
Connect the signal, interconnect, detector, power, and other circuits to the terminals as shown on the manufacturer's wiring diagram.

When setting cabinets directly on a concrete foundation, set them on a sealant and seal the inside and outside of the joint between the cabinet and concrete base with caulk.

Arrange the field leads in an orderly fashion within the cabinet. Do not cut field leads shorter than the furthest terminal for the same function in the cabinet.

J. Emergency Vehicle Pre-Emption (EVP).
Install EVP equipment when specified in the contract. Program the time settings established by the local municipality.

K. Uninterruptible Power Supply (UPS).
Install a battery backup system for each signal when specified in the contract. Provide a UPS having the following characteristics:

- Provides full battery powered backup for the traffic controller in normal or flashing operations;
- Flash activation contacts to prolong battery life;
- Power conditioning and transient filtering;
- True sine wave output with ±2 percent voltage regulation;
- Power management and diagnostic functions;
- Ethernet port with software to monitor or download data logs of the backup system;
- Suitable for operation from -40°F to 120°F;
- Able to run in flash operation for a minimum of 3 hours under battery backup;
- Capable of running the intersection for 30 minutes at 1000 watts, then switching to flash operation to conserve power;
- Includes an external bypass switch rated at 30 amp 250 VAC and uses 30 amp relays; and
- Included generator hookups.

L. Remove Existing Equipment.

1. General.
Before work begins contact the local utility company and arrange a time for the power to be disconnected. The local utility will remove the meter.

Remove the existing foundations to a minimum depth of 3 feet below the ground line and the surface restored to match adjacent areas.

2. Removal of Signal Heads.
If no new signal heads are to be installed, disconnect the circuits at the controller terminal strip. Tape the wires together and place them in the bottom of the controller cabinet.

3. Remove Flashing Beacon System.
Disconnect and remove the flashing beacon system.

4. Remove Traffic Signal System.
Disconnect and remove conductor, controller cabinet, and standard. Remove the traffic signal heads and mounting brackets from the standards. Remove the signal heads from the mounting brackets.

Remove and dispose of the traffic control cable and concrete foundation.

5. **Remove Traffic Signal Controller and Foundation.**
Disconnect and remove the controller cabinet. Remove and dispose of the concrete foundation.

6. **Remove Feed Point.**
Disconnect and remove switch box, meter trim, and conduit. Remove and dispose of the concrete foundation.

M. Tests and Acceptance.

1. General.

Furnish all instruments and personnel required for testing and record test results. If a subcontractor performed electrical work, ensure the subcontractor is present during testing and inspection.

The Engineer will perform the initial and final inspections when:

- Winds are 30 mph or less;
- Ambient temperature is 15°F or greater; and
- It is not raining or snowing.

2. Placement of Signals into Service.

a. General.

Before the Engineer will allow the removal of signal head covers and placement of the signals into service perform the tests outlined in this section.

b. Malfunction Management Unit Test.

Provide an Athens Technical Specialist, Inc (ATSI) test report for the malfunction management unit or perform a malfunction management unit test on site. If a malfunction management unit test is performed on site, record the test results on form SFN 60836 *Traffic Signal Malfunction Management Unit Test* and submit the form to the Engineer.

b. Ground Test.

Before opening to traffic, perform a ground test. The maximum allowable resistance at the controller cabinet is 10 Ohms. The maximum allowable resistance at each traffic signal standard is 25 Ohms. Record and submit the test results on form SFN 60834, *Traffic Signal Ground Test*.

3. Initial Inspection.

After the signal system is operational and in service, submit a request to schedule the initial inspection. The system must be fully operational for a minimum of 15 days before the Engineer will perform the initial inspection. The Engineer will record the inspection results on form SFN 59867, *Traffic Signal Inspection Checklist* or form SFN 60845 *Flashing Beacon Inspection Checklist*. The Engineer will supply the Contractor with a memo summarizing any deficiencies.

4. **Supplemental Inspections and Final Acceptance.**
   After performing corrections, submit a request for a supplemental inspection. The Engineer will perform a supplemental inspection within 30 days of receiving the request.

   If this inspection discloses any unsatisfactory items, the Engineer will provide the Contractor with a written list of items that require correction. After correcting the items, request another supplemental inspection.

   If the Engineer determines that the work is complete, the signal system must operate for 14 consecutive days without interruption from defective equipment or improper workmanship.

   If the signal system fails within the 14 days, make necessary repairs. After repairs are complete, request another supplemental inspection.

   If the signal system operates for 14 consecutive days without interruption from defective equipment or improper workmanship, the Engineer will consider the last supplemental inspection as the final inspection and will accept the signal system.

772.05 METHOD OF MEASUREMENT

The Engineer will measure items, completed and in place, as specified in Section 109.01, "Measurement of Quantities" and as follows:

The Engineer will measure each traffic signal system installed. A traffic signal system is comprised of the signal system at a single intersection.

772.06 BASIS OF PAYMENT

Pay Item	Pay Unit
Traffic Signal System – Site ____	Each
Remove Signal Heads	Each
Remove Flashing Beacon System	Each
Remove Traffic Signal System	Each
Remove Traffic Signal Controller	Each
Remove Feed Point	Each

When the "Traffic Signal System – Site ____" item is included in the Contract, the Contractor may submit a schedule of values for each signal system site detailing the individual component costs. The Engineer will review the schedule of values and if acceptable, will make progressive payments based on the schedule and as the work is completed. The Engineer will not make payment beyond 80 percent of the contract unit price until the signal system site is accepted.

If no schedule of values is submitted, the Engineer will make a determination of overall signal system construction progress and make progressive payments up to 95 percent of the contract unit price until the signal system is accepted.

Such payment is full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

SECTION 802
PORTLAND CEMENT CONCRETE

802.01 Mix Design

A. General.

1. Development.

Develop a mix design based on the requirements of this section. Perform the specified aggregate and strength tests and submit the results with the mix design. Submit the completed mix design a minimum of 14 days before beginning concrete placement operations.

Use materials slated for use on the project when developing and testing the mix design. If any material or material source changes, develop and submit a revised mix design and test results.

Provide concrete that is air entrained.

Concrete is divided into classifications as shown in Table 802-01.

Table 802-01

Concrete Class Designation	Cementitious Material Content (lbs) per CY	Water-Cement Ratio (Max)
AAE	600 – 650	0.44
AE	550 – 600	0.47
ASE	575 – 625	0.40

A numeral following the alphabetical designation for the class of concrete indicates the gradation of coarse aggregate to be used in the mix, based on Table 802-03. If a specific gradation is not designated, use any gradation from Table 802-03. For ASE concrete, use aggregate that meets the requirements of Section 802.01 C.4, "Well Graded Aggregate".

2. Class AE and AAE Mixes.

Design a mix that will attain a compressive strength of 3,000 psi within 7 days or a flexural strength of 450 psi within 7 days.

Mix designs used for Section 550, "Concrete Pavement" will be required to attain both a compressive strength of 3,000 psi and a flexural strength of 450 psi within 7 days.

Measure compressive strength according to AASHTO T 22 and flexural strength according to AASHTO T 97. Apply a correction factor of 0.92 when using 4 inch x 8 inch concrete cylinders.

3. Class ASE Mix.

Design a mix that will attain a minimum compressive strength of 3,000 psi within 30 hours or a minimum flexural strength of 450 psi within 30 hours.

Develop a maturity curve according to ASTM 1074. Use 6 inch x 12 inch cylinders or flexural beams for strength determination.

4. **Certificate of Compliance.**
Submit a certificate of compliance for non-aggregate materials.

B. Cement.
Provide cement as specified in Section 804.01 “Cement” .

C. Aggregate.

1. **General.**
Base the aggregate content of the concrete mix on a saturated surface-dry condition of the aggregates. Determine the relative proportions of each stockpile and adjust the batch quantity of each aggregate as necessary to compensate for any free water on the surface of the aggregate or for any water that will be absorbed by the aggregate.

2. **Coarse Aggregate.**
Provide coarse aggregate that meets requirements of Table 802-02 and the appropriate numerical designation from Table 802-03.

Table 802-02
Miscellaneous Coarse Aggregate Properties

Test	Method	Max. Percent by Weight of the Plus No. 4 fraction
Shale	NDDOT 3	0.7
Iron oxide particles	NDDOT 3	4.0[1]
Lignite and other coal	NDDOT 3	0.5
Soft Particles (Excluding Shale, Iron oxide particles and Lignite and other coal)	NDDOT 3	2.5
Thin or Elongated Pieces	NDDOT 3	15
L.A. Abrasion	AASHTO T 96	40.0
Soundness (Sodium Sulfate)	AASHTO T 104	12

[1] For concrete for spall repairs and bridge deck overlays, the maximum iron oxide particles shall be 2.0 percent.

Table 802-03
Coarse Aggregate Gradation

Sieve Size	Aggregate Size and Percent Passing by Weight		
	3	**4**	**5**
1-1/2 inch	100		
1 inch	95 – 100	100	
3/4 inch		90 – 100	100
1/2 inch	25 – 65		90 – 100
3/8 inch	15 – 55	20 – 55	40 – 70
No. 4	0 – 10	0 – 10	0 – 15
No. 8	0 – 5	0 – 5	0 – 5
No. 200	0 – 1.0	0 – 1.0	0 – 1.0

3. Fine Aggregate.

Use fine aggregates that meet the gradation in Table 802-04 and the miscellaneous properties in Table 802-05.

Test fine aggregates in accordance with AASHTO T 21. If the results of the analysis are darker than the standard color, determine the compressive strength of mortar mixed using the aggregate in accordance with AASHTO T 71. If the results of the AASHTO T 71 test result in a relative strength less than 95 percent, do not use the fine aggregate.

Table 802-04
Fine Aggregate Gradation

Sieve Size	Percent Passing
3/8 Inch	100
No. 4	95 – 100
No. 16	45 – 80
No. 50	10 – 30
No. 100	0 – 10
No. 200	0 – 3.0

Table 802-05
Miscellaneous Fine Aggregate Properties

Test	Method	Requirement
Soundness (sodium sulfate)	AASHTO T 104	10% max.
Lightweight pieces in Aggregate	ND T 113	2% max.

4. Well Graded Aggregate.

Use a well graded aggregate that meets the gradation in Table 802-06 and the properties specified in Table 802-02 and 802-05.

When testing material properties specified in Table 802-02 and Table 802-05, divide aggregate samples into course and fine aggregate on the No. 4 sieve.

Table 802-06
Well Graded Gradation

Sieve Size	Percent Passing
1-1/4 inch	100
1 inch	95 – 100
3/4 inch	90 – 100
3/8 inch	55 – 70
No. 8	31 – 42
No. 16	18 – 35
No. 50	0.0 – 10
No. 200	0.0 – 3.0

D. Water.

Provide water as specified in Section 812, "Water".

The water content of the mixed concrete includes the quantity of mixing water measured into the batch plus any free water on the surface of the aggregates, but does not include water absorbed by the aggregates.

Use the minimum water content required to produce a workable, plastic mix having a consistency that permits a satisfactory rate of discharge, proper placement, and consolidation of the concrete.

E. Slump.

If concrete is pumped from the mixer or truck, adjust the slump at the mixer to give the proper consistency at the point of deposit in the forms.

Provide concrete that has a slump that meets the requirements in Table 802-07.

Table 802-07
Slump Requirement

Concrete Application		Min Inches	Max Inches
Pavements:	Formed Paving	1.0	4.0
	Slipformed Paving	0.0	2.0
Structures:	Structural Concrete	1.0	4.0
	Bridge Decks	1.0	3.0
	Barrier Curbs	1.0	4.0
	Barrier Curbs Slipformed	0.0	2.0
	Box Culvert, Top and Bottom	1.0	4.0
	Box Culvert, Sides	1.0	5.0
Applications	not listed above	1.0	4.0

F. Admixtures.

1. General.

Use admixtures as specified in Section 808 "Concrete Admixtures".

2. **Bridge Deck Concrete.**
   Use a retarding admixture in Class AAE-3 concrete in bridge decks when the temperature of the concrete or the ambient air temperature at the time of placement exceeds 75°F. Provide a retarding admixture that meets the requirements of AASHTO M 194 and that are classified as Type B or D under ASTM C 494.

3. **ASE Concrete.**
   A non-calcium chloride accelerator may be used, but must meet the requirements of AASHTO M 194 and be classified as Type C under ASTM C 494. Accelerating admixtures are limited to a maximum of 2.0% by weight of cement.

G. Supplementary Cementitious Material (SCM).

1. **Concrete Used in Bridges, Beams, and Box Culverts.**
   When placing concrete under section 602, 604, 606, 622, and 650; use Class F Fly Ash meeting the requirements of Section 820.02 B. "Class F Fly Ash" Class F Fly Ash may replace cement on a 1:1 ratio, up to a maximum of 29 percent by weight.

2. **ASE Concrete.**
   Include SCM in the mix at a rate between 10 percent and 20 percent, by weight, of the cementitious material in the mix.

3. **Other Concrete.**
   SCM, meeting the requirements of Section 820, "Supplementary Cementitious Material (SCM)", may replace cement on a 1:1 ratio, up to a maximum of 35 percent by weight.

H. Air Content.
Use one of the following methods to entrain air in the concrete:

1. Air-entraining cement;
2. A chemical admixture as specified in Section 808, "Concrete Admixtures"; or
3. A combination of 1. and 2.

Supply concrete with an air content between 5.0 and 8.0 percent of the volume of the concrete at the time of placement.

I. Tests on Concrete.
Furnish the concrete necessary for the tests.

Near the site of concrete placement, provide a level area protected from construction activities near the site of placement for the Engineer to conduct tests.

802.02 EQUIPMENT

Item	Section
Batch Plant	155.02
Mixer	155.03
Transporting	155.04

802.03 CONSTRUCTION REQUIREMENTS

A. Handling and Storing Materials.

1. Cement or SCM.
Handle and store cement and SCM of different types, brands, or sources separately. Provide storage that protects the cement or SCM against dampness. Do not use cement that contains caked lumps or is salvaged from spillage.

2. Aggregates.
Handle and stockpile each separate aggregate component of different source or grading separately. Provide adequate equipment and material to ensure a continuous batching operation.

Do not operate aggregate hauling equipment on the stockpile.

Do not use material from the bottom one foot of the stockpile.

The Engineer will reject aggregates that become intermixed with aggregates of different source or become contaminated by foreign materials. Remove rejected aggregate from the plant site.

The Engineer will reject segregated aggregate unless the aggregate is uniformly remixed to meet the specified gradation.

Allow washed aggregates to drain for at least eight hours before use to obtain stable and uniform moisture content. The Engineer will consider gravity drainage in the weigh hoppers or truck boxes evidence that the moisture content is not stable. The moisture content is not uniform if the variations in moisture content of any aggregate component causes fluctuations in the consistency of successive batches of the mixed concrete.

Store freshly washed aggregates separately from the drained aggregates in use.

B. Batching of Concrete Materials.

1. General.
When directed by the Engineer, test the batching operation accuracy on a certified scale. Weigh the batched ingredient on a platform scale. Perform the accuracy test at no additional cost to the Department.

Stop mix production if the scale is out of tolerance. Fix and recertify the batching scale before continuing mix production.

2. Batching Cement and SCM.
Batch bulk cement and SCM to a tolerance of 1 percent of the weight specified in the mix design.

3. Batching Aggregate.
Batch aggregate components to a tolerance of 2 percent of the weight specified in the mix design.

4. Batching Water.
Measure the mixing water for each batch by volume or by weight. Add the designated quantity of mixing water to each batch, within a tolerance of 1 percent.

C. Measuring and Dispensing Admixtures.
Measure admixtures used in the concrete and dispense using the manufacturer's recommendations to give a uniform distribution.

Dispense admixture using a clean device that repetitively controls the batching of the admixture within a tolerance of 5 percent of the required volume of material or 1 fluid ounce, whichever is greater. Arrange dispensing equipment to allow convenient, visual observation of the volume of admixture dispensed.

If using more than one admixture in the same batch, add the admixtures separately to prevent contact in their concentrated form.

D. Mixing and Transporting Concrete.

1. General.
Mix the concrete at the site of placement or by a ready-mix method.

Mix the concrete in the quantity required to provide continuous placement and finishing operations. Do not add water to reestablish the required consistency of concrete.

Operate the mixer so successive batches of concrete do not merge or intermix during the mixing cycle.

Mix all concrete until the cement, water, aggregates, and admixtures are uniformly distributed.

Do not use materials containing frost or lumps of frozen material.

If weather conditions begin damaging the work, stop concrete mixing operations.

2. Mixing.
Measure the mixing time from the time all solid materials are in the drum until discharge of that batch begins. Charge the drum so a portion of the mixing water enters in advance of the aggregates and cement. Add all remaining water after charging the aggregate and cement and before 1/4 of the mixing time has elapsed. Include transfer time in multiple compartment mixers in mixing time.

Use a minimum mixing time per batch of 60 seconds. Mix the concrete for a minimum of 90 seconds if temporarily operating the mixer under manual timing control or the mixer has a rated capacity of less than 10 cubic feet.

3. Transporting Concrete.
Deliver concrete to the site of placement in an agitating truck, in a truck mixer operated at agitating speed, or in approved non-agitating equipment. Do not exceed 30 minutes in non-agitating equipment or 60 minutes in agitating equipment, between introducing the cement to the mixture and the time the concrete has been completely discharged.

Limit the amount of time between introducing the cement into the mix and fully discharging the batch to:

- 30 minutes for non-agitating equipment; or
- 60 minutes for agitating equipment.

The Engineer may reduce these time limits if weather conditions affect the concrete adversely.

The Engineer may extend the 60 minute time limit to a maximum of 90 minutes if the ambient air and the concrete mix temperature at the time of mixing is less than 80°F, and if the mixed concrete meets the specified requirements for maximum water content and air content when discharged at the site of the work. The mix must be completely discharged within the 90 minutes. Do not add water to concrete after the 60 minute time limit.

Only produce truck-mixed concrete after all equipment, facilities, and methods for handling and storing materials and for proportioning, mixing, and transporting the concrete have been approved.

Discontinue the use of truck mixed concrete if the delivery of concrete is insufficient for continuous placement and finishing.

Discontinue the use of truck mixed concrete if any properties of the concrete are not meeting specifications.

Place a volume of concrete in the truck-mixer that does not exceed the maximum capacity shown on the manufacturer's rating plate.

Clean the truck-mixer at periodic intervals to prevent accumulation of hardened concrete, and empty it of all free water before receiving any batch ingredients.

After all ingredients are charged in a truck-mixer, rotate the mixer between 70 and 100 revolutions at mixing speed. If the batch volume is 90 percent or less than the rated mixing capacity, the Engineer may reduce the mixing to a minimum of 50 revolutions. After mixing is complete, revolve the mixer at agitating speed. If water is added, mix an additional 30 revolutions at mixing speed after mixing has begun or been completed.

4. Temperature Control.

After mixing, maintain the concrete temperature between 50°F and 90°F until placement.

The Engineer will allow heating or cooling aggregates, mixing water, or both if required to maintain the temperature range. Apply the following restrictions:

- Heat aggregates using indirect heat only and to temperatures not exceeding 150°F;
- If the aggregate or the water is heated to a temperature exceeding 100°F, combine the aggregate and water before placing them in contact with the cement;
- If heated by steam, drain aggregates as specified in Section 802.01 C, "Aggregate" before measuring it into the batches; and
- Use heating methods that heat the materials uniformly.

SECTION 804
CEMENT AND LIME

804.01 CEMENT

Use one of the following materials:

- Portland Cement that meets the requirements of AASHTO M 85, Type II; or
- Blended Hydraulic Cement that meets the requirements of AASHTO M 240, Type IL(MS).

ASTM C452 test results below 0.05 percent are considered a passing MS performance test in lieu of the ASTM C1012 test shown in AASHTO M 240.

804.02 LIME

Use hydrated lime that meets AASHTO M 216.

SECTION 806
GROUT AND EPOXY

806.01 RAPID-HARDENING CEMENTITIOUS MATERIALS

Use material that meets the requirements of ASTM C 928, Type R1.

806.02 EPOXY RESIN ADHESIVES

Use material that meets the requirements of AASHTO M 235, Type IV, Grade 3. Select the appropriate Class of adhesive based on the surface temperature of the concrete the adhesive will be applied to.

SECTION 808
CONCRETE ADMIXTURES

808.01 AIR-ENTRAINING ADMIXTURES
Use air-entraining admixtures that meet the requirements of AASHTO M 154.

808.02 CHEMICAL ADMIXTURES
Chemical admixtures may be used, but must meet the requirements of AASHTO M 194 and be classified as Type A under ASTM C 494. Other types of admixtures may be used, but must be approved by the Engineer before use.

