Georgia Department of Transportation

Supplemental Specifications Modifying the 2021 Standard Specifications Construction of Transportation Systems

2024 Edition

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Supplemental Specifications Construction of Transportation Systems

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Modifying the Standard Specifications, 2021 Edition

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The Standard Specifications for the Construction of Transportation Systems, dated January 21, 2021 shall be modified and expanded in accordance with the revisions, deletions, and additions contained herein.

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Section 102—Bidding Requirements and Conditions

Replace Section 102 with the following:

102.01 Prequalification of Bidders

Before submitting a bid in excess of $2,000,000, the Bidder shall have been prequalified with the Department and received a Certificate of Qualification in accordance with the Rules and Regulations approved and adopted by the State Transportation Board. Bidders submitting bids of $2,000,000 or less shall have been registered with the Department. In addition, the aggregate total amount a Bidder may have under contract shall not exceed the Current Capacity of the Bidder.

Bidders intending to consistently submit Proposals shall prequalify at least once every two years. However, qualifications may be changed during that period upon the submission of additional favorable reports or upon unsatisfactory performance. In addition, the Department reserves the right at any time to require the Contractor to furnish a current financial and experience statement.

102.02 Competency of Bidders

The Department may limit the amount of work awarded to any Contractor, based on the information furnished the Department in the Prequalification process. The Department may also limit the aggregate amount of work awarded to any non-prequalified Contractor.

The Department may refuse any Contractor Proposals to bid on additional work if the Contractor is behind schedule on work he has with the Department, as determined from the Progress Schedule called for in the Specifications. This refusal will apply to all applications for Proposals, made in the name of an individual, firm, partnership, or corporation with which the delinquent Contractor is affiliated.

102.03 Contents of Proposal Forms

The Department will make available to the prospective Bidder a Void for Bidding Proposal Form which may be accessed on the Office of Construction Bidding Administration web page. This form will state the location and description of the contemplated construction and will show the approximate estimate of the various quantities and kinds of work to be performed or materials to be furnished and will have a schedule of Items for which Unit Bid prices are invited. The Proposal Form will state the time in which The Work must be completed, the amount of the Proposal Guaranty, and the date of the opening of Proposals. The Form will also include any Special Provisions or requirements that vary from or are not contained in the Specifications. Also included with each Proposal Form will be a Non-Collusion Certificate, Construction Contractors Bid Opportunity List, and Request for Eligibility to Bid. All papers contained in the Proposal Form are considered a part thereof and must not be detached or altered. The Plans, Specifications, and other documents designated in the Proposal Form will be considered a part of the Proposal whether attached or not.

102.04 Interpretation of Estimates

The quantities of work to be performed and materials to be furnished to complete the construction of The Work as shown on the Plans and contained in the Proposal are approximate and are to be used for comparing Bids. The Department does not guarantee that the quantities indicated on the Plans or given in the Proposal will be the actual construction quantities. The Contractor shall not plead deception or misunderstanding because of variation from these quantities or minor variations from the locations, or character of the Work. Payment to the Contractor will be made only for the actual quantities of work performed in accordance with the Plans and Specifications. If, when construction is completed, the actual quantities are more or less than the quantities given in the Proposal, the Unit Prices Bid in the Proposal will still prevail, except as otherwise provided in Subsection 104.03 and Subsection 109.05.

102.05 Examination of Plans, Specifications, Special Provisions, and Site of the Work

The Bidder is expected to examine carefully the site of the proposed work, the Proposal, Plans, Specifications, Supplemental Specifications, Special Provisions, and Contract forms before submitting a Proposal. The submission of a Proposal shall be considered prima facie evidence that the Bidder has made such examination and is satisfied as to the conditions to be encountered in performing The Work and as to the requirements of the Plans, Specifications, Supplemental Specifications, Special Provisions, and Contract.

It is the obligation of the Bidders to make their own interpretation of all subsurface data that may be available as to the nature and extent of the materials to be excavated, graded, or driven through. Such information, if available and furnished to the Bidders by the Department, does not in any way guarantee the amount or nature of the material which may be encountered.