SECTION 810
CONCRETE CURING MATERIALS

810.01 CURING MATERIALS

A. Burlap Cloth.
Use burlap cloth that meets the requirements of AASHTO M 182.

B. Liquid-Membrane-Forming Compounds.

1. Type 2.
Supply curing compound that meets the requirements of ASTM C 309 Type 2.

2. Type 2, Class B.
Supply curing compound that meets the requirements of ASTM C 309 Type 2, Class B and meets the requirements of Table 810-01.

Table 810-01

Properties	Value
Total Solids, % by weight of compound	42 minimum
% Reflectance in 72 hours	65 minimum
Loss of Water, kg/m2 in 24 hours	0.15 maximum
Loss of Water, kg/m2 in 72 hours	0.4 maximum
Settling Test (NDDOT 6)	2 maximum
V.O.C. Content, g/L	350 maximum

Use a resin that is 100 percent poly-alphamethylstyrene.

3. Curing Compound for Pigmented Concrete.
Use a curing compound when curing pigmented concrete that meets the requirements of ASTM C 309 Type 1-D.

SECTION 812
WATER

812.01 WATER

Use water that is clean and free of oil, acid, alkali, organic matter, and other substances detrimental to the finished product. If the water source is known to be potable, no testing will be required. If the potability of the water is unknown, the Engineer will test the water according to the requirements of Table 812-01. Where the source of water is relatively shallow, enclose the intake to exclude silt, mud, grass, or other solid materials.

Table 812-01

Test	Requirement	Test Method
Total Solids by Mass	< 2500 ppm	ASTM C 1603
Sulfate	< 3000 ppm	ASTM D 516
Chloride	< 500 ppm	ASTM D 512
pH from 6.0 to 8.6		

If one or more test shown in Table 812-01 exceed the requirements, with the exception of the pH, then the water source is not acceptable.

If test results show a pH value less than 6.0 or more than 8.6, the Engineer will determine the compressive strength of mortar mixed using the sampled water in accordance with AASHTO T 106. The 7 day compressive strength will be compared to results obtained using distilled water in place of the sampled water. If the sampled water specimens achieve less than 90 percent of the strength of the distilled water specimens, do not use the water source.

SECTION 816
AGGREGATES

816.01 GENERAL
Provide material consisting of sound, durable particles of gravel or sand which may include limited quantities of fine soil particles as binding material. Use material that is free of any deleterious material or organic material.

816.02 MISCELLANEOUS AGGREGATES
Supply aggregate that meets the requirements of Table 816-01.

Table 816-01
Miscellaneous Aggregates

Sieve Size Or Testing Method	Aggregate Class							
	2	3	3M	4	5	7	8	13
	Percent Passing or Testing Requirement							
3 inch		100						
1-1/2 inch							100	
1 inch			100		100	100		100
3/4 inch	100	80-100	80-100	100	90-100	95-100		70-100
1/2 inch						85-100		
3/8 inch	50-95					60-90		
No. 4		35-85	35-85	35-85	35-70	15-25	35-80	38-75
No. 8						2-10		22-62
No. 10	0-15							
No. 30	0-4	20-50	20-50	10-50	16-40			12-45
No. 200		0-15	4-10	7-17	4-10	0-3		7-15
ND T 113, Shale (max %)		12.0%	12.0%	15.0%	12.0%	8.0%	20.0%	12.0%
AASHTO T 96, L.A. Abrasion (max %)				50%	50%	40%		50%
NDDOT 4, Fractured Faces[1]				10%	25%	85%		10%

[1] Minimum weight percentage allowable for the portion of the aggregate retained on a No. 4 sieve having at least 1 fractured face for Classes 4, 5, and 13 and at least 2 fractured faces for Class 7.

The maximum Plasticity Index (PI) for class 5 aggregate is based on the material gradation and is derived from the following formula:

$$\text{Max PI} = 10 - (\text{percent passing the No. 40 sieve} \div 10)$$

The PI of the material will be determined in accordance with test ND T 90, “Determining the Plastic Limit and Plasticity Index of Soils”.

816.03 AGGREGATES FOR BLOTTER AND SEAL COATS
Supply aggregate that meets the requirements of Table 816-02.

Table 816-02
Aggregates for Blotter and Seal coats

Sieve Size Or Testing Method	Aggregate Class					
	41	41M	42	43	44	45
	Percent Passing or Testing Requirement					
5/8 inch					100	
3/8 inch	100	100	100	100		100
No. 4	0-70	0-70	0-70	0-70	90-100	85-100
No. 8	0-12	0-12	2-20	0-17		
No. 16	0-6	0-6				45-80
No. 50						10-30
No. 200	0-1.5	0-1.5	0-5	0-2	0-20	0-3
ND T 113, Shale (max %)	8.0%	8.0%	8.0 %	8.0%		3.0%
AASHTO T 96, L.A. Abrasion (max %)	40%	40%	40%	40%		
NDDOT 4, Fractured Faces[1]		50%				

[1]Minimum weight percentage allowable for the portion of the aggregate retained on a No. 4 sieve having at least 1 fractured face for Class 41M.

816.04 AGGREGATE FOR MICRO SURFACING

A. General.

Use aggregate that is manufactured crushed stone such as granite, slag, limestone, or other high quality aggregate or combination thereof.

Before stockpiling aggregate, perform the tests specified in Table 816-03.

Table 816-03

Test	Test Method	Requirement
Soundness of Aggregates by Use of Sodium Sulfate	AASHTO T 104	15% Max
Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine[1]	AASHTO T 96	30% Max
Deleterious Substances	ND T 176	60 or Higher

[1] Perform the AASHTO T 96 test on the parent aggregate

B. Mix Design.

Develop a mix design using aggregate that meets the requirements of Table 816-04. Establish mix design target values for each sieve and submit the mix design before beginning placement operations.

Table 816-04
Aggregate Gradation for Development of Mix Design

SIEVE SIZE	TYPE II %PASSING	TYPE III %PASSING
3/8”	100	100
#4	90 – 100	70 – 90
#8	65 – 90	45 – 70
#16	45 – 70	28 – 50
#30	30 – 50	19 – 34
#50	18 – 30	12 – 25
#100	10 – 21	7 – 18
#200	5 – 15	5 – 15

C. Stockpile Tolerances.

The mix design target values will be used for acceptance of material. Gradation tests may vary from the mix design target values based on the stockpile tolerance shown in Table 816-05. The percent passing each sieve for gradation tests may not fall outside the gradation limits specified in Table 816-04.

Table 816-05

SIEVE SIZE	STOCKPILE TOLERANCE
3/8”	-
#4	± 5%
#8	±5%
#16	±5%
#30	±5%
#50	±4%
#100	±3%
#200	±2%

D. Acceptance.

1. Stockpile Testing.

Perform a gradation test in accordance with ND T 11 and ND T 27 for every 500 tons of material produced and placed in the stockpile. Also perform test ND T 176 when performing gradation tests. Submit the test results to the Engineer.

The Engineer will perform acceptance testing. If the result of the Engineer’s testing lead to rejection of the stockpile, additional material may be blended with the stockpiled material so that the stockpile meets the requirements. The Engineer will resample and retest for both gradation and deleterious substances to determine if the stockpiled material will be accepted.

If choosing to blend additional material into the stockpile, use additional material that meets the requirements of Table 816-06. After blending, develop and submit a new mix design.

2. **Gradation.**
The Engineer will obtain 5 independent samples from the stockpile and perform a gradation analysis in accordance with ND T 11 and ND T 27. If the average gradation for each sieve is within the stockpile tolerance of the mix design target values, the Engineer will accept the material.

If the stockpile is rejected, additional material may be blended with the stockpiled material to obtain the required gradation. The Engineer will resample and retest to determine if the stockpiled material will be accepted.

If choosing to blend additional material into the stockpile, use additional material that meets the requirements of Table 816-03. After blending, develop and submit a new mix design.

3. **Deleterious Substances.**
The Engineer will determine the amount of deleterious substances in the aggregate using the same samples obtained in Section 816.04 D.2, "Gradation". If the average of the test results is 60 or higher, the Engineer will accept the material.

816.05 AGGREGATE FOR SLURRY SEAL

A. General.
Use aggregate that is manufactured crushed stone such as granite, slag, limestone, or other high quality aggregate or combination thereof. Use aggregate with 100 percent of the parent aggregate larger than the largest stone in the specified gradation.

Before stockpiling aggregate, perform the tests specified in Table 816-06.

Table 816-06

Test	Test Method	Requirement
Soundness of Aggregates by Use of Sodium Sulfate	AASHTO T 104	15% Max
Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine[1]	AASHTO T 96	35% Max
Deleterious Substances	ND T 176	60 or Higher

[1] Perform the AASHTO T 96 test on the parent aggregate

B. Mix Design.
Develop a mix design using aggregate that meets the requirements of Table 816-07. Establish mix design target values for each sieve and submit the mix design before beginning placement operations.

Table 816-07
Aggregate Gradation for Development of Mix Design

SIEVE SIZE	TYPE II %PASSING	TYPE III %PASSING
3/8”	100	100
#4	90 – 100	70 – 90
#8	65 – 90	45 – 70
#16	45 – 70	28 – 50
#30	30 – 50	19 – 34
#50	18 – 30	12 – 25
#100	10 – 21	7 – 18
#200	5 – 15	5 – 15

C. Stockpile Tolerances.

The mix design target values will be used for acceptance of material. Gradation tests may vary from the mix design target values based on the stockpile tolerance shown in Table 816-08. The percent passing each sieve for gradation tests may not fall outside the gradation limits specified in Table 816-07.

Table 816-08

SIEVE SIZE	STOCKPILE TOLERANCE
3/8”	-
#4	± 5%
#8	±5%
#16	±5%
#30	±5%
#50	±4%
#100	±3%
#200	±2%

D. Acceptance.

1. Stockpile Testing.

Perform a gradation test in accordance with ND T 11 and ND T 27 for every 500 tons of material produced and placed in the stockpile. Also perform test ND T 176 when performing gradation tests. Submit the test results to the Engineer.

The Engineer will perform acceptance testing. If the result of the Engineer’s testing lead to rejection of the stockpile, additional material may be blended with the stockpiled material so that the stockpile meets the requirements. The Engineer will resample and retest for both gradation and deleterious substances to determine if the stockpiled material will be accepted.

If choosing to blend additional material into the stockpile, use additional material that meets the requirements of Table 816-06. After blending, develop and submit a new mix design.

2. **Gradation.**
   The Engineer will obtain 5 independent samples from the stockpile and perform a gradation analysis in accordance with ND T 11 and ND T 27. If the average gradation for each sieve is within the stockpile tolerance of the mix design target values, the Engineer will accept the material.

3. **Deleterious Substances.**
   The Engineer will determine the amount of deleterious substances in the aggregate using the same samples obtained in Section 816.05 D.2, "Gradation". If the average of the test results is 60 or higher, the Engineer will accept the material.

SECTION 817
SALVAGED BASE COURSE

817.01 SALVAGED BASE COURSE

A. General.

Salvage base course must include a minimum of 30 percent of one or more of the following materials:

- existing bituminous material;
- existing concrete material;
- stockpiled bituminous material; and
- stockpiled concrete material.

The remaining portion of the salvage base material may be composed of the following materials:

- virgin aggregate;
- existing aggregate base;
- existing bituminous material;
- stockpiled bituminous material;
- existing concrete material; and
- stockpiled concrete material.

The total amount of bituminous material in salvaged base course is limited as specified in Section 817.01 D, "Salvage Base Course Containing Bituminous Material".

If seeking to substitute virgin aggregate in lieu of salvaged base course, submit a written request, including a detailed justification. If the request is approved, the virgin material must meet the requirement of class 5 aggregate as specified in Section 816.02, "Miscellaneous Aggregates".

If the quantity of removed material exceeds the amount of salvaged base course needed for the work, dispose of the excess material in accordance with Section 107.17, "Removed Material".

Produce salvaged base that is free of reinforcing steel, soil, scoria, and other deleterious materials.

B. Salvaged Base Course Gradation.

Sieve Size	Percent Passing
1-1/2 inch	100
1 inch	90 - 100
No. 4	35 - 85
No. 30	16 - 50
No. 200	0.0 - 12.0

C. Virgin Aggregate for Blending with Salvage Base Course.

Provide virgin aggregate meeting the requirements of Class 5 aggregate in Section 816, "Aggregates" when blending with salvage base course.

D. Salvage Base Course Containing Bituminous Material.

1. General.
If salvaged base course is to be placed beneath a concrete surface, the salvaged base course may be composed of 100 percent recycled bituminous material.

If salvaged base course is to be placed beneath a bituminous asphalt surface or used as a final surfacing, the following specifications apply.

2. Blending Bituminous Material Obtained from the Work.
If using bituminous material salvaged from the work, create blended material that is between 30 and 50 percent salvaged bituminous material, by weight of the blended stockpile.

3. Existing Bituminous Material Stockpiles.
If using stockpiled bituminous material, limit the amount of asphalt binder material in the stockpile using one of the following methods:

a. Extraction Test Method.
Obtain three samples of the material in accordance with ND T 2 under the supervision of the Engineer. The Engineer will take possession of the samples and determine the amount of asphalt binder in stockpile.

The Engineer will determine the percentage of asphalt binder in the stockpile in accordance with AASHTO T 164 and average the results obtained from the three samples. The material will be rejected if any single sample has a value greater than 4.0 percent or the average extraction is greater than 3.5 percent. If the stockpile is rejected, the stockpiled material may be blended with other material.

b. Blending by Weight.
Create blended material that is between 30 and 50 percent bituminous material, by weight of the blended stockpile.

E. Salvage Base Course Containing Concrete Material.
Salvaged base course may be up to 100 percent concrete material. Dispose of existing reinforcing steel removed from the work as specified in Section 107.17, “Removed Material”.

SECTION 818
BITUMINOUS MATERIALS

818.01 GENERAL REQUIREMENTS

At the time of delivery, submit a certificate of compliance for each car and tank truck of material. In addition to the requirements of Section 106.01 C, "Certificate of Compliance", provide the following information on each certificate of compliance:

1. Destination;

2. Gross, Tare, and Net Weights if Shipped by Truck;

3. Car Initials and Number or Tank Truck Number;

4. Type and Grade of Bitumen;

5. Date of Shipment; and

6. Specific Gravity.

818.02 SPECIFIC REQUIREMENTS

A. Performance Graded (PG) Asphalt Cement.
If the Performance Graded (PG) asphalt cement called for in the plans contains an S, H, V, or E designation, use PG asphalt cement that meets AASHTO M 332

Base asphalt may be modified with Polyphosphoric Acid (PPA). PPA may make up no more than 0.50 percent of the finished binder, by weight.

The Engineer will accept PG asphalt according to the Combined State Binder Test Group procedures.

Under the observation of the Engineer, obtain one sample for every 250 tons of material for each supplier and grade of asphalt cement, or fraction thereof.

B. Rapid-Curing Cutback Asphalt.
Use rapid-curing cutback asphalt that meets AASHTO M 81.

C. Medium-Curing Cutback Asphalt.
Use medium-curing cutback asphalt that meets AASHTO M 82.

D. Slow-Curing Cutback Asphalt.
Use slow-curing cutback asphalt that meets ASTM D 2026, except that the minimum flash point for the SC 800 shall be 240°F.

E. Cationic Emulsified Asphalt.

1. Cationic Emulsified Asphalt.
Use cationic emulsified asphalt that meets the requirements of AASHTO M 208.

2. Modified Cationic Emulsified Asphalt.
Use emulsified asphalt grades that meet the requirements of AASHTO M 316.

Use asphalt with a maximum 3.0 percent oil distillate by volume of emulsified asphalt when tested according to AASHTO T 59, Residue and Oil Distillate by Distillation on Emulsified Asphalt. Use the manufacturer's recommended distillation temperature when using CRS-2P emulsion.

F. Anionic Emulsified Asphalt.
Use emulsified asphalt that meets AASHTO M 140.

818.03 BITUMINOUS MATERIALS FOR MICRO SURFACING

Use emulsified asphalt and emulsified asphalt residue that meets the requirements specified in AASHTO M 316 for CQS-1hP or CQS-1P and Table 818-01. The cement mixing test is not required.

Mill or blend the polymer material into the asphalt or emulsifier solution before the emulsification process.

Table 818-01

Test	Specification	Requirement
Settlement and Storage Stability of Emulsified Asphalts, 24-h	AASHTO T 59	1% Minimum
Distillation of Emulsified Asphalt[1]	AASHTO T 59	62% Minimum
Tests on Emulsified	**Asphalt Residue**	
Softening Point of Bitumen (Ring and Ball Apparatus)	AASHTO T 53	135°F Minimum

[1] Hold the temperature for this test at 350°F for 20 minutes.

818.04 BITUMINOUS MATERIALS FOR SLURRY SEAL

Use emulsified asphalt that conforms to Grade CQS-1h as specified in AASHTO M 208. The cement mixing test is not required.

SECTION 820
SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM)

820.01 GENERAL

A. Certificate of Compliance.
At the time of delivery, submit a certificate of compliance for each car and tank truck of material. In addition to the requirements of Section 106.01 C "Certificate of Compliance", provide the following information on each certificate of compliance:

A. Fly ash or Slag source by name of company and location of plant.
B. Gross, tare, and net weight if shipped by truck.
C. Car initials and number or tank truck number.
D. Date of shipment.

In addition to the certificate of compliance, supply fly ash or slag test data in the form of a chemical and physical analysis report, prepared by an independent lab, before proceeding with the concrete mix design.

B. Storage Requirements.
Provide weather-tight storage facilities for the SCM.

C. Material Limitations.
When using SCM, choose a material type and class for inclusion in the mix design.

820.02 FLY ASH

A. General.
The available alkalies, or equivalent, as Na_2O, max percentage is 2.0. If the available alkalies percentage is above 2.0 percent, determine the alkali-silica reactivity according to ASTM C 1567. If the expansion is less than 0.10 percent at 16 days, the material will be accepted.

Submit results of the ASTM C 1567 test with the Certificate of Compliance for cement. Provide results from tests performed no more than one year before the date of certificate submission.

B. Class F Fly Ash.
If using fly ash, use fly ash from an electrical generating plant using a single coal source not using limestone injection.

Use fly ash that meets the requirements of AASHTO M 295, Class F, with the following modifications:

A. Revise "Silicon Dioxide (SiO_2) plus aluminum oxide (Al_2O_3) plus iron oxide (Fe_2O_3), min percent" to 66.0.
B. Revise "Loss on ignition, max percent" to 2.0.
C. The silicon dioxide (SiO_2) shall be at least 40.0 percent by dry weight of the total fly ash composition.

Before developing the concrete mix design, submit fly ash test data prepared by an independent lab. Include a chemical and physical analysis report with the test data.

C. Class C Fly Ash.

If using fly ash, use fly ash from an electrical generating plant using a single coal source not using limestone injection.

Use fly ash that meets the requirements of AASHTO M 295, Class C.

820.03 SLAG

If using slag, use slag cement that meets AASHTO M 302, Grade 100 or Grade 120.

SECTION 822
PENETRATING WATER REPELLENT

822.01 GENERAL
Submit a Certificate of Compliance for the penetrating water repellent. Provide a penetrating water repellent treatment solution that consists of an organosilicon compound dissolved in a solvent carrier that, when applied, produces a hydrophobic surface covalently bonded to concrete.

Use an Alkyl-Alkoxysilane organosilicon compounds:

Provide a solution meeting the following requirements:
- Solvent carrier leaves less than 1 percent residue upon evaporation;
- Contains 100 percent active solids;
- Certified to meet or exceed the performance criteria listed below based on a single application of the solution according to the manufacturer's recommended rate of coverage;
- Does not stain, discolor, or darken concrete;
- Application does not alter the surface texture or form a coating on concrete surfaces;
- Compatible with the use of special surface finish texture coatings as specified; and
- Treated concrete is surface dry a maximum of 4 hours after application.

822.02 TESTING
Provide a repellent that, when applied to concrete meets the following requirements:

A. Absorption.

Test	Duration	Max. Absorption	Method
Water Immersion	48 hours	1% by weight	ASTM C 642
	50 days	2% by weight	ASTM C 642

B. Chloride Ion Penetration.

Test	Duration	Max. Absorption	Method
Salt Water Ponding[1]	90 days	0.75 lb per yd^3	AASHTO T 259
		Depth: 0.5 inch to 1 inch	AASHTO T 260

[1] Based on non-abraded specimens

C. Scaling Resistance to Deicing Chemicals.

Test	Duration	Visual Rating	Method
Salt Water Ponding	50 Cycles	0 at 25 cycles	ASTM C 672
		≤ 3 at 50 cycles	ASTM C 672

SECTION 826
JOINT MATERIALS

826.01 GENERAL

Submit a Certificate of Compliance for the joint sealant.

Beginning in 10/1/2020 submit the NTPEP testing results for the joint sealant along with the certificate of compliance.