102.06 Preparation of Proposal

The Bidder shall submit its Proposal on the form furnished by the Department (GDOT). The blank spaces on the Proposal shall be filled in correctly for each Pay Item (except alternate items) and input the Unit Price or a Lump Sum Price as called for in the Proposal for each Pay Item listed therein. In addition, the Bidder shall also show the products of the respective Unit Prices and quantities and the total amount of the Bid by adding the amounts of all Bid Items. In the event of a discrepancy in any of the figures, the Unit Price will govern, and the Bid will be recalculated.

In the case of Alternate items, Unit Prices shall be entered for only one alternate.

The Non-Collusion Certificate on the Department's standard form included in the Proposal shall be executed.

The Certificate of Current Capacity shall be executed under oath and substantiated by the report of Status of Contracts on Hand.

The Construction Contractors Bid Opportunity List standard form shall be completed with the required information.

The Georgia Security and Immigration Compliance Act Affidavit shall be completed with the required information.

The Bidder shall notify the GDOT Office of Construction Bidding Administration by transmitting the completed Request for Eligibility to Bid Form D. O. T. RFETB for each Letting Call Order Number in which the Bidder intends to submit a bid by no later than 12:00 p.m. the day preceding the letting.

The Bidder's Proposal shall be signed by Digital Signature by the individual, by one or more members of a partnership, or by one or more of the officers of a corporation, whichever is applicable. In the event of a joint venture, the Proposal shall be signed by Digital Signature by each individual involved, by each partnership through one or more of its members, or by each corporation through one or more officers of the corporation, whichever is applicable. Proposals not properly signed may be disqualified and rejected.

All bids shall be submitted using the GDOT/AASHTO (American Association of State Highway and Transportation Officials) AASHTOWare Project Bids™ Bid Component (Project Bids) software. When submitting a bid electronically, the Bidder's Proposal shall consist of the Bid pages generated by the Project Bids software including the General page, Schedule of Items page, Disadvantaged Business Enterprise (DBE) List page (if applicable), Certifications FE page and the Bid Bond page. By submitting a bid electronically, the Bidder acknowledges all requirements included in the proposal, amendments, plans, Standard Specifications, Supplemental Specifications, and Special Provisions are a part of the Bid and Contract.

The electronic bid shall be submitted by the following method:

A. Electronic Bid Submission via the Internet and Bid Express™.

(Note: The Bidder shall secure an account and a valid Digital ID from Bid Express™ (www.bidx.com) in order to use this method.

Instructions for preparing and submitting bids by this method are as follows:

1. Access to the electronic bidding information is available on Bid Express™ at www.bidx.com and the GDOT Construction Bidding Administration website at http://www.dot.ga.gov/PS/Business/Contractors.
2. Before running the electronic bidding programs, the Bidder shall read the on-line help documentation for the AASHTOWare Project Bid™ software.
3. Zero (0) is considered to be a valid bid. The Bidder shall not enter 0 in any Unit Price field unless zero is the intended bid for that item.
4. All addenda shall be included in the electronic bid submitted.
5. “Joint Bids” are allowed with Electronic Bid Submission via the Internet and Bid Express™
6. The Bidder shall select tools and then check bid from the AASHTOWare Project Bid™ menu to check the bid and assure there are no errors prior to submitting the electronic bid. The electronic bid may be changed and resubmitted electronically to Bid Express™ as many times as desired prior to the advertised cutoff time specified in the Notice to Contractors. The last bid submitted for a given Letting Call Order Number prior to the cutoff time will be the Bid.
7. The Bidder shall make no claim against the Department in the event it is unable to submit its bid to Bid Express™ and/or Bid Express™ is unable to submit the bid(s) to the Department. The Department reserves the right to postpone the public reading of bids in the event of technical difficulties.

B. Proposal Guaranty and Power of Attorney via the Internet and Bid Express™.

A fully executed Proposal Guaranty and Power of Attorney for each Letting Call Order Number bid shall be submitted and verified via the Internet and Bid Express™ by the time and date set in the Notice to Contractors for submission of Proposals.

The Proposal Guaranty for a “Joint Bid” shall include the names of all Joint Venture parties involved in the bid.

102.07 Rejection of Proposals

Proposals may be rejected as irregular if their consideration is conditioned upon the acceptance or rejection of other Proposals submitted by the same Bidder, if the Georgia Security and Immigration Compliance Act Affidavit is not completed, if the Request For Eligibility To Bid D.O.T (Form RFETB) has not been submitted, if the Certificate of Current Capacity is not executed under Oath and substantiated, if a Unit Price is not shown for each Pay Item, or if they fail to comply with the Electronic Bidding System (EBS) bidding requirements. In the case of alternate items, Unit Prices shall be entered for only one alternate. The Department reserves the right to disqualify and reject any Proposal that is not properly signed in accordance with the requisite of Subsection 102.06.

A. Collusion

Any and all Proposals will be rejected if the Department believes that collusion exists among the Bidders and no participant in such collusion may submit future Proposals for the same work. The Department reserves the right to review and to refuse to consider any Proposal if the Bidder fails to execute the Non-Collusion Certificate.

B. Single Proposals

Only one Proposal from any person, partnership, or corporation under the same or different names shall be submitted on any Project.

C. Unbalanced Bids

Proposals may be rejected if any of the Unit Prices are obviously unbalanced. The Department will decide whether any Unit Prices are unbalanced either excessively above or below a reasonable cost analysis value determined by the Engineer, particularly if these unbalanced amounts are substantial and contrary to the interest of the Department.

D. Omissions and Alterations

Proposals may be rejected as irregular if they show any omissions, alterations of form, additions or conditions not called for, unauthorized alternate bids, erasures or changes not initialed, or other irregularities.

E. Debts

The Department reserves the right to reject Proposals from Bidders who have not paid or satisfactorily settled all legal debts due on other Contracts at the time Proposals are received.

F. Technicalities

The Department reserves the right to reject any and all Proposals and to waive technicalities at any time before the Contract has been signed by the Department.

G. Non-Prequalified Bidders

Proposals submitted in excess of $2,000,000 by non-prequalified contractors under Rule 672-5 of the Department's Rules and Regulations Governing the Prequalification of Prospective Bidders will be disqualified and rejected.

H. Failure to List Disadvantaged Business Enterprise (DBE) Participants

If the contract has an established DBE goal, the Department reserves the right to reject and disqualify any proposal if the bidder has failed to list bona fide DBE participants with sufficient participation to achieve at least the established goal. The Department may consider for award a proposal with less participation than the established goal if both:

- The bidder can demonstrate that no greater participation could be obtained and;
- The participation proposed by the low bidder is not substantially less than the participation proposed by the other bidders on the same contract.

I. Failure to Submit Georgia Security and Immigration Compliance Act Affidavit

No Proposal will be considered without submission of the completed Georgia Security and Immigration Compliance Act Affidavit for each Letting Call Order.

J. Failure to Submit Request For Eligibility To Bid

No Proposal will be considered without submission of the completed Request for Eligibility To Bid Form for each Letting Call Order

102.08 Proposal Guaranty

No Proposal will be considered unless it is accompanied by a Proposal Guaranty of the character and in an amount not less than the amount indicated in the Proposal. Each bid submitted must be accompanied by a separate Proposal Guaranty. No Proposal Guaranty will be considered to cover any Bid except the one to which it is attached and verified for.

102.09 Delivery of Proposals

Each Proposal, together with the Proposal Guaranty, shall be submitted in a sealed envelope so marked as to identify its contents without being opened (See Section 102.06.A), unless submitted electronically via the Internet and Bid Express™ (See Section 102.06.B). Proposal forms are not transferable. Proposals will be received until the time and date set in the Notice To Contractors and shall be in the hands of the officials indicated by that time. Proposals received after the advertised cutoff time established for submission of Proposals will be returned unopened to the Bidder.