Submit a copy of the manufacturer's recommendations pertaining to the heating and application of the joint sealant material to the Engineer before the beginning of work. Follow the manufacturer's recommendations. Do not allow the sealer in the field application equipment to exceed the safe heating temperature recommended by the manufacturer. Do not heat any given quantity of material at the pouring temperature for more than six hours and do not reheat the material. Do not place material if the temperature is below the manufacturer's recommended minimum application temperature.

Do not mix different manufacturer's brands or different types of sealant together.

Place sealant materials when the air temperature is above 40°F.

826.02 MATERIALS

A. Hot Applied Joint Sealant.

1. Type I.

Provide joint sealant that meets the requirements of ASTM D 6690, Type I, with the following modifications:

- The sealant shall consist of a blend of asphalt cement and vulcanized crumb tire rubber. The asphalt cement shall meet the requirements of AASHTO M 226;
- The minimum softening point is revised to 88°C; and
- The sealant shall have a specific gravity between 1.13 and 1.17.

Provide crumb rubber at a rate of at least 12 percent of the total weight of sealant mixture.

Provide crumb rubber that is free of deleterious material and that meets the gradation in Table 826-01. Calcium carbonate may be added to mixture, but the maximum quantity shall not exceed 4 percent of the weight of the crumb rubber.

Table 826-01

Sieve Size	Percent Passing
No. 8	100
No. 10	95 – 100
No. 30	0 – 20
No. 50	0 - 5

2. Type IV.

Provide joint sealant that meets the requirements of ASTM D 6690, Type IV, except the penetration value requirement is revised to 120 to 150.

Provide joint sealant with a unit weight between 9.0 and 9.35 pound per gallon.

B. Cold Applied Joint Sealant.

1. Sealant.
Provide a one-part silicone joint sealant that meets the requirements of ASTM D 5893, Type NS and the following:

- Low modulus; and
- Is capable of withstanding repeated joint movement between 50 percent shrinkage and 100 percent expansion without losing adhesion to the concrete and without cohesion failure.

2. Backer Rod.
Use backer rod that meets the requirements of ASTM D 5249, Type 1 or Type 3.

C. Preformed Expansion Joint Fillers for Structural Construction.
Provide preformed expansion joint fillers that meet AASHTO M 213.

D. Preformed Expansion Joint Filler for Concrete (Bituminous Type).
Provide preformed expansion joint filler that meets AASHTO M 33.

E. Preformed Elastomeric Compression Joint Seal.
Provide preformed elastomeric compression joint seal that meets ASTM D 2628.

F. Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
Provide preformed expansion joint fillers that meet ASTM D 8139.

SECTION 830
PIPE AND DRAINAGE STRUCTURES

830.01 CONCRETE PIPE AND DRAINAGE STRUCTURES

The Department will evaluate the fabricator's concrete pipe plant according to Department procedures described in Field Sampling and Testing Manual, Quality Assurance Program for Prestressed and Precast Concrete Products. The results of this evaluation will determine if the material may be accepted by certificate of compliance as specified in Section 106.01 C, "Certificate of Compliance".

Use an ACPA or NPCA certified plant in the construction.

A. Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

Provide pipe that meets AASHTO M 170, M 206, or M 207 for the specified diameters and strength class except use aggregates that meet the requirements in:

- Table 802-02 of Section 802.01 C.2 "Coarse Aggregate"
- Table 802-05 of Section 802.01 C.3 "Fine Aggregate"

B. Work Drawings.

Provide work drawings for Class IV and V Pipes that include:

- Reinforcing steel layouts;
- Type and strength of concrete and reinforcing steel;
- All concrete and reinforcing dimensions;
- Installation and handling instructions; and
- Design calculations.

Submit calculations and work drawings that are signed, sealed, and dated by a Professional Engineer registered in the State of North Dakota as set forth in NDCC Title 43.

C. Fasteners and Tie Bolts.

Provide tie bolts and nuts that are of steel meeting ASTM A 307 Grade A. Provide steel washers that meet ASTM A 1008 or ASTM A 1011. Provide fastener castings that are gray iron castings that meet ASTM A 48 Class 20.

830.02 METAL PIPE

A. Ductile Iron Sewer Pipe.

Provide pipe that meets ASTM A 746.

B. Metallic (Zinc or Aluminum) Coated Corrugated Steel Culverts, Storm Drains, and Underdrains.

Provide metallic coated corrugated steel culverts, storm drains, and underdrains that meet AASHTO M 36.

C. Polymer-Coated Corrugated Steel Pipe.

1. Steel Pipe.

Provide steel pipe that meets AASHTO M 246.

2. **Polymer-Coated Corrugated Steel Pipe.**
   Provide polymer-coated corrugated steel pipe that meets AASHTO M 245.

   Use polymer-coated corrugated steel pipe that has helical or spiral corrugations with a continuous lock seam extending the length of each pipe.

3. **Coupling Bands.**
   Use coupling bands that meet AASHTO M 246.

   Use coupling bands with the same polymer coating grade as that used for fabrication of the polymer-coated corrugated steel pipe, and that has the same metallic coating.

D. Structural Plate for Pipe, Pipe Arches, and Arches.
Provide structural plate for pipe, pipe arches, and archers that meets AASHTO M 167.

E. Aluminum Alloy Structural Plate for Pipe, Pipe Arches, and Arches.
Provide alloy structural plate for pipe, pipe arches, and arches that meets AASHTO M 219.

F. Smooth Wall Steel Pipe Culvert.
Provide smooth wall steel pipe culverts that are welded steel pipe of new material, that meets ASTM A 139, Grade B and has a minimum yield strength of 35,000 psi. The Department will not require the hydrostatic test required by ASTM A 139. Use minimum wall thicknesses as specified in Table 830-01.

Table 830-01

Diameter of Pipe	Minimum Wall Thickness Through Roadway Embankment
24 inches	0.312 inch
30 inches	0.406 inch
36 inches	0.469 inch
42 inches	0.500 inch
48 inches	0.563 inch
54 inches	0.656 inch
60 inches	0.719 inch
66 inches	0.813 inch
72 inches	0.875 inch

830.03 PLASTIC PIPE

A. Plastic Pipe for Non-Pressure Drainage of Sewage and Surface Water (Outside Buildings).

1. **Acrylonitrile-Butadiene-Styrene (ABS).**
   Provide ABS that meets ASTM D 2680

2. **Acrylonitrile-Butadiene-Styrene (ABS).**
   Provide ABS that meets ASTM D 2751.

3. **Polyvinyl Chloride (PVC).**
   Provide PVC that meets the requirements of ASTM F 949 or Type PSM PVC pipe that meets the requirements of ASTM D 3034.

4. **Corrugated Polyethylene (PE) Pipe.**
   Provide corrugated PE pipe that meets AASHTO M 252.

B. Plastic Pipe for Water Distribution Lines (Outside Buildings).

1. **Acrylonitrile-Butadiene-Styrene (ABS).**
   Provide ABS that meets ASTM D 1527 Schedules.

2. **Polyethylene (PE).**
   Provide PE that meets ASTM D 2104, Schedule 40.

3. **Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe (SDR-PR).**
   Provide PVC and CPVC compounds that meet ASTM D 1784 and that are Class 12454-B (Type 1, Grade 1).

4. **Polybutylene (PB) Plastic Pipe (SDR-PR).**
   Provide PB plastic pipe that meets ASTM D 2662.

C. Plastic Drain, Waste, and Vent (DWV) Pipe and Fittings.

1. **Acrylonitrile-Butadiene-Styrene (ABS).**
   Provide ABS that meets ASTM D 2661.

2. **Polyvinyl Chloride (PVC).**
   Provide PVC that meets ASTM D 2665.

3. **Polyvinyl Chloride (PVC).**
   Provide 3.25 inch outside diameter PVC that meets ASTM D 2949.

D. Plastic Hot and Cold Water Distribution Systems (Inside Buildings).

1. **Polybutylene (PB).**
   Provide PB that meets ASTM D 3309.

2. **Chlorinated Polyvinyl Chloride (CPVC).**
   Provide CPVC that meets ASTM D 2846.

E. Plastic Gas Pipe, Tubing, and Fittings.
Provide gas pipe, tubing, and fittings that meet ASTM D 2513.

F. Corrugated Polyethylene Culverts.
Provide corrugated polyethylene culverts that meet AASHTO M 294, Type S.

830.04 ADJUSTMENT RINGS

A. Precast Concrete.
Provide adjustment rings that meets AASHTO M 199.

B. High Density Polyethylene.
Provide adjustment rings meeting the requirements of Table 830-02 when tested according to ASTM D 4976, and AASHTO M 306 load ratings HS20 & HS25.

Table 830-02

Property	Test Method	Requirement
Melt Flow Index	ASTM D 1238	0.3 To 30 g/10 min.
Density	ASTM D 792	0.94 to 0.98 g/cm^3
Tensile Strength	ASTM D 638	2,000 to 5,000 psi

C. Expanded Polypropylene.
Provide expanded polypropylene adjustment rings meeting ASTM D 4819 Classification B6D7G4L3$M_2$4S2$T_1$7W7 when tested according to ASTM D 3575, and AASHTO M 306 load ratings HS20 & HS25.

SECTION 834
STRUCTURAL STEEL AND RELATED MATERIALS

834.01 STRUCTURAL STEEL

A. Structural Carbon Steel
Use structural carbon steel that meets AASHTO M 270, Grade 36.

B. High Strength, Low Alloy Steel
Use high strength, low alloy steel that meets AASHTO M 270, Grade 50.

C. High Strength, Low Alloy Structural Steel (Weathering)
Use high strength, low alloy structural steel that meets AASHTO M 270, Grade 50W.

Supply steel from a single source.

D. High Strength Steel Plate.
Use high strength steel plate that meets AASHTO M 270, Grade HPS 100W.

E. Structural Steel for Pins and Rollers.
Use structural steel for pins and rollers 9 inches or less in diameter that meets either AASHTO M 102, Class C, D, F, or G; or AASHTO M 169, Grades 1016 to 1030.

834.02 CAST METAL

A. Gray Iron Castings
Use gray iron castings that meet AASHTO M 105, Class 35 B.

B. Malleable Castings.
Use malleable casting that meet ASTM A 47, Grade No. 35018.

C. Ductile Iron Castings
Use ductile iron castings that meet ASTM A 536, Grade 60-40-18.

834.03 BOLTS, NUTS, AND WASHERS

A. General.

1. Documentation.
For bolts, nuts, and washers, in addition to submitting a certificate of compliance as specified in Section 106.01, C “Certificate of Compliance”, submit the following:

a. A mill test report that states the melting and manufacturing location for mill steel used in the manufacture of bolts, nuts, and washers;
b. A report that states the lot numbers and manufacturing location for the components; and
c. A test report that includes the location where the tests were performed and complete results for all required tests.

2. Rotational Capacity Testing of Assemblies.
Perform the rotational capacity test according to ASTM F 3125 Grade A 325, except as modified by this specification.

a. General.
Perform rotational capacity tests on all bolt, nut, and washer assemblies before shipping.

If galvanized parts are required, perform the rotational capacity test after galvanization.

Washers are required as part of the tests even if the final assembly does not require washers.

b. Assemblies.
Test each combination of bolt lot, nut lot, and washer lot as an assembly.

c. Rotational Capacity Lot Numbers.
Assign each combination of lots a rotational capacity lot number. Washers do not need to be identified as part of the assembly lot if they are not required in the final assembly.

d. Testing Frequency.
Test a minimum of two assemblies per rotational capacity lot.

e. Testing Device.
Use a Skidmore-Wilhelm Calibrator, or an approved alternate, to perform the rotational capacity tests.

Test bolts that are too short for the Skidmore-Wilhelm Calibrator in a steel joint. The tension requirements of Table 834-02 do not apply. Compute the maximum torque required in Section 834.03 A.2.g, “Results” using a value of “P” equal to the Turn Test Tension in Table 834-02.

f. Performance of the Test.
The minimum rotation from initial tightening (10 percent of the specified proof load) shall be as specified in Table 834-01.

Table 834-01

Bolt Length	Amount of Turn
Length ≥ 4 diameters	240 degrees (2/3 turn)
4 diameters < Length ≤ 8 diameters	360 degrees (1 turn)
Length > 8 diameters	480 degrees (1-1/3 turn)

The tension reached at the rotation specified in Table 834-01 shall be equal to values for the Turn Test Tension shown in Table 834-02.

Table 834-02

Diameter (in)	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Installation Tension (kips)	12	19	28	39	51	56	71	85	103
Turn Test Tension (kips)	12	22	32	45	59	64	82	98	118

g. Results.
After exceeding the Installation Tension specified in Table 834-02, obtain and record a reading of the tension and torque.

The maximum torque (T) shall be equal to 0.25 the measured bolt tension (P) and the bolt diameter (D):

$$T \text{ (foot pounds)} \leq 0.25 \times P\text{(pounds)} \times D\text{(feet)}$$

3. Shipping.
Ship bolts, nuts, and washers 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 nuts and washers may be shipped in separate containers. Permanently mark each container with the rotational-capacity lot number such that identification will be possible at any stage before installation.

B. Unfinished Regular Bolts and Nuts.
Use unfinished regular bolts and nuts that meet ASTM A 307.

C. High Tensile Strength Bolts.
Use bolts that meet ASTM F 3125 Grade A 325.

When testing the thickness of galvanization on bolts, take measurements on the wrench flats or top of the bolt.

D. High Tensile Strength Nuts.
Use nuts that meet ASTM A 563, Grade C, D, C3, DH, or DH3 or AASHTO M 292, Grade 2 or 2H.

When galvanized nuts are specified, use galvanized nuts that meet the requirements of ASTM A 563, Grade DH or DH3 or AASHTO M 292 Grade 2H. Perform tests on nuts after over tapping and after the application of galvanizing and lubricant. When testing the thickness of galvanization on nuts, obtain measurements on the wrench flats.

Regardless of surface finish, use nuts that meet the requirements of ASTM A 563 Supplementary requirements S1, S2, and S3.

E. High Tensile Strength Washers.
Use washers that meet ASTM F 436.

If galvanized washers are specified, perform hardness testing after galvanizing. Remove coating before taking hardness measurements.

F. Direct Tension Indicators.
Use direct tension indicators that meet ASTM F 959.

SECTION 836
REINFORCING STEEL, DOWEL BARS, AND TIE BARS

836.01 GENERAL

Tag all material delivered to the project site with a metal or plastic tag showing the manufacturer's heat number. Place the heat numbers on the tag in one of the following manners:

- Embossed numbers;
- Printed using waterproof ink; or
- Engraved numbers.

836.02 REINFORCING STEEL

A. Deformed and Plain Steel Bars for Concrete Reinforcement.
Use deformed and plain bars that meet AASHTO M 31, Grade 40 or 60. If epoxy coated bars are specified, use bars that have been coated as specified in ASTM A 775.

B. Welded Deformed Steel Bar Mats for Concrete Reinforcement.
For concrete reinforcement, use fabricated steel bar or rod mats that meet AASHTO M 54, Grade 40 or 60.

836.03 WIRE REINFORCEMENT

A. Steel Welded Wire Reinforcement, Deformed, for Concrete.
Use welded deformed steel wire reinforcement that meets AASHTO M 221.

B. Steel Welded Wire Reinforcement, Plain, for Concrete.
Use welded steel wire reinforcement that meets AASHTO M 55.

C. Steel Wire, Deformed, for Concrete Reinforcement.
Use deformed steel wire for concrete reinforcement that meets AASHTO M 225.

D. Steel Wire, Plain, for Concrete Reinforcement.
For concrete reinforcement, use cold drawn steel wire that meets AASHTO M 32.

E. Steel Strand, Uncoated Seven-Wire for Concrete Reinforcement.
Use pre-tensioning steel that meets AASHTO M 203.

836.04 DOWEL BARS FOR PAVEMENT JOINTS

A. General.
Use dowels that meet the requirements of AASHTO M 31 or M 322.

Use dowels that are epoxy coated as specified in ASTM A 775, except exposed ends resulting from saw cutting or shearing do not need to be patched.

Saw cut or shear dowels to the required length and clean the dowels to remove all cutting burrs, loose mill scale, rust, grease, and oil. If dowels are sheared, variation of the bars from true round shape shall not exceed 0.04 inches in diameter or thickness and any variation shall not extend more than 0.04 inches from the sheared end.

B. Dowel Bars for Expansion Joints.

Fit the free end of dowels for expansion joints with a metal sleeve of an approved design covering one to three inches of the dowel. Use a sleeve that has a closed end and a stop to hold the closed end at least one inch from the end of the dowel bar. Use a sleeve that does not collapse or distort in handling and placing of the dowels and concrete.

836.05 TIE BARS FOR PAVEMENT JOINTS

Use tie bars that are epoxy coated according to ASTM A 775. Select tie bars based on Table 836-01.

Table 836-01

Joint Location	Reference
Centerline and Between Adjacent Driving Lanes	Section 836.02 A, "Deformed and Plain Steel Bars for Concrete Reinforcement"
All Other Locations	AASHTO M 31, Grade 40, deformed

SECTION 840
PILING

840.01 STEEL PILING

A. Steel H-Piling and Special Sections.
Use materials for steel piling and special sections that meet AASHTO M 270, Grade 50.

B. Shells for Steel Encased Concrete Piling.
Use shells for steel encased concrete piling that are either cylindrical pipe or tapered fluted.

Use cylindrical pipe shells that are electric welded steel pipe or seamless steel pipe and that meet ASTM A 252, Grade 2. Use end closure plates that are 3/4 inch flat steel plate welded directly to the pipe and that do protrude beyond the perimeter of the pile.

840.02 TIMBER PILING

A. Requirements.
Use timber piling that is clean-peeled and meets ASTM D 25. Provide a certificate of compliance for timber piling.

B. Dimensions.
Provide piles with the diameters shown in Table 840-01.

Table 840-01

Length of Piles	Diameter (Inches)	
	3 Feet from Butt	At Tip
Under 40 feet	12	8
40 to 74 feet	13	7
75 to 90 feet	13	6
Over 90 feet	As shown elsewhere	in the contract

C. Treatment.
If specified, treat timber piling according to Section 846, "Preservatives and Pressure Treatment Processes for Timber".

In addition to the requirements of Section 106.01 C, "Certificate of Compliance", include the following information on the certificate of compliance:

- The species of timber;
- Type of preservative; and
- Method of treatment.

840.03 SHEET PILING FOR PERMANENT INSTALLATION

A. Steel Sheet Piling.
Use steel sheet piling that meets AASHTO M 202.

B. Corrugated Steel Sheet Piles.

Provide steel sheet piles that are of the continuous interlock type and of the lengths and section modulus specified. Use new sheeting constructed using a base metal composed of open hearth steel.

Form the interlock by bending the metal through 180 degrees or more, leave an opening of sufficient size to allow free slippage of the adjoining sheet pile, while maintaining a reasonably snug fit.

Provide sheet piles that are true, straight, and uniform in section. Use corner sections that are of the same section modulus and material as the regular sections.

SECTION 846
PRESERVATIVES AND PRESSURE TREATMENT PROCESSES FOR TIMBER

846.01 TIMBER PRESERVATIVES

Provide material that meets AASHTO M 133.

SECTION 852
PAINTS, OILS, AND THINNERS

852.01 PAINTS AND ENAMELS

A. Lamp Black
Use lamp black pigment that meets ASTM D 209.

B. Chrome Yellow and Chrome Orange
Use chrome yellow and chrome orange pigments that meet ASTM D 211.

C. Enamels.
Use enamel that meets the general requirements of Federal Specifications A-A-2962A, Notice 2 Enamel, Alkyd, Exterior, Solvent Based, Low VOCm with the following exceptions:

1. Alkyd resin shall be a Type I or Type II alkyd meeting Federal Specification TT-R-266 Resin, Alkyd; Solutions.
2. Specular gloss, 60 degrees, shall be in the range of 40 to 70.

852.02 THREE COAT ORGANIC ZINC RICH PAINT SYSTEM

A. Materials.

1. General.
Use a three-coat paint system consisting of an organic zinc-rich epoxy primer, a polyamide epoxy intermediate coat, and an aliphatic polyurethane finish coat. Submit the three-coat system to the NTPEP testing program and submit the results to the Department. Provide a system from a single manufacturer. Provide components that are recommended for use as part of a three-coat system.

2. Organic Zinc-Rich Epoxy Primer.
Use an organic zinc-rich epoxy primer that is a multi-component, solvent based, chemically-curing, polyamide epoxy system. Use zinc dust pigment meeting the requirements of ASTM D 520, Type II.

Use primer capable of being spray applied to the manufacturer's recommended Dry Film Thickness (DFT) in one coat without sagging or mud cracking. After mixing the primer shall be smooth and uniform, and free of lumps or coarse particles.

Formulate the color of the primer to produce a distinct contrast with the blast cleaned steel and the subsequent intermediate coat. Add tinting materials that are inert and do not reduce the effectiveness of the galvanic protection.