102.10 Withdrawal or Revision of Proposals

Any Bidder may withdraw their Proposal prior to the advertised cutoff time specified via the Internet and Bid Express™, by using the AASHTOWare Project Bid™ software. Instructions on how to do so is included in the on-line help documentation for the AASHTOWare Project Bids™ software.

102.11 Public Bid

Bid results will be posted and available on Bid Express™ at www.bidx.com and the GDOT Construction Bidding Administration website at http://www.dot.ga.gov/PS/Business/Contractors at the time specified in the Notice to Contractors.

102.12 Material Guaranty

The Department reserves the right before the Contract is awarded to require the Bidder to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work, together with samples, which may be subjected to the tests provided for in the Specifications to determine their quality and fitness for the work.

102.13 Combination or Conditional Proposals

If the Department so elects, proposals may be issued for projects in combination and/or separately, so that bids may be submitted either on the combination or on separate units of the combination. The Department reserves the right to make awards on combination bids or separated bids to the best advantage of the Department. No combination of bids, other than those specifically set up in the proposals by the Department, will be considered. Separate contracts will be written for each individual project included in the combination.

Conditional proposals will be considered only when so stated in the special provisions.

102.14 Landscape Projects

Only qualified Landscape Contractors shall submit bids for Landscape Projects. Qualifications required are as follows:

1. The Contractor shall ensure that all nursery stock used on this project is obtained from a State certified nursery. All work done by the Contractor on this project shall be done under the direct supervision of a licensed nurseryman.
2. The Contractor shall have a certified pesticide operator's license for the State of Georgia and shall furnish evidence of such with the bid.
3. The Contractor shall have satisfactorily executed landscape plantings of a similar nature and shall furnish with this bid a certified statement of such compliance.

102.15 Submittal of "Georgia Security and Immigration Compliance Act Affidavit"

The Apparent Low Bidder for each Letting Call Number shall submit the completed "Georgia Security and Immigration Compliance Act Affidavit" to the GDOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope or an executed copy of the affidavit can be emailed to biddingadmin@dot.ga.gov by 12:00 noon on the first working day after the Bid Opening as a matter of Bidder responsibility.

If the "Georgia Security and Immigration Compliance Act Affidavit" is not delivered or emailed to the GDOT Office of Construction Bidding Administration by 12:00 noon on the first working day after the Bid Opening, the Bid will be subject to rejection.

102.16 Submittal of "Request For Eligibility To Bid"

All Bidders for each Letting Call Number shall submit the completed "Request For Eligibility To Bid Form D. O. T. RFETB" to the GDOT Office of Construction Bidding Administration, Room 1113, by no later than 12:00 p.m. on the day prior to the Bid Opening.

If the "Request for Eligibility To Bid Form D. O. T. RFETB" is not received by the GDOT Office of Construction Bidding Administration, Room 1113, by no later than 12:00 p.m. on the day prior to the Bid Opening, the Bid will be subject to rejection.

102.17 Submittal of "Certificate of Current Capacity" and "Status of Contracts on Hand"

The apparent low Bidder for each Letting Call Number shall submit the executed "Certificate of Current Capacity" and the "Status of Contracts on Hand" to the GDOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 p.m. on the first working day after the Bid Opening.

If the "Certificate of Current Capacity" and the 'Status of Contracts on Hand" are not delivered to the GDOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 p.m. on the first working day after the Bid Opening, the Bid may be subject to rejection.

102.18 Submittal of "Construction Contractors Bid Opportunity List"

All Bidders for each Letting Call Number shall submit the completed "Construction Contractors Bid Opportunity List" to the GDOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 p.m. on the third working day after the Bid Opening as a matter of Bidder responsibility.
If the "Construction Contractors Bid Opportunity List" is not delivered to the GDOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 p.m. on the third working day after the Bid Opening, the Bid may be subject to rejection.

102.19 Specialty Items Exempt from Prequalification of Bidders

The following items designated as Specialty Items for general transportation system construction and building construction, according to the provisions of Subsection 108.01, are exempt from the Prequalification of Bidders requirement stated in Subsection 102.01:

A. Utility items

Where a Contractor or Subcontractor has been approved to complete required utility work by the utility owner and such approval has been adequately demonstrated to the Department, Prequalification by the Department is not necessary for said utility work. Where approval is not required by the utility owner, the Contractor or Subcontractor must be prequalified by the Department.

B. Intelligent Transportation Systems (ITS)

Where the Contractor or Subcontractor supplies the Department with the required letter(s) of reference, the specific requirements concerning the number and nature of the letter(s) of reference to be set forth in more detail in the advertisement. ITS is defined to mean technologies and services which improve transportation safety, efficiency and mobility by integrating advanced technologies into vehicles and infrastructure. ITS can include but is not limited to a conduit system, fiber optic cable, dynamic message signs (DMS), video detection systems (IVDS), microwave vehicle detection systems (MVDS), closed circuit television (CCTV) cameras, Weather Monitoring and Reporting System (WMRS), communications electronics, communication network hubs electrical power service, and additional material as required to complete the installation.

C. Connected Vehicle (CV)

Where the Contractor or Subcontractor supplies the Department with the required letter(s) of reference, the specific requirements concerning the number and nature of the letter(s) of reference to be set forth in more detail in the advertisement. CV is defined to mean technologies including equipment, applications, or systems that use vehicle-to-infrastructure (V2I) or vehicle-to-vehicle (V2V) short range communications which address safety, system efficiency, or mobility on our roadways. CV can include but is not limited to Roadside Units (RSUs), Cabinet, Pole, communications electronics, pull boxes, fiber drops, fiber optic cable, conduit system and additional material as required to complete the installation.

Section 105—Control of Work

Replace Section 105 with the following:

105.01 Authority of the Engineer

The Engineer will decide all questions that may arise as to the quality and acceptability of materials furnished, work performed, and the rate of progress of the Work; the interpretation of the Plans and Specifications, and all questions as to the acceptable fulfillment of the Contract on the part of the Contractor. The Engineer will determine the quantities of the several kinds of work performed and materials furnished which are to be paid for under the Contract and his determination shall be final.

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

The Contractor may request and will receive written instructions from the Engineer upon any important items.

After the Contract has been executed, and before the Work begins, the Engineer may designate a time and place to hold a Preconstruction Conference with the Contractor. At such time, the Contractor shall furnish the Engineer with a Progress Schedule as provided in Subsection 108.03 unless this schedule has been specifically exempted by Special Provision. The Contractor will also be given a decision on any alternate Traffic Control Plan that he may have previously submitted.

Any matters pertaining to order of work, interpretation of Plans and Specifications, traffic control, utility adjustments, or others, may be discussed at the Preconstruction Conference.

105.02 Plans and Working Drawings

Plans will show details of all structures, lines, grades, typical cross sections of the roadway, location and design of all structures, and a summary of Items appearing in the Proposal.

The Plans will be supplemented by such Working Drawings as are necessary to adequately control the Work. Working Drawings for structures shall be furnished by the Contractor and shall consist of such detailed Plans as may be required to adequately control the Work and which are not included in the Plans furnished by the Department. They shall include stress sheets, shop drawings, erection plans, falsework plans, cofferdam plans, bending diagrams for reinforcing steel or any other supplementary plans, or similar data required of the Contractor. All Working Drawings must be approved by the Engineer before installation of these structures are permitted in the Work, and such approval shall not operate to relieve the Contractor of any responsibility under the Contract for the successful completion of the Work. The Contract Bid Prices shall include the cost of furnishing all Working Drawings.

Working Drawings shall be submitted using the electronic submission process used by the Department. All submittals shall be in portable document format (pdf) unless otherwise stated.