3. Intermediate Coat.
Use a two component chemically-curing polyamide epoxy for the intermediate coat. Mix the paint to be smooth, uniform, and capable of being spray applied.

Formulate the color of the intermediate coat to produce a distinct contrast with the primer and the finish coat.

4. **Finish Coat.**
Use a compatible two-component, aliphatic polyurethane finish coat with a weather resistant finish and the gloss and color as specified in the plans.

B. Certification and Acceptance.

1. **General.**
Submit a certification for the paint system that is less than 5 years old. The certification must be from the NTPEP Structural Steel Coatings Testing Program and the testing must meet the requirements of AASHTO R 31 and this specification.

In addition to the requirements of Section 106.01 C, "Certificate of Compliance", submit the following information:
- Manufacturer Contact Information;
- Completed NTPEP Test Data;
- Product Data Sheets; and
- Material Safety Data Sheets.

2. **Slip Coefficient.**
Report results only.

3. **Salt Fog Resistance.**
Use an exposure duration of 5,000 hours.

   a. **Blistering.**
   Use a coating that has a blistering conversion value of 7 or better.

   b. **Rust Creep.**
   Use a coating that shows no rust creep larger than 8 mm and that has a maximum average creep of 4 mm. Use a coating that shows no signs of rust outside the cutback.

4. **Cyclic Weathering Resistance Test.**
Use an exposure duration of 5,000 hours.

   a. **Blistering.**
   Use a coating that has a blistering conversion value of 7 or better.

   b. **Rust Creep.**
   Use a coating that shows no rust creep larger than 8 mm and that has a maximum average creep of 4 mm. Use a coating that shows no signs of rust outside the cutback.

5. **Abrasion Resistance.**
Report results only.

6. **Adhesion.**
Use a coating system that has an adhesion of 600 psi.

7. **Freeze Thaw Stability.**
Use a full system with a minimum adhesion of no less than 60% of the adhesion value recorded in Section 852.02 B.6, "Adhesion".

8. Coating Identification Tests.
Volatile organic content for each component of the system shall be a maximum of 3.5 pounds per gallon.

a. Organic Zinc-Rich Epoxy Primer.
Provide primer with a minimum of 70 percent total solids, by weight. Provide primer with a minimum of 75 percent zinc pigment, by weight of total solids.

b. Intermediate Coat.
Provide an intermediate coat with a minimum of 54 percent total solids, by weight.

c. Finish Coat.
Provide a finish coat with a minimum of 54 percent total solids, by weight.

C. Packaging and Labeling
Provide a label on each container that contains:

- The name of the manufacturer;
- The brand name;
- The lot number of the paint;
- Complete instructions for the use of the paint;
- The shelf life of the components; and
- The pot life of the mixture.

SECTION 854
GALVANIZING

854.01 GALVANIZING
Galvanize iron and steel products to meet AASHTO M 111.

Galvanize Iron and Steel Hardware to meet AASHTO M 232.

854.02 DAMAGED GALVANIZED COATINGS
Repair damaged galvanized coatings to meet ASTM A 780.

SECTION 856
EROSION CONTROL BLANKET AND TURF REINFORCEMENT MAT

856.01 EROSION CONTROL BLANKET (ECB)

A. General.

Provide erosion control blanket (ECB) of organic biodegradable mulch material such as straw, curled wood excelsior, coconut fiber, or any combination of these materials. Provide ECB that has a consistent thickness of mulch material evenly distributed over the entire area. Secure the ECB materials on at least one side with netting. Use netting of photodegradable polypropylene or other plastic material fused to the strand intersections. Provide ECB that has a minimum width of 48 inches and is weed and pest free.

Provide ECB that meets the requirements of Tables 856-01 and 856-02 for the type specified in the contract.

The requirements in Tables 856-01 and 856-02 are derived from information obtained from the Erosion Control Technology Council. All values must be within 10 percent of the values shown on the table.

Table 856-01
ECB Type 1 and 2

Type	ECB 1		ECB 2	
	Straw	**Wood**	**Straw**	**Wood**
Material	100% Straw	100% Excelsior Fibers	100% Straw	100% Excelsior Fibers
Fiber Length 80% Must Be Greater Than	3 inches	80% > 6 inches	3 inches	6 inches
Min Thickness ASTM D 6525	0.25 inch	0.25 inch	0.25 inch	0.25 inch
Net Opening Minimum (inch)	0.5 × 0.5	0.75 × 0.75	0.5 × 0.5	0.75 × 0.75
Max Shear Stress @ 0.50 inches soil loss ASTM D 6460	N/A	1.50 lbs/sf	1.50 lbs/sf	1.75 lbs/sf
Slope Gradient Application	≤ 3H:1V	< 3H:1V - 2H:1V	≤ 2H:1V	< 2H:1 - 1.5H:1V
Net Backing Type	Rapid Photodegradable Polypropylene		Polypropylene	
Functional Longevity	≤ 3 months		≤ 12 months	
Min Machine Direction Tensile Strength ASTM D 6818	50 lbs/ft		75 lbs/ft	

Table 856-02
ECB Type 3 and 4

Type	ECB 3		ECB 4	
	Straw/Coconut	**Wood**	**Coconut**	**Wood**
Material	70% Straw and 30% Coconut Fibers	100% Excelsior Fibers	100% Coconut Fibers	100% Excelsior Fibers
Fiber Length 80% Must Be Greater Than	3 inches	80% > 6 inches	3 inches	80% > 6 inches
Min Thickness ASTM D 6525	0.25 inch	0.25 inch	0.25 inch	0.50 inch
Max Shear Stress @ 0.50 inches soil loss ASTM D 6460	1.75 lbs/sf	2.00 lbs/sf	2.25 lbs/sf	2.25 lbs/sf
Slope Gradient Application	≤ 1.5H:1V	≤ 1.5H:1V	≤ 1H:1V	≤ 1H:1V
Net Backing Type	Polypropylene		Black UV Stabilized Polypropylene	
Functional Longevity	12 to 24 months		> 24 months	
Minimum Tensile Strength ASTM D 6818	100 lbs/ft		125 lbs/ft	

B. Wood Excelsior Blanket.
Provide wood excelsior blanket that consists of a machine-produced blanket of curled wood excelsior in which 80 percent of the fibers are 6 inches or longer. Provide a wood excelsior blanket that is smolder-resistant without the use of additives.

C. Straw Blanket.
Provide straw blanket that consists of agricultural straw in which 80 percent of the fibers are at least 3 inches in length. The straw shall be certified by an accredited agency to be 100 percent weed free.

D. Straw and Coconut Blanket.
Provide a machine-produced straw and coconut blanket that consists of 70 percent straw and 30 percent coconut fibers by weight in which 80 percent of the fibers are 3 inches or longer.

856.02 TURF REINFORCEMENT MAT (TRM)

Provide turf reinforcement mat (TRM) that is a three dimensional structure of entangled filaments. Use filaments that are either bonded by heat fusion at the intersections or stitched with polypropylene, nylon or polyester threads between two UV-Stabilized nettings. Provide TRM that is resistant to biological, chemical, environmental, and ultra-violet degradation. Provide a TRM that promotes and maintains the integrity of the grass root system. Provide TRM that meets the requirements of Table 856-03 for the type specified in the contract.

Table 856-03
TRM

TYPE	TRM 1	TRM 2
Matrix Fill Material	Wood Excelsior, Coconut or Polymer Fibers	100% Stabilized Polypropylene Fibers
Min Mass Unit Area ASTM D 6475 (natural fibers) 6566 (synthetics)	0.625 lbs/sy	0.625 lbs/sy
Minimum Thickness ASTM D 6525	0.25 inch	0.5 inch
Minimum Roll Width	6.5 ft	6.5 ft
Size of Net Opening	0.5 × 0.5 inch	0.5 × 0.5 inch
Max Shear Stress @ 0.50 inches soil loss ASTM D 6460, under vegetated conditions	6.0 lbs/sf	8.0 lbs/sf
ASTM D 6818	125 lbs/ft	150 lbs/ft

856.03 Staples

Use staples for ECM and TRM that are constructed of 11 gauge or heavier steel wire and that are either U-shaped measuring at least 1 inch across the top and at least 8 inches along each leg, or that are T-shaped measuring at least 4 inches across the top and at least 8 inches in length.

SECTION 858
GEOSYNTHETICS

858.01 GEOSYNTHETIC MATERIAL

Provide fabric consisting of polymeric filament or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene chloride. Woven slit film geotextile material is not allowed. Use fabric composed of filaments or yarns that are formed into a stable network that retain their relative position to each other. Use material that is inert to commonly encountered chemicals and meets requirements of Table 858-01 or Table 858-02. Values in Table 858-01 and 858-02 represent average roll values.

Use geosynthetics for materials included on Table 858-01 from manufacturers or suppliers that maintain compliance with the NTPEP audit program for geosynthetics. Include the NTPEP number identifying the material test results on the Certificate of Compliance. Submit the CoC a minimum of 21 days before material is incorporated into the work.

Table 858-01
Geosynthetics for Separation, Riprap, and Reinforcemen

Geosynthetic		Separation[2]		Riprap	Reinforcement
Material Property	**Test Method**	**S1**	**S2**	**RR**	**R1**
Ultimate Grab Strength[1], lbs., min.	ASTM D 4632	180	180	200	300
Wide Width Tensile Strength[1], lbs / inch., min.	ASTM D 4595	N/A	N/A	N/A	270
Ultimate Grab Elongation[1], %	ASTM D 4632	N/A	N/A	15 (min)	25 (max)
Trapezoid Tearing Strength, lbs., min. (any direction)	ASTM D 4533	50	50	50	100
Static Puncture Strength lbs., min.	ASTM D 6241	405	405	435	1000
AOS less than mm, (greater than US STD. Sieve)	ASTM D 4751	0.212 (70)	0.15 (100)	0.3 (50)	0.6 (30)
Permittivity, $sec.^{-1}$, min.	ASTM D 4491	0.5	0.05	0.5	0.5
UV Resistance (After 500 hrs.) % min Strength Retained	ASTM D 4355	70	70	70	70

[1] Weakest principal direction.
[2] Separation fabrics shall be nonwoven fabrics.

Table 858-02
Geosynthetics for Drainage

Geosynthetic Material Property	Test Method	D1	D2	D3[2]	D4[2]
Ultimate GrabStrength[1], lbs., min.	ASTM D 4632	180	80	100	N/A
Trapezoid Tearing Strength, lbs., min. (any direction)	ASTM D 4533	50	25	N/A	N/A
Static Puncture Strength lbs., min.	ASTM D 6241	435	135	180	180
AOS less than mm, (greater than US STD. Sieve)	ASTM D 4751	0.3 (50)	0.15 (100)	0.125-0.600 (30 - 120)	0.125-0.600 (30-120)
Permittivity, sec.$^{-1}$, min.	ASTM D 4491	0.5	0.05	0.7	1 relaxed
UV Resistance (After 500 hrs.) % min Strength Retained	ASTM D 4355	70	70	70	N/A
Sewn - Seam Strength, lbs	ASTM D 4632	160	70	90[3]	N/A

[1] Weakest principal direction.
[2] Type D3 and D4 fabric may only be used as a geosynthetic fabric sock. The type D4 fabric will be knit of 150 denier (min.) polyester yarn, exhibit minimum snag or “run” potential, be factory-applied to maintain a uniform installed weight, and conform to the outside diameter of the pipe with a snug fit throughout.
[3] May be constructed using welded seams.

858.02 GEOGRID

Provide a biaxial geogrid structure that is dimensionally stable and able to retain its geometry under construction stresses. Use material that is inert to commonly encountered chemicals and meets requirements of Table 858-03. Values in Table 858-03 represent minimum average roll values.

Table 858-03
Geogrid Geosynthetics

GEOGRID PROPERTY	TEST METHOD	GEOGRID TYPE G
Aperture Size	ID Calipered	0.5 - 1.5 inch
Tensile Strength[1] @ 2% Strain, lb/ft, min.	ASTM D 6637	400
Tensile Strength[1] @ 5 % Strain, lb/ft, min	ASTM D 6637	800
Ultimate Tensile[1] Strength, lb/ft, min.	ASTM D 6637	1,300
Junction Efficiency, %, min.	GRI[2] GG2	90
UV Resistance (After 500 hrs), % Strength Retained	ASTM D 4355	70

[1] Strength values represent weakest principal direction
[2] Geosynthetic Research Institute

858.03 REINFORCEMENT GEOGRID

Submit a Certificate of Compliance for reinforcement geogrid. Include the NTPEP number identifying the material test results on the Certificate of Compliance.

Values in Table 858-04 represent minimum average roll values.

Table 858-04
Reinforcement Geogrid

Geogrid Property	Test Method	Geogrid Type RG
UV Resistance (After 500 hrs), % Strength Retained	ASTM D 4355	70
Long Term Tensile Strength (T_{al})	AASHTO R 69	See Plans for Long Term Tensile Strength

SECTION 860
FENCE

860.01 CHAIN LINK FENCE

A. Fabric.
Provide chain link fabric composed of 9 gauge wire with a 2 inch mesh that meets the requirements of AASHTO M 181, Type I, Class C. Use wire that is knuckle finished on the top and bottom.

B. Tensioning Wires.
Provide tensioning wires that meet the requirements of AASHTO M 181, Type I, Class 2.

C. Posts, Rails, and Gate Frames.
Provide posts, rails, and gate frames that meet the requirements of AASHTO M 181, Grade 2.

860.02 BARBED WIRE AND WOVEN WIRE FENCE

A. Barbed Wire.
Provide barbed wire that meets the requirements of AASHTO M 280. Provide wire that has a minimum gage of 12½ and at least 2 point barbs.

B. Woven Wire.
Provide woven wire that meets the requirement of AASHTO M 279, Design Number 939-6-12½.

C. Staples.
Use staples that are 1.5 inches long and made of No. 9 gauge galvanized wire.

D. Steel Posts.
Provide posts that meet ASTM A 702, Type B Steel and galvanized in accordance with AASHTO M 111 or painted in accordance with Section 852.01 A, "Lamp Black", or Section 852.01 C, "Enamels".

Use angle-type end, corner, pull posts, and braces that are galvanized in accordance with AASHTO M 111, or painted in accordance with Section 852, "Paints, Oils, and Thinners".

Do not use posts that weigh less than 97 percent of the specified weight.

E. Wood Posts.
Treat wood posts as specified in Section 846, "Preservatives and Pressure Treatment for Timber". Use posts that have the inner bark shaved off, knots trimmed, and that are pointed for driving before treatment.

Provide posts that are within a tolerance of 1 inch of the specified length.

Provide posts that contain no decay, short kinks, or reverse bends. Posts may contain knots that are sound, smoothly trimmed, and do not impair the strength of the posts. Posts may have one way sweep that does not exceed 1.5 inches.

Provide naturally round posts cut from live trees of the species listed in Table 860-01.

Table 860-01

Pine	Fir
Spruce	Cedar
Aspen	American Elm
Eastern Cottonwood	

SECTION 862
GUARDRAIL AND POSTS

862.01 GENERAL
Provide steel components of guardrail galvanized according to Section 854, "Galvanizing".

862.02 WIRE ROPE AND FITTINGS FOR CABLE GUARDRAIL

A. Wire Rope and Connecting Hardware.
Provide wire rope and connecting hardware that meet AASHTO M 30, Type I, Class A. Provide connecting hardware that develops the full strength of a single cable 25,000 pounds.

B. Cast Steel Components.
Provide cast steel components that meet AASHTO M 103.

C. Socket Baskets and Wedges.
Design socket baskets for use with the wedge detailed on the plans.

D. Bolts, Nuts, and Washers.
Use bolts that meet ASTM A 307, Grade A.

Use nuts that meet ASTM A 563, Grade A.

Use hook bolts that, when installed, develop an ultimate pull open strength between 500 and 1,000 pounds applied in a direction normal to the longitudinal axis of the post.

Use steel washers that meet the dimensional requirements of ANSI B 27.2, Type A plain washer.

E. Washer Plates.
Use end and line post washer plates that meet AASHTO M 183.

862.03 GUARDRAIL UNITS AND FITTINGS FOR W-BEAM GUARDRAIL
Provide W-Beam guardrail units, backup plates, flared end sections, and buffer end sections that meet AASHTO M 180, Class A, Type II. Use terminal connectors that meet AASHTO M 180, Class B, Type II.

A. Button Headed Bolts and Hex Bolts.
Use button headed bolts that meet ASTM A 307.

Use hex bolts that meet ASTM A 307, Grade A.

Use nuts that meet ASTM A 563, Grade A.

B. Plates.
Use rectangular plate washers that meet AASHTO M 180. Use break-away cable treatment, cable end plates, bearing plates, and anchor plates that meet AASHTO M 180.

C. Washers.
Use steel washers that meet the dimensional requirements of ANSI B 27.2, Type A plain washers.

D. Break-Away Cable Terminal Assembly.
Use a stud that meets ASTM A 449. Ensure threads are ANSI Class 2A fit before galvanizing. Before galvanizing, mill a 3/8-inch slot into the stud end for the locking pins.

Use a swaged fitting machined from hot-rolled carbon steel that
- Meets ASTM A 576, Grade 1035;
- Is annealed suitable for cold swaging; and
- Was galvanized before swaging.

Drill a lock pin hole to accommodate a 1/4 inch plated spring steel pin through the head of the swage fitting to retain the stud in the proper position. After galvanization, the Engineer will allow the head to be tapped 0.023 inch over ANSI Class 2B Tolerance.

Use wire rope that meets AASHTO M 30, Type II, Class A.

Use the swaged fitting, stud, and nut to develop the breaking strength of the wire rope.

Use steel washers that meet the dimensional requirements of ANSI B 27.2, Type A plain washers.

Use a one inch nut that meets ASTM A 563, Grade A.

After galvanizing, the Engineer will allow the pitch diameter of the nut to be tapped 0.023 inch over the ANSI Class 2B Tolerance.

E. W-Beam Guardrail End Treatments.
Provide W-beam guardrail end treatments that meet the requirements of MASH TL-3.

Provide an impact head that is capable of flattening, cutting, kinking or bending the guardrail away from the impacting vehicle. Attach the impact head to the first post as specified by the supplier. Anchor a breakaway cable assembly to the guardrail. Use break away posts and standard line posts for the remaining posts. Provide guardrail elements that are 12 gauge sections meeting AASHTO M 180. Provide timber posts that meet requirements for materials that passed the crash testing.

862.04 TREATED WOOD GUARDRAIL POSTS

A. General.
Provide timber used for treated wood posts for beam guardrail that is made from timber with a stress grade of 1,200 psi or more. Test according to West Coast Lumber Inspection Bureau, Southern Pine Inspection Bureau, or other appropriate timber association.

Provide posts meeting the following:
- No decay;
- No knots that are unsound, not smoothly-trimmed, and do not impair the post's strength;

- No checks wider than 1/4 inch or deeper than 3 inches;
- One way sweep that does not exceed 1-1/2 inches;
- No exaggerated and unsightly winding twist;
- No short kinks; and
- No defects that give the post an unsightly appearance.

Before treatment, shave off all the inner bark and closely trim the knots of round timber posts.

Use a preservative that meets Section 846, "Preservatives and Pressure Treatment Processes for Timber". Use the same treatment for all posts on the Project. Treat timber offset blocks.

B. W-Beam.

Provide rectangular timber posts and offset blocks that are either rough sawn or S4S with nominal dimensions shown in the Contract. After end cuts have been made and holes have been drilled, treat posts and offset blocks as specified in Section 846.01, "Timber Preservatives". Use a size tolerance for rough sawn blocks of 1/4 inch in the directions of the bolt holes. Use rough sawn blocks that meet the same requirements as the treated timber guardrail posts.

C. 3-Cable.

Provide round treated timber posts used for three-cable guardrail that are between 4.5 and 6.5 inches in diameter.

862.05 STEEL GUARDRAIL POST

Provide steel posts, adjustment blocks, blockouts, attachment angles, and base plates that meet AASHTO 270 Grade 36.

SECTION 880
PAVEMENT MARKINGS

880.01 WATER BASED PAVEMENT MARKING PAINT

A. Material Requirements.

1. General.

Use acrylic emulsion polymer or modified acrylic polymer in the manufacture of the water-based pavement marking paint.

Provide paint capable of receiving and holding glass beads for producing retroreflective pavement marking.

Provide paint that is free of heavy metals as defined by the EPA.

Provide finished paint that is:

- Fast-drying;
- Capable of withstanding air and roadway temperatures without:
  - Bleeding;
  - Staining;
  - Discoloring; or
  - Deforming;
- Smooth;
- Free of:
  - Coarse particles;
  - Skins; or
  - Any other deleterious materials that are detrimental to its use or appearance;
- Homogeneous; and
- Will not have detrimental interactions with common roadway chemicals.

Provide paint film that is capable of maintaining the original dimensions and placement during the curing period without:

- Chipping;
- Spalling; or
- Cracking.