105.03 Conformity with Plans and Specifications

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

Plan dimensions and contract specification values are to be considered as the target values to be strived for and complied with as the design values from which any deviations are allowed. It is the intent of the Specifications that the materials and workmanship shall be uniform in character and shall conform as nearly as realistically possible to the prescribed target value or to the middle portion of the tolerance range. The purpose of the tolerance range is to accommodate occasional minor variations from the median zone that are unavoidable for practical reasons. When either a maximum and minimum value or both are specified, the production and processing of the material and the performance of the Work shall be so controlled that material or work will not be preponderantly of borderline quality or dimension.

In the event the Engineer finds the materials or the finished product in which the materials are used not within reasonably close conformity with the Plans and Specifications, but that reasonably acceptable work has been produced, the Engineer shall then make a determination if the Work shall be accepted and remain in place. In this event, except in cases where the appropriate price adjustments are provided for in the Specifications covering the materials and/or the finished product, a Supplemental Agreement will be executed documenting the basis of acceptance that will provide for an appropriate price adjustment in the Contract Price for such work or materials as the Engineer deems necessary to conform to his determination based on engineering judgement.

In the event the Engineer finds the materials or the finished product in which the materials are used or the work performed are not in reasonably close conformity with the Plans and Specifications, and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

105.04 Coordination of Plans, Specifications, Supplemental Specifications, and Special Provisions

The Standard Specifications, the Supplemental Specifications, the Plans, Special Provisions, and all supplementary documents are essential parts of the Contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work.

In cases of discrepancy, the governing descending order will be as follows:

1. Project Specific Special Provision
2. Project Plans including Special Plan Details
3. Special Provisions
4. Supplemental Specifications
5. Standard Plans included in the Project Plans
6. Standard Plans included in the Construction Standards and Details Book (CS&D Book) as denoted in the Project Plans
7. Standard Specifications

The following words when used herein shall have the following meanings:

Special Plan Details: Special Design or Special Construction Details

Standard Plans: Construction Standards and/or Construction Details

Construction Standards and Details Book (CS&D Book): Annual compilation of the approved Construction Standards and Details for use on projects letting within a calendar year.

Calculated dimensions will govern over scaled dimensions.

The Contractor shall take no advantage of any apparent error or omission in the Plans or Specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the Plans and Specifications.

A. Specifications of Other Organizations

When work is specified to be done or when materials are to be furnished according to the published specifications of organizations other than the Department, the latest specifications published by those organizations at the time bids are received shall apply unless otherwise specified.

AASHTO Interim Specifications and ASTM Tentative Specifications will be considered effective on date of issue.

B. Item Numbers

The first three digits of any Item Number in the itemized proposal designates the Specification section under which the Item shall be constructed.

105.05 Cooperation by Contractor

The Contractor will be supplied with an electronic copy of approved Plans and contract assemblies including Special Provisions. The Contractor shall be responsible for maintaining one set of the approved Plans on the project site at all times.

The Contractor shall give the Work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, Inspectors, and other Contractors in every way possible.

The Contractor shall have access to the Engineer at all times, as his agent, a competent Superintendent, capable of reading and thoroughly understanding the Plans and Specifications, and thoroughly experienced in the type of work being performed, who shall receive instructions from the Engineer or his authorized representatives. The Superintendent shall have full authority to execute orders or directions of the Engineer without delay and to promptly supply such materials, equipment, tools, labor, and incidentals as may be required. Such superintendence shall be furnished irrespective of the amount of work sublet.

The Superintendent shall notify the Engineer prior to starting any Pay Item Work. The Prime Contractor shall coordinate and be responsible to the Engineer for all activities of subcontractors.

105.06 Cooperation with Utilities

The Department will notify all utility companies, all pipeline owners, all railroad companies, or other parties affected of Award of the Contract, giving the name and address of the Contractor, and will assist the Contractor in arranging for all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals, railroad facilities, and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense, except as otherwise provided for elsewhere in the Contract.

It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances in their present location or relocated positions, and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from said utility appurtenances or the operation of moving them. Delays and interruptions to the controlling Item or Items of the Work are covered in Subsection 107.21.G.

It shall be the Contractor's responsibility to plan with each utility owner a schedule of operations which will clearly set forth at which stage of the Contractor's operations the utility owner will be required to perform his removal and relocation work.

105.07 Cooperation Between Contractors

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

When separate Contracts are let within the limits of any one project, each contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the Work being performed by other Contractors. Contractors working on the same project shall cooperate with each other.

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

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others. At the request of the Structure Contractor, the Engineer will designate an area within the right-of-way, adjacent to each structure, to be reserved for use by the Structure Contractor for storage of equipment and materials necessary to construct the particular structure. So long as he occupies this area, the Structure Contractor shall be responsible for its maintenance. The Structure Contractor must relinquish this area, however, as it becomes practical to utilize completed portions of the structure.

105.08 Construction Stakes, Lines and Grades

(Subsection 105.08 Omitted)

105.09 Authority and Duties of the Resident Engineer

The Resident Engineer, regardless of his administrative title, is the Engineer designated by the Department to be the direct representative of the Chief Engineer. The Resident Engineer has immediate charge of the engineering details of each construction project and is responsible for contract administration. Such administration includes the designation of subordinates to represent him and make routine decisions. The Resident Engineer has the authority to reject defective material and to suspend any work that is being improperly performed.

105.10 Duties of the Inspector

Inspectors employed by the Department are authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the Work and to the preparation, fabrication, or manufacture of the materials to be used. The Inspector will not be authorized to alter or waive the provisions of the Contract. The Inspector will not be authorized to issue instructions contrary to the Plans and Specifications or to act as foreman for the Contractor.

105.11 Inspection of the Work

All materials and each part of the detail of the Work shall be subject to inspection by the Engineer.

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

Upon the Engineer’s request, the Contractor, at any time before final acceptance of the project, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the Work to the standard required by the Specifications. Should the Work thus exposed or examined prove acceptable, the uncovering or removing and the replacing of the covering or making good of the parts removed will be paid for as extra work; but should the Work so exposed or examined prove unacceptable, the uncovering, or removing and the replacing of the covering or making good of the parts removed will be at the Contractor's expense.

Any work done or materials used without supervision or inspection by an authorized Department representative may be ordered removed and replaced at the Contractor's expense, unless the Department representative failed to inspect after having been given reasonable notice in writing that the Work was to be performed.

When any unit of government or political subdivision or any railroad corporation is to pay a portion of the cost of the Work covered by the Contract, its respective representatives shall have the right to inspect the Work. Such inspection shall in no sense make any unit of government or political subdivision or any railroad corporation a party to the Contract and shall in no way interfere with the rights of either party hereunder.

105.12 Removal of Unacceptable and Unauthorized Work

All work that does not conform to the requirements of the Contract will be considered unacceptable unless otherwise determined acceptable under the provisions in Subsection 105.03.

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the Work, shall be removed immediately and replaced in an acceptable manner.

Except as elsewhere noted, no work shall be done without lines and grades having been given by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the Plans or as given, except as herein specified, or any extra work done without authority will be considered as unauthorized and will not be paid for under the provisions of the Contract. Work so done may be ordered removed or replaced at the Contractor's expense.

Upon failure on the part of the Contractor to comply forthwith with any order of the Engineer made under the provisions of this section, the Engineer will have authority to cause unacceptable work to be remedied or removed and replaced and to cause unauthorized work to be removed, and to deduct the costs from any monies due or to become due the Contractor.

105.13 Claims for Adjustments and Disputes

Whenever the Contractor asserts or intends to assert a claim for damages or additional compensation, or believes that it is or will be entitled to damages or additional compensation, whether due to delay, acceleration, extra work, changes in the Work or conditions affecting the Work, breach of contract, or other causes, the Contractor shall follow the procedures set forth in this Section. Compliance with the provisions of this Section will be an essential condition precedent to any recovery of damages or additional compensation for damages by the Contractor. No action or inaction by the Department constitutes, or will be deemed to constitute, a waiver of the Contractor's full compliance with the provisions of this Section 105.13 – including but not limited to communications with the Contractor about the claim, receipt of the Notice of Potential Claim or Certified Claim, participation in weekly meetings, auditing of claims, or participation in mediation.