2. Physical Properties

a. General

Provide paint with the physical properties specified in Table 880-01.

Characteristic	Requirement	Test
Volatile Organic Compounds	1.25 lbs/gal Max	ASTM D 3960
Viscosity	83-98 Krebs units	ASTM D 562
Grind	3 Hegman Units Minimum	ASTM D 1210
No-Pick-Up Time	10 Minutes Max	ASTM D 711

b. Dry Through Time.
Provide paint with a maximum dry through time of 150 minutes. Dry through is when a twisting thumb action, without pressure, does not distort the paint film. Apply the paint to a non-absorbent substrate at a wet film thickness of 15 mils, with a tolerance of 1 mil. Place the substrate, with the film applied, in a humidity chamber controlled at 90 percent relative humidity with a tolerance of 5 percent and at 72.5°F with a tolerance of 2.5°F.

c. Water Resistance.
Prepare a 15 mil wet film thickness sample on a non-absorbent substrate; allow to dry at 25°C ±1 for 72 hours. Immerse the sample in distilled water without circulation at 25°C ±1. After 18 hours, remove the sample and allow the panels to dry for two hours. Examine the sample for paint softening, blistering, wrinkling, and loss of adhesion.

d. Freeze-Thaw Stability.
Place 1 pint of paint in chamber maintained at -10±1°C for 16 hours. Remove the paint from the chamber and place in ambient conditions (25±1°C) for eight hours. Repeat for a total of five cycles. Acceptable paint shall show no coagulation and no change in viscosity greater than 5 Krebs Units after completion of the freeze thaw cycles.

e. Color.
Provide paint with pigment that falls within CIE Chromaticity coordinate limits specified in Table 880-02. Make color determinations for liquid marking material over the black portion of a 2A or 5C Leneta Chart or equal a minimum of 24 hours after application of a 15-mil wet film. Determine color readings in accordance with the requirements of ASTM E 1349 using CIE 1931 2-degree standard observer and CIE standard illuminant D65.

Table 880-02

Color	1x	1y	2x	2y	3x	3y	4x	4y
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375
Yellow	0.560	0.440	0.490	0.510	0.420	0.440	0.460	0.400

f. Contrast Ratio.
Provide paint that when tested according to ASTM D 2805 has a minimum contrast ratio (hiding power) that is 0.96 when drawn down with a 0.005 bird film applicator on a 2A or 5C Leneta Chart and air-dried for 24 hours. Calculate the contrast ratio as black/white.

g. Reflectance.
Determine the daylight directional reflectance of paint according to ASTM E 1349. Apply a 15-mil wet film to a 2A or 5C Leneta Chart and allow the paint to air dry for 24

hours. Provide white paint with a minimum of 84 percent reflectance and yellow paint with a minimum of 50 percent reflectance.

h. Durability.
Provide paint with a minimum durability rating of 7 on both concrete and asphalt pavement, when tested in the skip line area of a Northern NTPEP Test Deck.

i. Retroreflectivity.
The minimum retroreflectivity of beaded lines, on both concrete and asphalt pavement, after 12 months of exposure on a Northern NTPEP Test Deck shall be 75 milicandelas per foot candle per square foot, when measured in the skip line area according to ASTM E 1710.

B. Manufacturing and Packaging

If the project quantities are more than 1,000 gallons, manufacture the paint in lot sizes of 1,000 gallons or more. If the project quantities are less than 1,000 gallons, manufacture the entire project quantity in one lot.

Store paint at a temperature of at least 32°F.

Use paint within 12 months from the time of manufacture.

C. Acceptance.

1. General.

Use preapproved pavement marking paint. A list of preapproved pavement marking paint lots is available at the Department's website: www.dot.nd.gov. Review the requirements on the website for pavement marking paint preapproval submittals.

The Department will determine conformance to this Specification using the evaluation of test data from NTPEP or other Department-approved facilities, however, the Department reserves the right to utilize additional methods when determining conformance.

2. Certificate of Compliance.

Submit a Contractor Certificate of Compliance according to Section 106.01 C "Certificate of Compliance" and include the manufacturer's name in the "Material Certified" field of the form.

D. Glass Beads.

1. General.

Use glass beads for pavement marking that meet AASHTO M 247, Type II except use beads that have a minimum of 80 percent true spheres. Use beads that have a dual surface treatment consisting of a moisture resistant silicone treatment and a silane adherence surface treatment.

Furnish beads in moisture proof containers or moisture proof bags. Mark each container or bag with name of contents, manufacturer, lot or batch number, ton number, coating type, date of manufacture and the net weight.

2. **Acceptance.**
Use preapproved glass beads for pavement marking. A list of preapproved glass bead lots is available at the Department's website: www.dot.nd.gov.

Materials will be added to the list based on successful sampling and testing according to the NDDOT *Materials Sampling and Testing Manual*.

Provide a certificate for each lot of the material furnished, giving the properties of the beads and certifying that they meet the required specifications. In addition to the certificate of compliance specified in Section 106.01 C, "Certificate of Compliance" include the date of manufacture.

880.02 EPOXY PAVEMENT MARKING PAINT

A. General.
Provide a slow cure material suitable for all applications of pavement markings under controlled traffic conditions. Provide material that is completely free of Tri-Methyl Propane Tri-Acrylate (TMPTA) and other multi-functional monomers.

B. Epoxy Resin Material.

1. **General.**
Provide material composed of epoxy resins and pigments only. Provide material that does not give off solvents to the environment upon application to a pavement surface.

2. **Color.**
Provide material that meets the requirements of Table 880-03 and 880-04 when tested in accordance with ASTM D 2805.

Table 880-03
CIE Chromaticity limits using illuminant "C" for Epoxy

Color	1x	1y	2x	2y	3x	3y	4x	4y
White	0.355	0.355	0.305	0.305	0.285	0.325	0.335	0.375
Yellow	0.510	0.490	0.473	0.453	0.490	0.432	0.537	0462

Table 880-04
Daylight Directional Reflectance (Y)

Color	Minimum Value
White	83
Yellow	50

3. **Adhesion Capabilities.**
Provide material with an adhesion value of at least 300 psi and a failure that occurs 100% in the concrete when a sample prepared to the manufacturer's recommendations is tested according to ASTM D 7234.

4. **Abrasion Resistance.**
Provide material with a wear index of 100 or less when tested according to ASTM D 4060 with a CS-17 wheel under a load of 1,000 grams for 1,000 cycles. The wear index is the weight in milligrams that is abraded from the sample under the test conditions.

5. **Hardness.**
   Provide material with Type D durometer hardness of at least 75 and no more than 90 when tested according to ASTM D 2240. Before performing the test, cure the material for 72 hours at a temperature between 71°F and 75°F.

6. **Tensile Strength.**
   Provide material with a tensile strength of at least 4,500 psi when tested according to ASTM D 638. Before performing the test, cure the material for 72 hours at a temperature between 71°F and 75°F.

7. **Compressive Strength.**
   Provide a material with a compressive strength of at least 12,000 psi when tested according to ASTM D 695. Before performing the test, cure the material for 72 hours at a temperature between 71°F and 75°F.

8. **Shelf Life.**
   Provide material with individual components that do not require mixing before use when stored for a period of less than 12 months.

9. **Yellowness Index.**
   Provide material with the following properties when a sample prepared to the manufacturer's recommendations and tested according to ASTM E 313:

   - Initial yellow index reading: 10 Max (Before QUV); and
   - A yellow index reading of 30 Max after the sample has been placed into a QUV for 72 hours.

10. **No-Pick-Up Time.**
    Provide material with a no-pick-up time between 10 and 45 minutes when tested in accordance with ASTM D 711. Prepare the material according to the manufacturer's instructions and apply at a 20 mil wet film thickness at a temperature between 71°F and 75°F with the proper application of glass beads.

C. Sampling Rate and Procedures.

Use only preapproved pavement marking paint. A list of preapproved pavement marking paint lots is available at the Department's website: www.dot.nd.gov.

Submit one pint samples of each manufacturer's lot or batch furnished for the contract at least 30 days before use. Submit all samples to the Department's Materials and Research Laboratory. Identify the samples as follows:

- Manufacturer's name;
- Manufacturer's product number;
- Lot/Batch number;
- Color;
- NDDOT project numbers; and
- Date manufactured.

D. Glass Beads.

Provide Glass Beads that meet the requirements of AASHTO M 247 Type II, and that have a roundness of at least 80 percent, and that are moisture treated.

E. Packaging of Epoxy Components.
Containers for epoxy components shall be marked with the manufacturer's name, product identification number, lot or batch number, date of manufacture, color, net weight of contents.

880.03 PREFORMED PATTERNED PAVEMENT MARKING FILM

A. General.
Use markings within the manufacturer's recommended shelf life. Store markings in accordance with the manufacturer's instructions.

B. Composition.
Provide retroreflective pliant polymer pavement markings that consist of a mixture of polymeric materials, pigments and glass beads distributed throughout its base cross-sectional area, with a reflective layer of ceramic beads bonded to a polyurethane topcoat surface.

Provide material with a patterned surface with between 35 and 65 percent of the surface area raised and presenting a near vertical face to traffic approaching from all directions.

Ensure the channels between the raised areas are substantially free of exposed beads or particles.

Provide material that has minimal exposed beads and particles between the raised areas.

Provide preformed markings that conform to pavement contours by the action of traffic.

Provide pavements markings applied using a pressure sensitive adhesive in accordance with the manufacturer's instructions. Provide markings that are immediately ready for traffic after application.

C. Skid Resistance.
Provide tape that has a surface that provides an initial minimum skid resistance value of 45 BPN when tested according to ASTM E 303. Obtain the values at downweb and at 45 degree angle from downweb. Average the two values to find the skid resistance of the patterned surface.

D. Thickness.
Provide patterned material that, without adhesive, has a minimum thickness of 65 mils at the thickest portion of the patterned cross-section and minimum thickness of 20 mils at the thinnest portion of the cross-section.

E. Beads.
Provide ceramic beads on the surface of the material that have a minimum index of refraction of 1.7 when tested according to ASTM E 1967. Provide glass beads, that when mixed into pliant polymer, have a minimum index of 1.5 when tested according to ASTM E 1967.

F. Patchability.
Provide film capable of being patched using the same type of material.

G. Reflectance.
Provide markings that have minimum initial retroreflectance values specified in Table 880-05 when measured according to ASTM D 4061. Measure specific luminance (SL) expressed as millicandelas per square foot per foot candle.

Table 880-05

	White	Yellow
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
SL[1]	500	300

[1]Obtain reflectance measurements using an "Ecolux" brand retroreflectometer or equivalent.

880.04 SHORT TERM PAVEMENT MARKING

A. Short Term Pavement Marking – Type NR (Non-Removable).
Place short-term pavement marking that meets Section 880.01, "Water Based Pavement Marking Paint".

B. Short Term Pavement Marking – Type R (Removable).

1. General.

a. Color.
For white marking film, provide film that closely matches Color Chip 37925 of Federal Standard 595b. For yellow marking film, provide film that closely matches Color Chip 33538 of Federal Standard 595b.

b. Beads.
Provide bead adhesion such that beads are not easily removed when the material surface is scratched with a thumbnail.

c. Adhesive.
Provide preformed tape that is immediately ready for traffic after application and is pre-coated with a pressure-sensitive adhesive that adheres to pavement without the use of heat, solvents, or other additional adhesive means.

d. Removability.
Provide marking film that is removable from asphalt and concrete surfaces intact or in large pieces, either manually or with a roll-up device at temperatures above 40°F without the use of heat, solvents, grinding or blasting.

e. Skid Resistance.
The surface of the markings provides an initial minimum skid resistance value of 50 BPN when tested according to ASTM E 303.

f. Initial Reflectance.
Provide films that have initial minimum reflectance values specified in Table 880-06 when measured as specified in ASTM D 4061. Measure specific luminance (SL) expressed as millicandelas per square foot per foot candle. Use 6 minutes of arc as

the angular aperture of both the photoreceptor and light projector. Use the geometric center of the sample as the reference center, and take the reference axis perpendicular to the test sample.

Table 880-06

	White			Yellow		
Entrance Angle	86.0°	86.0°	86.5°	86.0°	86.0°	86.5°
Observation Angle	0.2°	0.5°	1.0°	0.2°	0.5°	1.0°
SL	1,770	1,270	750	1,310	810	450

2. **Type R – WR (Wet Reflective) Pavement Markings.**
When Type R – WR are specified in the plans, provide white and yellow films that have minimum initial retroreflectance values specified in Table 880-07, when measured in accordance with ASTM E 2832. Measure specific luminance (SL) expressed as millicandelas per square foot per foot candle. Use 6 minutes of arc as the angular aperture of both the photoreceptor and light projector. Use the geometric center of the sample as the reference center, and take the reference axis perpendicular to the test sample.

Table 880-07

	White	Yellow
Entrance Angle	88.76°	88.76°
Observation Angle	1.05°	1.05°
SL	250	200

880.05 RAISED PAVEMENT MARKERS

Provide raised pavement markers that consist of a plastic shell with one or more prismatic reflective faces with a minimum of 1 square inch of reflective surface for each direction required to reflect incident light. Provide markers fitted with pressure-sensitive adhesive for application to a prepared surface.

Provide materials that are easily applied and removed.

SECTION 885
DETECTABLE WARNING PANELS

885.01 REQUIREMENTS

A. Construction.
Use detectable warning panels with a minimum size of 1 foot × 1 foot. Use panels with a surface consisting of truncated domes aligned in a square or radial grid pattern. Do not use surface applied detectable warning panels.

B. Dome Size.
Provide truncated domes in a detectable warning surface that have a base diameter of 0.9 inches minimum to 1.4 inches maximum, a top diameter of 50 percent of the base diameter minimum to 65 percent of the base diameter maximum, and a height of 0.2 inch.

C. Dome Spacing.
Provide truncated domes in a detectable warning surface that have a center-to-center spacing of 1.6 inches minimum and 2.4 inches maximum and a base-to-base spacing of 0.65 inches minimum measured between the most adjacent domes.

D. Friction.
Provide panels that have a minimum coefficient of friction of 0.80 when tested according to ASTM C 1028.

E. Materials.
Provide Detectable Warning Panels that are cast iron, concrete pavers, stainless steel, or a composite material.

1. Cast Iron.
Provide cast iron panels with a minimum thickness of 0.2 inches. Use either grey cast iron that meets AASHTO M 105, Class 35 B or use ductile cast iron that meets ASTM A 536, Grade 65-45-12. Provide panels without a surface coating and allow the panels to transition to the iron's natural patina.

2. Concrete Pavers.
Provide concrete paver panels that meet requirements of ASTM C 936, have a minimum thickness of 3/4 inches, and are yellow or brick red throughout the panel.

3. Stainless Steel.
Provide stainless steel panels that meet the following requirements:

- Minimum thickness of 1/2 inches;
- Yellow or brick red in color;
- Has a baked or powder-type surface applied coating that was applied to the panel during manufacture; and
- Show no signs of deterioration or other defects from salt spray after 1,000 hours of exposure according to ASTM B 117.

Do not use field-applied surface coatings or paint.

4. **Composite.**
   Provide composite panels that meet the following requirements:
   - Minimum thickness of 0.16 inches;
   - Yellow or brick red throughout the panel;
   - Minimum compressive strength of 25,000 psi according to ASTM D 695;
   - Minimum flexural strength of 29,000 psi according to ASTM D 790;
   - Minimum tensile strength of 11,500 psi according to ASTM D 638;
   - Maximum water absorption of 0.07 percent according to ASTM D 570; and
   - Show no signs of deterioration or other defects from salt spray after 200 hours of exposure according to ASTM B 117.

5. **Galvanized Steel.**
   Provide galvanized steel panels that meet the following requirements:
   - Minimum thickness of 0.14 inches;
   - Yellow or brick red in color;
   - Has a baked or powder-type surface applied coating applied to the panel during manufacture;
   - Meets Section 854, "Galvanizing";
   - Minimum tensile strength of 35,000 psi according to ASTM A 370; and
   - Show no signs of deterioration or other defects from salt spray after 1,000 hours of exposure according to ASTM B 117.

   Do not use field-applied surface coatings or paint.

SECTION 894
HIGHWAY SIGNS AND POSTS

894.01 SIGN BACKING MATERIAL

A. Flat Sheet Aluminum.
Provide flat sheet aluminum that is an alloy meeting ASTM B 209 Alloy 6061 T6, or 5052-H38.

B. Extruded Aluminum Panels.
Provide Extruded Aluminum Panels that meet ASTM B 221 Alloy 6063 T6. Furnish the panels in 12 inch and 6 inch sections. Provide panels that are flat and straight.

C. Shop Surface Preparation and Processing.
Prepare sign sheeting and panels to conform with the reflective sheeting manufacturer's warranty requirements.

Shop drill holes. Do not field drill any holes required in the sign backing.

894.02 RETROREFLECTIVE SHEETING MATERIALS

A. General.

1. Materials.
When submitting the certificate of compliance for retroreflective sheeting, submit manufacturer warranties and guarantees for materials, parts, workmanship, or performance.

Apply retroreflective sheeting according to manufacturer's recommendations.

Treat the surface of the barricade rails, drums, or cones as recommended by the sheeting manufacturer before applying the reflective sheeting.

2. Silk Screen Printing.
Use retroreflective sheeting within one year from the manufactured date. Mark the packaging cartons or roll goods with the manufacturer's lot numbers and manufacture date.

3. Digital Printing.
Fabricate digitally printed signs using equipment, materials and processes that have been certified by the sheeting manufacturer. Submit a copy of the certification to the Engineer with certificate of compliance.

Follow the sheeting manufacturer's quality control process during the manufacture process.

Apply a UV-protective clear overlay to the entire face of the sign supplied by the reflective sheeting manufacturer.

B. Type III Retroreflective Sheeting
Provide Type III retroreflective sheeting that meets ASTM D 4956, Type III.

C. Type IV Retroreflective Sheeting.
Provide Type IV retroreflective sheeting that meets ASTM D 4956, Type IV.

D. Type VI Retroreflective Sheeting.
Provide Type VI retroreflective sheeting that meets ASTM D 4956, Type VI.

E. Type XI Retroreflective Sheeting.
Provide Type XI retroreflective sheeting that meets ASTM D 4956, Type XI.

894.03 POSTS AND HARDWARE FOR SIGNS

Galvanize all materials requiring galvanization according to Section 854, "Galvanizing".

A. Hardware for Signs.

1. General.
Coat aluminum bolts, nuts, U-bolts, lockwashers, and washers with a minimum of a 0.002 inch anodic coating, followed by a chromate seal. Galvanize all steel bolts, nuts, U-bolts, lockwashers, and washers.

The Engineer may approve the use of substitute alloys in lieu of the specified hardware alloy for signs upon submission of Certificate of Compliance that the proposed substitute alloy that meets or exceeds the applicable specifications to the designated alloy.

2. Bolts.
Fabricate aluminum panel bolts to meet ASTM B 211, Alloy 2024 T4 or 6061 T6.

Use steel panel bolts and machine bolts that meet ASTM A 307.

3. Nuts.
Fabricate aluminum nuts, hex nuts, and vandal-resistant nuts of aluminum alloy to meet ASTM B 211, Alloy 6061 T6.

Use steel hex nuts that meet ASTM A 307.

Use a torque control nut system or torque wrenches to obtain the required torques for fuse joints and slip base used in the breakaway system. Use a torque control nut system that provides automatic torque control, consistently-controlled preload, vibration resistance, high strength, easy installation, simple inspection, and resistance to weather effects.

Use a torque control nut that is designed to mate with standard high strength bolts meeting ASTM F 3125 Grade A 325. Use nuts with a minimum stripping strength of the threads that is equal to or exceeds the strength level of the mating bolts.

If using torque control nuts, provide a Certificate of Compliance.

Provide self-locking nuts that meet Federal Specification MIL-DTL-32258. Install according to the manufacturer's recommendations.

4. **Washers.**
   Fabricate:
   - aluminum lockwashers to meet ASTM B 209, Alloy 7075 T6;
   - aluminum flat washers to meet ASTM B 209, Alloy 2024 T4;
   - steel lockwashers to meet ANSI B 27.1;
   - steel flat washers to meet ASTM A 307; and
   - plastic washers to the sheeting manufacturer's specifications.

5. **Stringers.**
   Use aluminum stringers made of aluminum alloy that meets ASTM B 221, Alloy 6061 T6 or ASTM B 308, Alloy 6061 T6.

   Use steel stringers that meet ASTM A 36.

6. **Aluminum Alloy Castings.**
   Use permanent mold castings or sand castings for brackets, post caps, and fuse plates.

   Use aluminum alloy permanent mold castings that meet ASTM B 108, Alloy SG70A F or SG80A T6.

   Use aluminum alloy sand castings that meet ASTM B 26, Alloy SG70A F or SG70A T6.

7. **Steel Castings.**
   Provide brackets, post caps, and fuse plates that meet AASHTO M 103, Grade 65-35.

8. **U-Bolts.**
   Fabricate aluminum U-bolts to meet ASTM B 211, Alloy 2017 T4.

   Fabricate steel U-bolts to meet ASTM A 307.

9. **Attachment Clip and Plate.**
   For attachment of steel panels use galvanized steel attachment clips and plates to meet ASTM A 283.

10. **Fuse Joint Bolts.**
    Fabricate aluminum fuse plate bolts and washers from aluminum meeting ASTM B 211, Alloy 2024 T4.

    Fabricate steel fuse plate bolts and washers to meet ASTM F 3125 Grade A 325. Use nuts with the capacity to develop the bolt strength. Use galvanized bolts, nuts, and washers.

11. **Breakaway Base Bolts.**
    Use steel bolts and washers that meet ASTM F 3125 Grade A 325, and nuts with the capacity to develop the bolt strength. Use galvanized bolts, nuts, and washers.

B. Posts.

1. **General.**
   Create welds on aluminum according to Section 6 and create welds on galvanized steel according to Section 5 of the *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

2. Aluminum Tubular Posts and Accessories.

Material	Specification
Drawn Seamless Tubes and	ASTM B 210, Alloy 6061 T6 or
Extruded Round or Square Tubes	ASTM B 241, Alloy 6061 T6
Extruded Structural Shapes	ASTM B 221, Alloy 6061 T6
Breakaway Bases	ASTM B 209, Alloy 6061 T6
Fuse Plates	ASTM B 209, Alloy 6061 T6
Fuse Plate Bolts and Washers	ASTM B 211, Alloy 2024 T4

3. Steel (Galvanized) Posts and Accessories.
Use AASHTO M 270, Grade 36 for all steel posts and accessories.

4. Square Steel Telescoping Tubular Posts.

a. Material.
Use steel posts that meet Grade 55 hot rolled carbon sheet steel, structural quality, ASTM designation A 1011.

b. Shape.
Use a square tube post formed of 12 gauge (0.105 U.S.S. gauge) and 10 gauge (0.135 U.S.S. gauge) steel, carefully rolled to size and is welded directly in the corner by high frequency resistance welding and externally scarfed to agree with corner radii.

c. Finish.
Provide signposts manufactured from hot-dipped galvanized steel according to ASTM A 653, with a G90 coating. Zinc coat the corner weld after scarfing. Coat the steel with a chromate conversion coating and a clear organic polymer topcoat. Galvanize both the interior and the exterior of the post.

d. Cross Section.
Use perforated tube that meets the requirements of Table 894-01 for the required size of tube.

Table 894-01

Size	U.S.S. Gauge	Weight (lbs/foot)	Moment of Inertia In^4	Cross Sect. Area In^2	Section Modulus In^3
1 1/2" × 1 1/2"	12	1.70	0.129	0.380	0.172
1 3/4" × 1 1/2"	12	2.06	0.231	0.485	0.264
2" × 2"	12	2.42	0.372	0.590	0.372
2 1/4" × 2 1/4"	12	2.77	0.561	0.695	0.499
2 1/2" × 2 1/2"	12	3.14	0.605	0.841	0.590
2 3/16" × 2 3/16"	10	3.43	0.804	0.803	0.643
2 1/2" × 2 1/2"	10	4.01	0.979	1.010	0.785

e. Holes.

Punch holes that are:

- 7/16 × 1/64 inches in diameter;
- on one inch centers;
- on all four sides;
- down the entire length of the post;
- on centerline of each side;
- in true alignment; and
- opposite each other directly and diagonally.

Remove all metal from the holes.

f. Length.

Provide post of lengths within 1/4 inch of the specified length.

g. Telescoping Properties.

Provide square tubes that have the ability to telescope all consecutive sizes freely at least ten feet without the necessity of matching any particular face to any other face. Provide holes and ends that are free of burrs. Provide ends that are square.

h. Tolerances.

(1) Outside Size Tolerances.

Nominal Outside Dimensions	Outside Tolerances at all sides at Corners
1 1/2" × 1 1/2"	0.006"
1 3/4" × 1 1/2"	0.008"
2" × 2"	0.008"
2 1/4" × 2 1/4"	0.010"
2 1/2" × 2 1/2"	0.010"
2 3/16" × 2 3/16"	0.010"

Measure the outside dimensions at least 2 inches from the end of the tube.

(2) Wall Thickness Tolerances.

Provide a wall thickness that is no less than 0.008 inches from the specified thickness and no more than 0.011 inches greater than the specified thickness.

(3) Convexity and Concavity.

Provide posts with a convexity and concavity of less than 0.010 inches. Determine by measuring the convexity and concavity from the center of the flat sides to the corner.

(4) Squareness of Sides and Twist.

Nominal Outside Dimensions	Squareness Tolerance	Twist Permissible in 3 Feet Length
1 1/2" × 1 1/2"	0.009"	0.050"
1 3/4" × 1 1/2"	0.010"	0.062"
2" × 2"	0.012"	0.062"
2 3/16" × 2 3/16"	0.014"	0.062"
2 1/4" × 2 1/4"	0.014"	0.062"
2 1/2" × 2 1/2"	0.015"	0.075"

Provide posts that have sides that are 90 degrees to each other within the squareness tolerance listed above.

(5) Straight Tolerance.
Provide posts with a variation in straightness of less than 1/16 of an inch in 3 feet.

(6) Corner Radii.
Provide posts with a standard outside corner radius of 5/32 of an inch within a tolerance of 1/64 inch.

i. Installation.
Do not modify the square end of the post or provide a pointed square end. Provide a square end that is capable of being driven into the ground with the use of an approved driving cap.

j. Slip Base Assembly.
Provide manufacturer certification that the chemistry, geometry, and mechanical properties are the same as those used in the tests and that the assembly will meet FHWA change-in-velocity requirements.

5. Accessories.

a. Anchor Plates.
Use anchor plates that meet ASTM A 36, 10 gauge galvanized according to ASTM A 653 with a G90 coating.

b. Safety Retainer-Spacer Strap.
Use steel straps that meet AISI 1020.

c. Nuts and Bolts.
Use steel bolts that meet ASTM A 354, Grade BD, case hardened. Use nuts that meet AASHTO M 291, Grade DH. Use lockwashers that are heavy-duty external type. Use nuts and bolts that are cadmium plated that meet ASTM A 165, Type 05, except when using clear chromate.

d. Fabrication.
Provide machine straightened finished posts that have a uniform finish, free from defects affecting its strength, durability, or appearance. Provide holes and ends that are free of burrs.

Punch the sign posts and stringers on the center line with 7/16 inch diameter holes on one inch centers for the entire length.

Punch the base posts on center line with a minimum of 12 holes that are 7/16 inch diameter on one inch centers. Punch the first hole one inch from the top.

Provide posts with a pointed bottom.

Provide sign post, base posts, retainer-spacer, and anchor plates that are galvanized.

6. Structural Steel Posts.
Provide structural steel posts that are fabricated from material conforming to Section 834.01 A, "Structural Carbon Steel" that are galvanized after fabrication.

894.04 DELINEATORS

A. Posts.
Provide steel posts that meet ASTM A 702.

Provide galvanized steel posts or provide aluminum posts that meet ASTM B 308, Alloy 6061-T6. If providing galvanized steel posts, provide posts galvanized as specified in Section 854, "Galvanizing".

B. Reflectors.
Use reflective sheeting that meets Section 894.02 E, "Type XI Retroreflective Sheeting" that is white or yellow adhesive coated and permanently adhered to aluminum or galvanized steel. If using galvanized steel, provide steel galvanized as specified in Section 854, "Galvanization".

Use backing material that meets Section 894.01 A, "Flat Sheet Aluminum".

894.05 STRUCTURES FOR OVERHEAD SIGNS

A. General.
Galvanize all materials requiring galvanization according to Section 854, "Galvanizing" after fabrication.

Submit work drawings for all structures for overhead signs according to Sections 105.08 A.3, "Additional Section 600 Work Drawing Submittal Requirements".

1. Welding.

a. General.
Perform all steel welding according to the specifications for welding of steel structures in the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

b. Treatment of Welded Areas.
Punch a minimum 3/4 inch hole into chords to facilitate galvanizing the struts and diagonal tubes. Provide two 1/2 inch holes at the top and bottom of the chords on the capped end to facilitate galvanizing. Provide on the end tower vertical columns two 1/4

inch holes in the base plate and two 3/4 inch holes at the top of each column to facilitate galvanizing.

c. Repair Galvanization.
Repair damaged galvanization according to Section 854, "Galvanizing".

2. Grating and Handrail.
If grates require splicing, make the splice at the center of the support. The rail may be in one or more pieces with a post assembly at each end of each piece of rail.
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Provide aluminum grating that meets ASTM B 221, Alloy 6063 T6. Provide aluminum grating that resists a point load of 500 pounds and has a deflection of 1/4 inch or less when loaded with a uniform load of 100 pounds per linear foot. Base the deflection on a simple span, 5 feet in length.

Provide U-bolts, bolts, washers, nuts, and clips of austenitic stainless steel.

Provide aluminum railing composed of 1.25 inch nominal diameter Schedule 40 pipe and fittings, with flush surfaces. Weld and grind smooth joints between the pipe and fittings.

Fabricate railings in sections of adequate size that allow the sections to be raised and lowered by one person from one end of each section.

B. Free Standing Overhead Signs.

1. Round Tubes and Standard Pipe.
Provide steel galvanized round tubes and standard pipe members that meet AASHTO M 270 Grade 36, or ASTM A 53 (Grade B Steel).

2. Round-Tapered or Octagonal-Tapered Tubes.
The Engineer will allow the overhead sign structure to be designed and fabricated from round-tapered or octagonal-tapered steel tubes instead of round and standard pipe.

Retain major dimensions, such as truss cross section and length, and end towers vertical dimensions. If this option is chosen, furnish to the Engineer all necessary calculations and drawings used in designing these structures. Design the structures according to the latest issue of the *AASHTO publication of Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*. Use a wind velocity of 90 mph to compute the wind pressures on the signs and structures.

Submit work drawings after the above design has been submitted and reviewed.

Use round-tapered or octagonal-tapered tube members that have a minimum yield strength of 50,000 psi after fabrication. Design the shaft to have no more than one longitudinal weld. Provide a galvanized shaft.

3. Flat Bars.
Provide galvanized flat bar members that meet the requirements in AASHTO M 270 Grade 36.

4. **Flange.**
   Use flange, base plate, clamps, and plate material that is of the same material used in fabricating columns and truss chords.

5. **Truss.**
   Provide galvanized steel shapes that meet AASHTO M 270 Grade 36.

6. **Hardware.**
   Fabricate galvanized steel bolts to meet ASTM F 3125 Grade A 325. Fabricate steel U-bolts from round steel bars. Thread the U-bolts on both ends meeting ASTM A 307 and galvanize the U-shaped bolts.

7. **Anchor Bolts, Nuts, and Washers.**
   Provide anchor bolts made of medium carbon, hot rolled steel bars meeting AASHTO M 314 Grade 55 and that meet the requirements in Table 894-02.

Table 894-02

Yield Strength	55,000 psi
Ultimate Strength	75,000 to 95,000 psi
Elongation (2-inch gage), min	21%[1]
Reduction in Area, min	30%[2]
Longitudinal Charpy V-Notch, min	15 ft-lbs at 40°F

[1] Elongation (eight-inch gage), minimum18 percent for bolts tested full section.
[2] Bolts over 2 to 2-1/2 inch, 22 percent min; over 2-1/2 to 3 inch, 20 percent min.

Perform notch toughness tests on specimens according to Test Frequency P of ASTM A 673 and the orient the notch perpendicular to the longitudinal axis of the anchor bolt. It may be necessary to heat the steel in order to meet the Charpy V-Notch impact requirements.

Use galvanized anchor bolts, nuts, and washers.

Provide threads on the anchor bolts that are 8UN series as specified in ANSI B1.1 and have Class 2A tolerances before coating. After coating, the maximum limit of pitch and major diameters may exceed the Class 2A limit by 0.021 inch for bolts 1 inch and smaller, and by 0.031 inch for bolts larger than 1 inch in diameter. Anchor bolt threads may be cut or rolled into the round bar stock.

Use nuts for anchor bolts that meet ASTM A 563, Grade A, heavy hex. Provide threads that are 8UN series that meet ANSI B 1.1 Class 2B tolerances and tapped oversize after coating by not more than 0.021 inch for nuts 1 inch and smaller, or more than 0.031 inch for nuts larger than 1 inch. Lubricate the nuts as specified in Supplementary Requirement S1 of ASTM A 563.

Use circular washers that meet ASTM F 436

Provide a Certificate of Compliance for all bolts that includes the results of yield strength, tensile strength, elongation, reduction of area, and charpy tests, and identification to the heat number of the steel, and to furnace lot number if heat treated.

Stamp anchor bolts for cantilever and truss sign supports to identify them to a specific test report before sampling the bolts for testing. Stamp anchor bolts in the end of the hook to identify them to a specific heat number. Stamp anchor bolts in the threaded end cross section to identify them to a specific test report.

The Engineer will sample anchor bolts (including nuts and washers) for destructive testing at the following frequency:

- Cantilever sign supports - 1 bolt per cantilever per heat;
- Truss sign supports - 1 bolt per truss assembly per heat; and
- Other uses - 1 bolt per heat per project.

Order additional bolts for sampling.

C. Overhead Signs on Bridge Structures.

1. Plates.
Use brackets and reinforcing plates that meet ASTM B 209, Alloy 6061 T6.

2. Angles, I-Beams, and Channels.
Use aluminum shapes that meet ASTM B 308, Alloy 6061 T6.

3. Bolts, Nuts, Washers, and Lockwashers.
Provide nuts, bolts, washers, and lockwashers used in the erection and fabrication of the overhead sign structures on bridges made of austenitic stainless steel. Fabricate the bolts used for the attachment to the bridge according to ASTM F 3125 Grade A 325 and galvanize the bolts.

SECTION 895
HIGHWAY LIGHTING

895.01 DESCRIPTION
Furnish material that meets the requirements of the Institute of Electrical and Electronics Engineers (IEEE), Underwriters Laboratories (UL), and the Institute of Transportation Engineers (ITE).

895.02 CONDUIT

A. General.
Submit a certificate of compliance for conduit.

B. Steel Conduit.
Provide corrosive-resistant steel conduit meeting UL 6.

C. PVC.
Provide PVC conduit that meets the requirements of UL 651 suitable for direct burial applications and has a minimum wall thickness equivalent to Schedule 40 as defined by ASTM D 1785.

D. HDPE.
Provide HDPE conduit that meets the requirements of UL 651 and ASTM D 3035 that is suitable for direct burial applications. Use HDPE conduit that has a minimum wall thickness equivalent to DR 15.5 as defined by ASTM D 3035.

895.03 CONDUCTORS

A. Feeders.

1. General.
If using conductors as feeders provide either a single conductor or multiple stranded conductors formed into a cable. Provide underground phase and neutral conductors that are insulated to meet the requirements for direct burial cable, rated at 600 volts, and that meet ASTM B 3 and B 8.

2. Single Conductor.
Use single conductor marked with Style “RHW-USE” and the required AWG size on the sheath. Use stranded No. 6-AWG-Type THW or THHN/THWN for grounding conductor. Rubber insulation specifically listed for that purpose by UL does not require an outer cover.

3. Multiple Conductor.
Provide Style USE for multiple conductor that meets NEMA Standards WC-70, rated at 0 through 600 volts, modified as follows:

a. Provide multiple conductors insulated with either cross-linked thermosetting polyethylene (XLP), or butyl.

b. Use multiple conductors that have circuit identification. Assemble conductors into a cable of circular cross section with filler, binder, armor, and an overall outer cover.

c. Use armor that is a bronze tape meeting ASTM B 130 with a minimum thickness of 10 mils and a spiral overlap of not less than 1/4 inch. Use an outer cover on the polyethylene insulated type that is a polyvinyl chloride material, and an outer cover on the butyl insulated type that is a neoprene rubber material.

d. Provide circuit identification, conductors, cables, fillers, and binders that meet Part 5 of NEMA WC-70 except only obtain identification by colored tapes, colored compounds, or colored coatings, and use rubber or rubber-like material fillers.

B. Internal Conductor.

Provide copper No. 12 AWG, stranded, Type THWN/THHN that meets ASTM B 3 and B 8 for the conductor connecting:

- The fuse kit in the base of the light standard to the luminaire ballast;
- The sign lighting load center to the sign lighting ballast; and
- Fuse kit in the pull boxes to lighting luminaire ballast.

The Engineer will not require an outer covering on rubber insulation if UL has specifically listed the rubber for the purpose of insulating.

895.04 FEED POINT

Provide feed points constructed of aluminum or stainless steel.

Provide a cabinet that has a NEMA 3R rating and is pad or pole mounted.

Install photoelectric cell near the top of the cabinet that controls the “on/off” switching of the light circuits. Place a 3 to 5 minute delay switch in the light circuits.

Install a pilot relay between the photoelectric cell and the lighting circuit relays. Enclose the relays and ensure they are normally in the “open” position.

Install circuit breakers in the cabinet in a load center type panel board. Provide a panel board of a type approved for service equipment.

Install a test switch that bypasses the photoelectric cell.

895.05 LIGHTING STANDARDS

A. General.

Design lighting poles to meet the requirements of AASHTO publication, *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*.

When a breakaway base is required, provide a manufacturer Certificate of Compliance stating the light standard base meets the AASHTO requirements for both breakaway and structural adequacy.

Use a wind velocity of 90 mph with the following height and exposure correction factor:

- If the light pole is less than 33 feet use a K_z[a] of 1.00; or

- If the light pole is greater than 33 feet use the $K_z{}^a$ found in Table 3.8.4-1 “Height and Exposure Factors, $K_z{}^a$”.

Apply different wind pressures to the structure at different heights rather than using an average wind pressure for the entire height of the structure.

Design each structural component on light standards 55 feet or greater for fatigue using the requirements of Table 11.6-2, “Fatigue Importance Categories for HMLT’s”.

Furnish all the necessary calculations and drawings used in the design of poles with the work drawing submittal. A Professional Engineer duly registered in the State of North Dakota must sign, seal, and date the calculations and work drawings used in the design of lighting standards.

B. Material.

1. General.

Fabricate the light standard from steel using either one- or two-piece construction. Construct welds that develop the full strength of the adjacent shaft section.

Provide either galvanized or stainless-steel light standards. Provide a shaft that has no more than one longitudinal weld.

2. Galvanized Material.

Provide galvanized standards, including the mast arm, shaft, and base galvanized as specified in Section 854, “Galvanizing”. Fabricate round or multi-sided shafts for galvanized steel poles that to have minimum yield strength of 48,000 psi.

3. Stainless Steel Material.

Provide a multi-sided shaft for stainless steel poles that has a minimum yield strength of 60,000 psi. Use stainless steel that meets the requirements of ASTM A 666, Type 201 for mast arm, shaft, and base.

C. Mast Arm.

1. General.

Provide either a davit-type or truss design mast arm.

2. Davit-Type.

Provide a davit-type mast arm made of the same material as the shaft and that has a tenon adapter for receiving the luminaire.

3. Truss.

Provide a truss mast arm assembly consisting of upper and lower members securely joined using one or more vertical struts.

Use steel pipe upper and lower members with a minimum diameter of 2 inches. On the pole end of the upper and lower members, provide a welded steel fitting suitable for attachment to the pole using cap screws.

Install an opening near the top of the shaft to provide a cable entrance from the shaft into the mast arm. Weld a steel adapter into this opening that will act as a smooth cable guide for wiring and as a support for the attachment plate that is welded to the mast arm.

D. Base.

1. General.
Install either an anchor base or a transformer base.

Install a grounding lug inside the base.

2. Anchor Base.

a. General.
Provide an anchor base that is a one-piece steel casting or hot-rolled carbon steel plate. Use a steel casting that meets ASTM A 27, Grade 65-35 using hot-rolled carbon steel that meets AASHTO M 270, Grade 36.

Construct two continuous welds when securing the anchor base to the lower end of the shaft. Place the welds inside the base at the bottom of the shaft and at the top of the anchor base. Construct welded connections that develop the full strength of the adjacent shaft section.

Provide four bolt covers and cap screws for securing the covers to the base with the anchor base.

Locate a minimum 4 × 6 inch hand hole opposite the road side of the pole on each shaft. If the shaft is in a median, locate a minimum 4 × 6 inch hand hole parallel to the roadway. Install reinforcing frames inside the hole and secure the hole with a removable cover.

If breakaway base is required, install a slip base with the anchor base.

b. Slip Base.
Provide plates constructed of steel that meets the requirements of AASHTO M 270 Grade 36, bolts that meet the requirements of ASTM F 3125 Grade A 325, and a keeper plate that meets the requirements of ASTM A 653, Grade 33. Galvanize all materials as specified in Section 854, “Galvanizing”.

3. Transformer Base.

a. General.
Provide a steel or aluminum transformer base.

Install a grounding lug inside the base.

Install a door in the base that has a tamperproof lock.

Construct the base so that leveling nuts and hold down nuts placed on the anchor bolts secure the transformer base to the foundation; or provide four loose steel plate anchor clips to fasten the base to the anchor bolts.

Fasten the transformer base to the shaft anchor base using four galvanized hex head steel machine bolts and nuts that meet the requirements of ASTM F 3125 Grade A 325 and that are galvanized as specified in Section 854, "Galvanizing".

b. Steel Transformer Base.
Fabricate the steel transformer base from steel that is a minimum thickness of 7 gauge, with the top and bottom plate made of not less than 3/4-inch steel plate.

Galvanize the assembled base as specified in Section 854, "Galvanizing".

c. Aluminum Transformer Base.
Provide a casting that meets ASTM B 26 or B 108, Alloy 356 T6 and is smooth with all details well defined and true to pattern.

E. Festoon Circuits.
When a festoon circuit is specified, provide an electrical outlet 15 to 20 feet above ground level.

Provide all material and wiring required for festoon circuit outlets. Wire the outlets for 120 volts, 60 Hz, A.C. Provide the festoon receptacle with a single gang while-in-use cover. Provide body and plates made of gray colored polycarbonate, with a gasket made of closed cell foam, neoprene blend regular density, UL rated HBF. Mount covers vertically using stainless steel screws. Provide a cover that complies with NEC requirements for installation in wet locations.

895.06 STREET LIGHT LUMINAIRE

A. General.
Provide a luminaire that consists of a die-cast aluminum housing, optical system door, and a door-mounted ballast.

Finish the luminaire using baked-on gray enamel.

B. Slip Fitter.
Provide a luminaire with an adjustable slip fitter containing two or four bolts, suitable for tightening both internally and externally. Use a slip fitter capable of adapting to 1-1/4 inch through 2-inch pipe and that is adjustable to within 5 degrees from horizontal.

C. Optical Assembly.
Provide an optical assembly consisting of:
- An anodized aluminum reflector;
- An adjustable socket assembly;
- Filtered optical system of polyester fiber;
- A gasket for sealing between the reflector and refractor; and
- A borosilicate or acrylic polycarbonate prismatic refractor.

D. Ballast.

1. General.
Provide ballast that operates one lamp at the specified voltage using a 60 hertz power source capable of starting and operating the specified lamp.

Provide either a door mounted or removable power pad ballast.

2. Door Mounted.
Provide a door mounted integral ballast that is removable and replaceable using quick disconnect plugs. Use a ballast that is prewired to the lamp socket and terminal board, requiring only connection of the power supply leads to the terminal board.

3. Removable Power Pad.
Provide an easily removable power pad allowing complete ballast assembly replacement using a simple quick-disconnect.

895.07 FUSING

Fuse each light source in the base of each light standard. Make connections to power distribution circuits using field-applied waterproof kits.

Use a fused connector kit containing a pair of spring-loaded, 90 percent maximum conductivity contacts suitable for gripping a 15-ampere cartridge fuse. Provide fully annealed contacts constructed to be crimped to the cable and are retained securely in the proper position within the rubber or molded plastic housing.

Size each fuse kit to protect the light source.

Provide fused connector kits that:
- Are suitable for burial in the ground or installation in the sunlight; and
- Contain both line side and load side housings.

Provide housings that:
- Are made of water resistant synthetic rubber or molded plastic;
- Have a section to form a water seal around the cable;
- Have an interior arrangement which suitably and complementarily receives and retains the copper fuse contacts; and
- Have a section to provide a water seal between the two housings at the point of disconnection.

Provide a load side housing constructed to retain the fuse when disconnected. Permanently mark each housing “load side” and “line side.” Supply each kit with sufficient silicone compound to lubricate the metal parts and the rubber or molded plastic housing for easy assembly.

895.08 SIGN LIGHTING LOAD CENTER

Provide a load center cabinet that is weather-proof and constructed to receive a padlock.

Provide a grounding lug inside the cabinet.

895.09 SIGN LIGHTING LUMINAIRES

A. General.

Provide a sign lighting luminaire consisting of:

- An aluminum main casting containing a clamp mechanism;
- A terminal block;
- A socket assembly;
- A reflector; and
- A refractor door assembly.

Shield the luminaire to oncoming traffic so motorists see no direct light.

B. Clamping Mechanism.

Design the clamping mechanism for a 1-1/4 inch nominal pipe bracket using two 3/8-16 hex-head bolts and serrated, positive gripping, cast aluminum clamps. Design the clamping mechanism with a vertical adjustment range of 5 degrees up and 5 degrees down. Provide leveling pads on the bottom and inside of the luminaire casting.

C. Lighting Lamps.

In addition to the requirements of Section 106.01 C, "Certificate of Compliance", provide verification through photometric data that the specified uniformity ratio will be obtained.

D. Terminal Block.

Provide a terminal block under the reflector at the wire entry location. Use terminal screws that are captive to the terminal block. Install terminal plates that provide a positive hold action.

E. Reflector.

Hold the reflector in place using four screws. Provide keyhole slots in the reflector to permit removal without removing the mounting screws.

F. Refractor Door.

Attach the refractor door assembly to the main casting using two hinges at the front of the luminaire and two stainless steel, spring-tempered tension latches at the rear. Use spring latches that provide sealing pressure for the gasketed assembly. Provide an assembly that consists of an anodized extruded aluminum channel form fitted to the prismatic refractor using a captive gasket. Use a single piece gasket of high thermal-resistant material, incorporating a sealing pad. Provide a refractor assembly that is readily removable and capable of being completely immersed for cleaning. Protect the glass refractor using a rubber bumper mounted on the pipe bracket.

G. Ballast.

Enclose the ballast in a weather-proof enclosure constructed of cast aluminum. Mount the ballast enclosure directly to the ballast support with four 3/8-inch bolts. Locate 3/4-inch conduit openings on each side of the ballast enclosure for the electrical conductor to enter the ballast. Attach the gasketed cover plate to the bottom casting with four hex head bolts. Provide a 1-1/4 inch threaded pipe at the end of the ballast enclosure to support the luminaire.

895.11 SODIUM VAPOR WALL-MOUNTED LUMINAIRE

A. General.
Provide a luminaire consisting of a cast aluminum housing containing the ballast, terminal board, and anodized aluminum reflector and a cast aluminum door with a heat and impact resistant prismatic refractor sealed to it. Use a reflector having an anodized aluminum finish. Use a prismatic type refractor constructed of thermal and shock-resistant material. Provide a ballast that is an integral part of the housing and completely prewired. Provide a mogul base porcelain-grip type socket with two positions for beam control.

B. Housing.
Provide a luminaire housing that is die-cast corrosion-resistant aluminum and completely gasketed to keep out dust, insects, and other contaminants. Provide a ballast area having a neoprene gasket and a polyester fiber gasket in the optical assembly for maximum weather-resistant protection. Use a door assembly that is hinged to the housing at the bottom, protected by a safety chain, and secured using stainless steel latches. Construct the housing to allow installation on any flat surface and provide wiring holes including a threaded 3/4-inch side entry for exposed conduit.

895.12 SODIUM VAPOR UNDERPASS CEILING-MOUNTED LUMINAIRE

Provide a mounting system that protects the enclosed lamp from shock or breakage. Provide a fixture that is indestructible and guaranteed to withstand vandalism. Provide a fixture that is for ceiling mounting complete with 100-watt high-pressure sodium lamp, 240-volt high power factor ballast, and neoprene gaskets for outdoor use. Provide an unbreakable opalescent lens diffuser, ultraviolet stabilized for outdoor application, and 14-gauge steel backplates, of baked enamel finish, with stainless steel tamperproof screws.

SECTION 896
HIGHWAY TRAFFIC SIGNALS

896.01 CONDUIT

A. Steel Conduit.
Use steel conduit of corrosive-resistant material meeting the requirements in UL 6. Do not use aluminum conduit.

B. Nonmetallic Conduit.

1. General.
Use either polyvinyl chloride (PVC) or high-density polyethylene (HDPE) conduit for nonmetallic conduit.

2. PVC.
Provide PVC conduit that meets the requirements of UL 651 suitable for direct burial applications and has a minimum wall thickness equivalent to Schedule 40 as defined by ASTM D 1785.

3. HDPE.
Provide HDPE conduit that meets the requirements of UL 651 and ASTM D 3035 that is suitable for direct burial applications. Use HDPE conduit that has a minimum wall thickness equivalent to DR 15.5 as defined by ASTM D 3035.

896.02 CONDUCTORS

A. Feeders.
If using conductors as feeders, provide either a single conductor or multiple stranded conductors formed into a cable. Provide underground phase and neutral conductors insulated to meet the requirements for direct burial cable, rated at 600 volts, and that meet ASTM B 3 and B 8.

Use single conductor marked with Style “RHW-USE” and the required AWG size on the sheath. Use stranded No. 6-AWG-Type THW or THHN/THWN for grounding conductor. Rubber insulation specifically listed for that purpose by UL does not require an outer cover.

B. Loop and Loop Lead-In Conductor.

1. General.
Provide a loop and loop lead-in conductor selected from the list in this section.

2. Copper Loop Conductor.
Use No. 14 AWG, Type XHHW or THWN or THHN single-stranded 600-volt conductor or as recommended by the detector manufacturer.

3. Polyethylene Conduit Pre-Wired.
Provide a certificate of compliance stating that the 1/4-inch polyethylene conduit meets ASTM D 1248, Type III, E10, Category 5, Class C and Tables 896-01 and 896-02.

Table 896-01
Nominal Dimensions of Polyethylene Conduit

Property	Value (Inches)
Duct Size	0.250
Outside Diameter	0.250 ± 0.010
Wall Thickness	0.032 ± 0.010
Nominal Inside Diameter	0.185
Minimal Bending Radius	1.00

Table 896-02
Nominal Physical Properties of Polyethylene Conduit

Property	Test Value	ASTM Test
Tensile Strength @ yield, psi	3,200 min.	D 638
Ultimate Elongation, %	400 min.	D 638
Melt Index, gms/10 min.	0.5 max	D 1238
Carbon Black Content, %	2.00-3.00	D 1603
Density of Base Resin, gms/cc	0.941-0.959	D 1505
Brittleness Temperature, F_{20}	-75°C., max.	D 746
Environmental Stress Crack Resistance, F_{20}	48 hrs.	D 1693 Cond. B

Use conduit that also meets or exceeds the performance tests as specified in NEMA Standards Publication No. TC7, Part 3 as follows:

a. TC7-3.01 Compressions and Recovery

b. TC7-3.02 Impact Test

Use conduit that is permanently marked on the outside at regular intervals with the manufacturer's name, trademark, nominal conduit diameter, Type III, and year of manufacture.

4. Copper Loop Lead-In Conductor.
Use copper loop lead-in conductor that is a No. 14 AWG stranded polyethylene insulated twisted pair with a foil shield, or as recommended by the detector manufacturer, and place it in a common conduit with power and control circuit cable without interference.

Provide a jacket of HDPE with a nominal thickness of 0.032 inches.

5. Preformed Loop Detector.
Construct preformed loop detectors of PVC and loop conductor. Encase the loop detector in 1/2-inch schedule 40 PVC, with pipe fittings and glue. Terminate one corner with a 1/2-inch PVC tee fitting to provide an exit to the pull box conduit. Seal the PVC at the joints with water pipe fitting glue. Use a conductor of No. 14 AWG, Type XHHW or THHN or THWN, 600 volt stranded single conductor. Do not splice the loop conductor. Place three turns in the preformed loop. Twist the conductor from the loop to the pull box to provide a minimum of two to five turns per foot.

6. Microloop Probe.
Construct microloop probes with the lead-in cables in 3/8-inch saw slot or in sand in the roadway base. The Engineer will allow microloop probes to be connected in series with other microloop probes or in conventional wire loops. Operate microloop probes under the following parameters:

- Earth's Vertical Magnetic Field (0.2 to 1.0 oersted);
- Inductance (20 microhenries to 25 microhenries per probe plus 20 microhenries per 100 feet of wire);
- DC Resistance (0.5 ohms per probe plus 3.2 ohms per 100 feet of wire);
- Transducer Gain (typically 3.5 microhenries per oersted at 0.4 oersted ambient vertical field intensity); and
- Sensitivity with two probes (7.0 microhenries per oersted at 0.4 oersted ambient vertical field intensity).

Operate microloop probes at a temperature range of -35°F to 165°F. Construct microloop probes to detect all motorized vehicles.

C. Traffic Signal and Flashing Beacon Control Circuits.
Use cables rated for 600 volts and meet IMSA 19-1 or 20-1.

Use conductor consisting of Class B or Class C stranded copper. Insulate each conductor with 25 mils of polyethylene insulation.

Use fillers of a moisture-resistant material, and do not use jute. Use moisture resistant binder tapes.

Provide color coding of conductors that meets Table 5.1 of IMSA 19-1.

896.03 SAW SLOT SEALANT

Use a joint sealer that:

- Forms a resilient and adhesive compound capable of sealing the saw slot;
- Protects against infiltration of moisture and foreign material throughout repeated cycles of expansion and contractions with temperature changes;
- Uses a sealing compound that does not flow from the joint or will be picked up by vehicle tires at summer temperatures;
- Is of material that is capable of being brought to a uniform pouring consistency for completely filling the saw slot without large air holes or discontinuities and without damaging the material; and
- Is not an epoxy-type sealant.

896.04 FEED POINTS

A. Traffic Signal.
Include the following on a traffic signal feed point:

1. A 60-ampere size switch box.

2. One manually operated weatherproof switch, two-pole, single throw, 125/250 volts with 45 ampere breakers.

B. Flashing Beacon.
Include the following on a flashing beacon feed point:

1. A 60-ampere size switch box.

2. One manually operated weatherproof switch, two-pole, single throw, 125/250 volts with 15 ampere breakers.

3. A Radio Interference Filter (RIF) and a Surge Voltage Protector (SVP) on the AC 120 volts supply. Each rated at nominal 120 volts, 60 hertz, and a minimum of 30 amperes and not less than the current rating of the circuit breaker protecting it. There may be one RIF and one SVP protected by a common main circuit breaker before the AC 120 volts supply is split into the automatic and flash circuit breaker branch circuits, or a separate RIF and SVP may be used after each pole of the automatic and flash circuit breakers.

4. A solid-state flasher meeting NEMA Standards Publication No. TS 2, latest edition, Traffic Controller Assemblies with NTCIP Requirements, Section 6.

5. On flashing school crossing beacons install a time clock with the following capabilities:

   a. Automatic daylight savings time and leap year compensation.
   b. A minimum of 48-hour battery or capacitive backup-memory and timing maintained in event of power loss.
   c. A minimum of six program steps programmable to one-minute intervals.
   d. Operate on a line voltage of AC 95-135 volts, 60 hertz.
   e. Temperature range of -22°F to 165°F
   f. Liquid crystal display.
   g. Single Pole, Double Throw output relay rated 10-ampere, AC 115-volt resistive load.
   h. Terminal block for electrical connection that will accommodate wire sizes #16, #14 and #12-AWG.

6. If the flasher is not placed in a feed point cabinet, place it in a locked weatherproof cabinet of adequate size to mount the flasher and circuit breakers, on-off switch, time clock, and all necessary wiring. Provide two keys for the lock.

896.05 TRAFFIC SIGNAL STANDARDS

A. Design.
Design traffic signal standards to meet the requirements of AASHTO publication, Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Use a wind velocity of 90 mph with the following height and exposure correction factor:

- If the traffic signal is less than 33 feet use a K_z[a] of 1.00; or
- If the traffic signal is greater than 33 feet use the K_z[a] found in Table 3.8.4-1 “Height and Exposure Factors, K_z[a]”.

Apply different wind pressures to the structure at different heights rather than using an average wind pressure for the entire height of the structure.

Design each structure component using the requirements of Table 11.6-1, “Fatigue Importance Factors, I_F.”

Design the components for the total deflection, with galloping, at the free end of the traffic signal arm is limited to less than 8 Inches.

Furnish all the necessary calculations and drawings used in the design of poles with the shop drawing submittal. A Professional Engineer duly registered in the State of North Dakota must sign, seal, and date the calculations and work drawings used in the design of lighting standards.

B. Type II Standards.

1. Shaft.

Use a shaft constructed of:

- standard steel seamless pipe meeting ASTM A 36 or ASTM A 53; or
- standard aluminum pipe meeting ASTM B 429, Alloy 6061 T6, or 6063 T6.

Use a pipe that is 4-1/2 inches in outside diameter, with one end threaded for connection to the base. Calculate the design stresses for the shaft at the root of the thread.

2. Transformer Base.

Tighten the shaft securely in the base. Provide the base with holes to receive the anchor bolts, a handhole, and a grounding lug on the inside of the shaft or base. Place the grounding lug opposite the handhole and include a locking device for the handhole cover. Calculate the design stresses at the root of the thread or thinnest wall section. Use materials that meet ASTM A 27 Steel, or ASTM B 26, or B 108 Alloy 356 16 Aluminum.

C. Type IV, V, VI, and VII Standards and Combination Signals and Light Standards.

1. Shaft.

Provide a steel shaft that has a minimum yield strength of 48,000 psi after fabrication. Provide a combination light and signal shaft that is of two-piece construction.

Provide shafts with a minimum wall thickness of 0.179 inch for Types IV, V, VI, and VII shafts, and 0.239 inch for the combination light and signal shaft.

Taper the shafts with top and bottom diameters large enough to withstand their design load.

Construct the Type V, VI, and VII shafts with a top outside diameter of 4-1/2 inches for a post top slipfitter.

2. Mast Arm.

Construct the truss mast arm with both lower and upper members securely joined using vertical struts. Use members with a minimum wall thickness of 0.119 inch and minimum yield strength of 48,000 psi after fabrication.

Construct the monotube mast arm with a minimum wall thickness of 0.179 inch and a minimum yield stress of 48,000 psi after fabrication. Only use one longitudinal weld and no transverse welds in fabricating the monotube mast arm.

Design the signal mast arm to be rotated away from the roadway without disconnecting signal circuits or removing the mast arm.

3. **Transformer Base.**
Construct the steel transformer base to the size specified by the manufacturer to support the shaft and mast arm. Fabricate the transformer bases to have a minimum yield strength of 33,000 psi. Fasten the transformer base to the shaft anchor base with galvanized hex-head machine bolts and nuts meeting ASTM F 3125 Grade A 325, galvanized according to AASHTO M 232. Install a door opening opposite the street side of the transformer base, secured in place by an approved locking device. Provide a grounding lug on the inside of the base.

4. **Luminaire Extension.**
Design the shaft extension for mounting the luminaire the same as the rest of the shaft. Construct the galvanized steel extension with a minimum wall thickness of 0.119 inch and a minimum yield strength of 48,000 psi after fabrication. Galvanize the extension and hardware according to Section 854, “Galvanizing”. Construct the stainless-steel extension with a minimum wall thickness of 0.721 inch and a minimum yield strength of 60,000 psi. Use stainless steel that meets the requirements of ASTM A 666, Type 201. Provide a tapered shaft that has a bottom and top diameter of sufficient size to withstand the design loads.

896.06 TRAFFIC SIGNAL HEADS

A. Standard Units.

1. **General.**
Use circular signal heads with LED conforming to ITE Standards. Use 1808, Type 304 stainless steel for exposed screws and fasteners.

Use Circular Signal Head LED Modules that fit into traffic signal housings built to the Vehicle Traffic Control Signal Heads (VTCSH) Standard or use stand-alone units that incorporate a housing meeting the performance requirements of the VTCSH Standards.

Connect the module directly to the existing electrical wire system.

Use a vehicle arrow traffic head conforming to VTCSH “Part 3: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules” of the ITE.

Use modules that fit into signal housings built to the VTCSH Standard.

Design retrofit replacement modules for existing signal lamps to not require special tools for installation. Provide modules that install into the existing signal housing, only require the removal of existing optical components, that are weather tight, fit securely in the housing, and connect directly to existing electrical wiring.

2. Housing.

a. General.
Provide a one-piece aluminum alloy die casting housing, or a one-piece polycarbonate resin material housing. Provide a housing door made of the same material as the housing.

Install metal reinforcement plates to reinforce the bottom of the signal head when it is mounted on a pedestal-type signal standard.

Provide two sets of internal bosses in each section for horizontal mounting of a terminal block.

Construct the top and bottom exteriors flat to align the assembled sections.

Fasten individual signal sections together either with machine screws between each section or by the three-bolt and two-washer method.

b. Polycarbonate Housings.
Use a polycarbonate housing that is at least 0.090 inch thick and is ribbed with at least two vertical ribs in addition to ribs on the top and bottom surfaces. When using plumbizers, install metal plate reinforcing.

3. Module.
Use a Circular Signal Head LED Module that:
- Is suitable for replacement into an existing signal housing;
- Only requires the removal of the existing optical unit components;
- Is weather tight and fit securely in the housing;
- Connects directly into the existing wiring; and
- Does not require special tools for installation.
- Is hard coated or otherwise made to comply with material exposure and weathering effects requirements of the Society of Automotive Engineers (SAE) J576.

Provide retrofit modules that install into an existing signal housing, only require the removal of existing optical components (i.e. lens, lamp module, gaskets, refractor), that are weather tight and fit securely in the housings, and connect directly to existing electrical wiring.

4. Visors.
Use aluminum alloy visors of either tunnel type or cap type. Include anti-sun phantom feature on signal heads.

5. Surface Finish.
Finish all surfaces with two coats of baked enamel. Oven bake the finish coat and ensure it meets Federal Specification TT-E-489. Paint the door and visors dull black. Mold the required color in the polycarbonate units.

B. Programmed Units.

1. Signal Visibility.
Erect and place the lens's color position to meet the requirements of the MUTCD and provide signal colors that meet the ITE Transmittance and Chromaticity Standard. Provide a signal unit that projects the desired signal so it is visible only to the lane of traffic it controls and permits the projected image to be seen; or is veiled from view anywhere in an area up to 15 degrees on either side of the centerline of the projected image.

2. Optical Limiter.
Use an optical limiter that projects the signal image to a distance between 900 and 1,200 feet and provides a veil or mask that can be applied to limit visibility of the image to a specific lane of traffic. Construct the limiter of heat resistant glass.

3. Intensity Controller.
Construct the intensity controller:

- With an integrated, directional light-sensing and regulating device interposed between lamp and line wires;
- To be compatible with the 60 hertz input and responsive within the range of 105 to 135 volts; and
- To provide a nominal terminal impedance of 1,200 ohms open circuit and corresponding holding current, and phase controlled if desired.

4. Material Composition.
Use die cast aluminum parts that meet ITE alloy and tensile requirements and have a chromate preparatory treatment. Use sheet metal parts including visors and backplates that meet ITE material requirements and include a chromate preparatory treatment.

Furnish the exterior of the signal case, lamp housing, and mounting flanges with high quality baked enamel prime and finish paint. Provide an optical black lens holder and case interior. Predrill the signal case and lens holder for backplates and visors. Paint the backplates, visors, and batten plates dull black.

Provide hinge and latch pins that are stainless steel. Seal all access openings with weather-resistant rubber gaskets.

5. Installation.
Equip the signal to mount to standard 1.5-inch fittings. Provide the signal section with an adjustable connection permitting incremental tilting from 0 degree to 10 degrees above and below the horizontal while maintaining a common vertical axis through couplers and mounting.

Construct the terminal connection to permit external adjustment about the mounting axis in 5-degree increments.

Use attachments such as visors, backplates, or adapters that conform to and readily fasten to existing mounting surfaces without affecting water and light integrity of the signal.

896.07 PEDESTRIAN SIGNALS

A. Two-Piece Pedestrian Signals.

1. Housings.

Use a pedestrian signal with a two section UPRAISED HAND symbol (symbolizing DON'T WALK) and WALKING PERSON symbol (symbolizing WALK). Use filled symbols and do not use the outline-symbol type indication. Construct the signal so the upper section displays the UPRAISED HAND symbol, and the lower section displays the WALKING PERSON symbol.

In pedestrian heads, use LED module conforming to the ITE "Pedestrian Traffic Control Signal Indications – Part 2: Light Emitting Diodes (LED) Pedestrian Traffic Signal Modules".

Use manufactured pedestrian signal housings that conform to the ITE "Pedestrian Traffic Control Signal Indications".

Provide a dust-free and weather-tight signal with molded gaskets between all component parts. Use stainless steel for all screws, fasteners, and metal parts.

Fit the two sections rigidly and securely together without a spacer. Make all sections identical and interchangeable. Mount the signal on 1.5-inch signal brackets.

Make each rectangular section a one-piece:

- Aluminum alloy die casting; or
- Polycarbonate resin material.

Provide two sets of internal bosses in each section for horizontal mounting or terminal strip facilities. Provide each section with an integrally-cast, serrated locking ring that will permit the rotation of the signal head in 5-degree increments.

Locate two hinge pin openings on the left side of each housing, and two noncorrosive inserts internally on the right side of each housing.

2. LED Module.

Install LED modules into pedestrian-signal housings that fit securely in the housings and connect directly into the existing wiring. Provide weather tight LED modules.

Provide an LED module for installation into an existing pedestrian-signal housing that:

- Only requires the removal of the existing optical unit components;
- Is weather tight;
- Fits securely in the housing; and
- Connects directly into the existing wiring.

For new installations, determine the minimum size of the message-bearing surface of a module by the length of the intended crosswalk, but in no case shall it be less than 9 inches by 9 inches. Size the message bearing surface in accordance with the minimum

dimensions given in Table 1, ITE Pedestrian Traffic Control Signal Indications, “Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules”.

Use an LED Signal Module capable of replacing the optical components of the pedestrian indication. Design the configurations of the walking person icon and the hand icon in accordance with Figure 1 and Figure 2, respectively, of ITE Pedestrian Traffic Control Signal Indications, “Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules”, latest edition.

3. **Visors.**
   Use aluminum alloy or polycarbonate resin tunnel type visors. Use signal heads that contain an anti-sun phantom feature.

4. **Surface Finish.**
   Finish all surfaces with two coats of oven-baked enamel. Paint the final coat of the door and visors dull black. Use paint that meets Federal Specification TT-E-489. Do not paint fastening devices. Mold the required color in the polycarbonate units.

B. Pedestrian Countdown Signal Head.
Furnish and install an LED pedestrian signal meeting the requirements of Light Emitting Diodes (LED) Pedestrian Traffic Signal Modules of the ITE. Furnish and install a countdown timer module. Use a filled-symbol type pedestrian signal. Do not use the outline-symbol type.

Use one of the following models of pedestrian signal, or an approved equal:

1. GE Lighting Solutions, GT1 LED Countdown Pedestrian Signals, 16 inches by 18 inches.

2. National Sign and Signal Co., Inc., 16 inches by 17-3/4 inches LED Pedestrian Signal and Count Down Timer Kit-16-inch Hand Man With 7-inch numerals.

Equip the pedestrian signal with a tunnel type visor.

896.08 PEDESTRIAN PUSH BUTTON POST AND BUTTON

Use a steel post that meets AASHTO 270, Grade 36.

Use die-cast aluminum for the push button housing.

Provide a push button assembly that is tamperproof and weatherproof to prevent electrical shock to the user under any weather conditions.

Provide a pedestrian push button that can be raised from or flush with its housings and is a minimum of 2 inches in the smallest dimension. Use a push button that requires no greater than 5 pounds to activate.

Provide one spare pedestrian push button assembly per intersection.

896.09 SURGE PROTECTION

A. Feed Point.

Install a lightning protection device on the feed point incoming lines to prevent lightning surges entering through the wiring from damaging electrical wiring and control equipment in the controller cabinets. Use a weatherproof lightning protection device that immediately drains lightning surges harmlessly to ground without maintenance. Install the lightning protection device in the knockout on the switch box.

Use a lightning protection device that is a two-pole, three-wire device designed for single-phase 120/240 volt three-wire grounded neutral service. Use tinned copper No. 14 AWG for all leads.

Provide a lightning protection device capable of:

1. Limiting the surge voltage to 3 kilovolt peak;

2. Conducting surge currents of at least 10 kiloamperes with an 8 by 20 microseconds (time to crest by time to second half-crest) waveform; and

3. Recovering to its former state after the surge is over, when the device is receiving power.

Provide an AC suppressor that meets ANSI C 621.1/IEEE, Standard 28, paragraphs 7.1 and 7.6, and that has a peak voltage that will not exceed 3 kilovolt when tested according to paragraphs 7.3 and 7.5 of the ANSI/IEEE Specification.

Install the AC line surge protector on the load side of the circuit breaker. Provide a circuit breaker that opens to give maximum protection if the protector should fail and short the circuit. Give the AC neutral the same protection as the AC load. Keep the arrester leads as short as possible. Make grounds directly to the cabinet wall or ground plate as near as possible to the object being grounded.

The Engineer will allow bringing the AC power into the cabinet via an underground conduit.

Make connections from the ground rod to the objects inside with AWG No. 8, or larger, copper wire.

B. Controllers.

Install a lightning protection device at each interconnect wire terminal connection on the cabinet terminal strip. Install a lightning protection device on the incoming power lines to prevent lightning surges entering and damaging electrical wiring and control equipment. Use a lightning protection device that does the following:

1. Clamps the surge to as low a voltage as possible, ideally to about twice the peak operating voltage of the circuit being protected.

2. Capable of conducting a surge current of at least 1,000 amperes at an 8 by 2 microseconds waveform without damage to itself.

3. Capable of dissipating at least 40 joules of energy without damage to itself.

4. Capable of suppressing six surges in rapid (1 second) succession as described in 1, 2, and 3 above without degradation of performance.

Install the interconnect line suppressors as close as possible to the point where the lines enter the controller cabinet. The Engineer will allow the use of surge suppressors packaged in one unit if the suppressors meet the performance requirements listed above. Keep the suppressor leads as short as possible.

896.10 CONTROLLER CABINET

Provide a control cabinet that meets the requirements of NEMA TS 2 Traffic Controller Assembly with NTCIP Requirements Section 7, except as follows:

1. Provide cabinets that are constructed entirely of aluminum. Ensure all hinges, lock nuts, and any other moving parts, are free and operate easily without damage to the gasketing.

2. Size the base mounted cabinet to provide space for the housing of all equipment specified as well as future coordination equipment. Construct the cabinet to be a minimum of 52 inches high, 44 inches wide, and 24 inches deep.

3. Provide a metal weatherproof cover that blocks air flow in cold weather, and adequately covers the fan vent assembly and the louver on the door. Install a gasket to the cover and attach the cover to the inside of the cabinet. Construct the cover of the same material as the cabinet.

   Provide a weep hole in the bottom loop on each end of the cabinet full-size door.

   Build the cabinet to contain the following items:

   - All items of control equipment specified in these Specifications.

   - Provide a thermostatically controlled minimum 250-watt strip-type heater mounted on the full-size door cover with a protective wire-mesh shield installed around the heater. Use a heavy-duty thermostat capable of being set within a temperature range of 30°F to 90°F.

   - Provide an electrical three-prong twist lock-type plug between the switch and the heater. Mount the heater thermostat on the auxiliary switch panel. Make the connection to the heater with stranded copper wire having 200°C insulation and non-insulated, solderless terminals.

   - Provide a minimum of two quad receptacles. Please one receptacle in the top right of the cabinet and the other in the top left. Fuse the receptacles ahead of the main circuit breaker.

   - Provide a switched lamp socket or LED light strip within the cabinet. Fuse the light source ahead of the main circuit breaker.

- Include the following in the maintenance switches inside the cabinet:
  - Stop time control.
  - Timer power.
  - Flash.

4. Use load switches and flasher with sockets that meet the requirements of NEMA TS 2 Traffic Controller Assembly with NTCIP Requirements Section 6. Supply load switches that have two LED indicators (input and output) per circuit.

   Provide the number of solid-state load switches required to operate the intersection. Provide one spare solid-state load switch, separately packaged, and marked.

5. Two radio interference filters with surge protectors, each rated at nominal AC 120 volts, 60 hertz, and minimum 30 amperes or greater based on load, with one filter and surge protector in the main automatic operation circuit and the other in the main flashing operation circuit.
7. Include two surface-mounted main circuit breakers with no back wiring in the cabinet. Use one breaker to carry the load during automatic operation and the other breaker to carry the load during flashing operation.

   Use single pole, 120/240-volt, 60 hertz, and 30 maximum ampere based breakers on the load. If the signal circuit load during automatic operation exceeds 30 amperes, use a three-pole common trip circuit breaker with 30 ampere rating for each pole or a single 60-amp breaker on that circuit. Split the signal bus load and equally divide it between the two poles. If the flash load exceeds 30 amperes, use a 30 ampere two-pole breaker with split flash on that circuit. Clearly mark each circuit breaker with “ON” and “OFF” positions and identify with the load which it is carrying (“AUTO” or “FLASH”).

9. Place a diagram sticker on the inside door of the controller cabinet.

10. Provide the following spare parts separately packaged and marked.
    - Solid-state Load switch;
    - Bus Interface Unit (BIU)

11. Install a UL-listed Plexiglass shield around the incoming power terminals or cover the incoming power terminals with a UL-listed silicon.

12. Place dust plugs in all components that that are open or unused.

896.11 CONTROLLER

Use a solid-state controller with front panel access to display cycle length, offset, and internal timing values. Provide access to these timing functions by keyboard entry as an integral part of the controller. Use a controller that meets NEMA environmental and electrical performance standards and has a liquid crystal display with:

- A minimum of 4 lines with 40 characters per line;
- A 16-range adjustment of contrast control; and
- A backlight that automatically turns off 10 minutes after the last key is pressed.

Use a display and keyboard that are functional over the temperature range of -34°F to 165°F.

1. Equip the controller with solid state signal load switching devices meeting NEMA requirements. Furnish load switches with indicator lights on the front panel.

2. Furnish each controller with a malfunction manager unit conforming to NEMA performance standards.

3. Furnish the controller with extra feature wiring to provide for remote flashing. Provide each wire with its own terminal connection. Use a flash control circuit to ensure that remote transfer to flashing from normal stop and go operation occurs during the No. 1 interval in the cycle. Provide a signal switching mechanism that is inoperative when the controller is in flashing condition.

4. Use load switches for pedestrian indications. Include cabinet wiring, load switch sockets, and connection facilities for pedestrian movements permissible.

Provide a technician trained in the operation of the controller to provide training at the time of signal activation for a minimum of two consecutive days.

Furnish a controller that meets current NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements.

896.12 LOOP DETECTOR AMPLIFIERS

Provide loop detector amplifiers that meet NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements.

Provide a self-tuning loop detector amplifier meeting Section TS 1-15.2.20.2 of NEMA Standards, Part 15.

896.13 RAILROAD PRE-EMPTION

Include all equipment and material required for railroad pre-emption in the controller cabinet. Use a rack switch for activating the railroad pre-emption that is normally closed.

896.14 EMERGENCY VEHICLE PRE-EMPTION

A. General.

Design the system to consider all possible conditions of priority control. Make software and hardware changes in the traffic controller if necessary. Design the controller so the indicator light is not illuminated until both conditions are met:

- Emergency phase is green; and
- Phase selector has registered a pre-emption call.

B. Certificate of Compliance.

In addition to the requirements in Section 106.01 C, “Certificate of Compliance”, submit a Manufacturer’s CoC for the pre-emption system components that includes the following:

1. Acquire all relevant controller information.

2. The number of vehicle phases (greens).

3. The desired greens for priority approaches.

4. The ring configuration of each controller.

5. The established pedestrian phase timing requirements.

6. The established minimum green times for non-priority phases.

7. The established manipulation method of each controller type.

8. A copy of the interface information that was supplied to installer.

9. A copy of the system checkout that the supplier assisted with prior to purchaser's acceptance by:
   - Verifying proper installation per recommended interfaces;
   - Verifying that optical ranges are properly set; and
   - Verifying that phase selector timings or controller software timings are properly set.

Include a certification in system checkout requirements when using the plug-in version of phase selector that when two plug-in units are used, the controller must recognize high frequency over low frequency and first-come, first-served.

Include a certification from the manufacturer of the pre-emption system components that the optical system cable has been tested and meets matched component system performance.

C. Optical Detector.

Provide a weatherproof optical detector capable of sensing and transforming pulsed optical energy into electrical signals usable by the phase selection equipment that:

- Is of high-impact polycarbonate construction with non-corrosive hardware;
- Is designed for mounting at or near an intersection on mast arm, pedestal, pipe, or span wire;
- Allows aiming of the two optical sensing inputs for skewed approaches or slight curves;
- Has a built-in terminal strip to simplify wiring connections;
- Receives power from the phase selector and is operational from 16 to 40 unregulated DC volts;
- Is responsive to the optical emitter at a distance of 1,800 feet;
- Can provide the necessary electrical signal to the phase selector through up to 1,000 feet of optical detector cable; and
- Employs a replaceable circuit board assembly and photocells to facilitate repair.

D. Optical Detector Cable.

1. Provide a cable that delivers:
   - The necessary quality signal from the optical detector to the phase selector over a non-spliced distance of 1,000 feet; and
   - Sufficient power to the optical detector over a non-spliced distance of 1,000 feet.

2. Provide cable that can be installed using one of the following methods:
   - Direct burial;
   - Conduit and mast arm pull; and
   - Exposed overhead (supported by messenger wire).

3. Provide cable with the following characteristics:
   - Weight does not exceed 0.04 pounds per foot;
   - Outside diameter does not exceed 0.3 inches;
   - Insulation rating is a minimum of 600 volts; and
   - Temperature rating is a minimum of 80° C.

4. Provide cable that has three conductors of AWG No. 20 7/28 stranded, individually tinned, copper color coded as follows:
   - Orange for delivery of optical detector power (+);
   - Blue for optical detector power return (-); and
   - Yellow for optical detector signal.

5. Provide conductors that are shielded with aluminized polyester and have an AWG No. 20 7/28 stranded and individually tinned drain wire to provide signal integrity and transient protection.

6. Use a shield wrapping with a 20 percent overlap to ensure shield integrity following conduit and mast arm pulls.

E. Phase Selection Equipment.

1. Use a priority control system manufactured to interface with, solid-state controllers with or without internal priority control capability, and Type 170 controllers with internal priority control software.

2. If using internal pre-empt controllers, use phase selectors:

   a. With a plug-in, two channel, dual priority device intended to be installed directly into the input file of internal preempt controller equipped with priority phase selection software;

   b. Powered from AC mains and contain an internal, regulated power supply to power optical detectors;

   c. Capable of recognizing the following pulse rates as delivered by the optical detectors:
      (1) Between 9.520 and 9.758 hertz as Frequency I; and
      (2) Between 13.780 and 14.290 hertz as Frequency II.

   d. With primary optical detector inputs and power outputs on the card edge. Provide two additional detector inputs, per channel, via a front panel connector;

   e. With an opto-isolated output that provides the following signals to the card edge:
      (1) Between 6.23 and 6.27 hertz pulse in response to a low frequency signal; and
      (2) A “Steady-On” in response to a high frequency signal.

f. That use a crystal controlled timing and optical pulse rate recognition circuitry to ensure:
   (1) Accurate optical signal (dual frequencies);
   (2) Synchronous logic;
   (3) Precise output pulse; and
   (4) Accurate call drop-out time.

g. Having six recessed range controls per channel, three per frequency, to independently adjust optical sensitivity;

h. Having a solid-state “Power-On” indicator;

i. Having a “Frequency I” and “Frequency II” solid-state indicator for each channel that performs as follows:
   - Flashing during call validation; and
   - Be steady-on when processing a valid call and during test switch operation.

j. Having a test switch for each channel to deliver Frequency I or Frequency II signal pulse rates to verify proper function at both optical emitter flash rates, first-come, first-served operation, and Frequency II override capability;

k. That can be set to a call dropout time of either 5 or 10 seconds. The call dropout time tolerance shall be at least the selected time and up to 2.5 percent longer than the selected time.

l. That will identify a Frequency II demand with any combination of up to 10 high and low priority emitter signals being received simultaneously and asynchronously on either channel; and

m. That do not exceed the following dimensions:
   - Length including handle 7.91 inches;
   - Width 1.11 inches; and
   - Height 4.50 inches.

F. Reliability.

Supply equipment for the optical priority remote traffic control system intended for use in the controller cabinet that meets the electrical and environmental specifications in the NEMA TS 2 Traffic Controller Assemblies with NTCIP Requirements.

G. Training.

Provide a technician trained in the operation of the priority control systems to provide training at the time of activation and available for a minimum of two consecutive days.

Provide training to the emergency vehicle operators in the operation of the system that includes introductory training, periodic training updates, and a leave-behind audio visual self-instruction course for on-going training.

Provide training in routine maintenance of the system.

Provide manufacturer's technical support that includes technical service, design engineering, manufacturing engineering, and research engineering for system development, process management of priority control components, and in-depth training of system users.

896.15 SPAN WIRE

Use a span wire that is a double galvanized seven-strand steel wire cable not less than 3/8 inch in diameter meeting ASTM A 475.

896.16 STABILIZATION WIRE

Use a stabilization wire that is a double galvanized seven-strand steel wire cable not less than 1/8 inch in diameter meeting ASTM A 475.

896.17 SERVICE POLE

Treat Class II wood service poles as specified in Section 846, "Preservatives and Pressure Treatment Processes for Timber".