A. Claims for Acceleration

The Department shall have no liability for any constructive acceleration. If the Department gives express written direction for the Contractor to accelerate its effort, then before Contractor incurs any cost for which it will seek compensation, both parties shall execute a Supplemental Agreement as provided in Subsection 104.03.

B. Claims for Delay and All Other Claims Except Acceleration

1. Claims for Delay: The Department shall have no liability for any delay, cost, impact, or damages that occurred more than one week (7 calendar days) prior to submission of the written notice required by Section 105.13.C. Failure of the Contractor to give such written notice within such time will be grounds for denial of the claim.

2. Claim Other than for Delay or Acceleration: For claims other than for delay or acceleration, if the Contractor does not submit the written notice required by Section 105.13.C before beginning the Work, or incurring

costs, out of which such claim arises, then the Contractor hereby agrees that it shall have waived any entitlement to damages or additional compensation for such Work or costs, and that the Contractor shall have no claim therefor.

3. The Department shall have no liability for damages beyond those items that are specifically payable, and only in the amount specifically provided, under this Section.

4. The Department will be liable only for those damages caused by or arising from acts or omissions on the part of the Department that violate the contractual duties owed to the Contractor by the Department hereunder. The Contractor assumes the risk of damages from all other causes.

5. The parties recognize that delays caused by or arising from right-of-way problems, defects in plans or design, redesign, changes in the Work ordered by the Department, the actions of suppliers or other contractors, the shop drawing approval process, injunctions, court orders, or other events, forces, or factors are commonly experienced in highway construction work. Such delays shall not constitute breaches of the Contract by the Department. However, such delays may constitute a basis for a claim for delay damages, but only if permitted under this Section 105.13 and other provisions of the Contract, or a request for a time extension under Section 108.07.E.

6. The term "delay" shall be deemed to mean any event, action, force, or factor that extends the Contractor's time of performance. This Section 105.13 is intended to cover all such events, actions, forces, or factors, whether they be styled "delay," "disruption," "interference," "impedance," "hindrance," "impact," or otherwise. For purposes of computing additional costs or damages permitted under this Section that result from delay, such delay will be limited to the impact to the critical path of the project that solely results from actions or inaction by the Department.

7. The following items, and only the following items, may be recoverable by the Contractor as "damages":

   a. Additional direct hourly compensation actually paid to employees for jobsite labor, including payroll taxes, insurance, benefits, and other reasonable labor burdens actually paid.

   b. Documented costs for materials.

   c. Additional equipment costs, as determined in accordance with this subsection.

   d. Documented costs of extended jobsite overhead, but only for delay claims.

   e. An additional 15 percent of the total of 105.13.A.7.a, b, c, and d, which sum includes the exclusive compensation recoverable for home office overhead and profit.

   f. Bond costs.

   g. Amounts paid to subcontractors, as determined by, and limited to, those items identified as payable under Sections 105.13.A.7.a, b, c, d, e, and f.

8. For purposes of computing additional equipment costs, rates used shall be based on the Contractor's actual experienced cost for each piece of equipment. These rates shall be supported by equipment cost records furnished by the Contractor. No equipment rates will be allowed in excess of 70 percent of the applicable rate stated in the *Rental Rate Blue Book*, with the appropriate adjustments noted in Subsection 109.05.

9. The parties agree that, in any claim for damages or additional compensation, the Department will have no liability for the following items of damages, cost, or expense:

   a. Profit, except as provided in Section 105.13.A.7.e.

   b. Loss of profit.

c. Labor inefficiencies, except as allowed under Subsection 105.13.B.6.

d. Home office overhead, except as provided in Section 105.13.A.7.e.

e. Consequential damages, including but not limited to loss of bonding capacity, loss of bidding opportunities, and insolvency.

f. Indirect costs or expenses of any nature.

g. Attorney’s fees, claims preparation expenses, or costs of litigation.

h. Interest of any nature.

C. Notice of Potential Claim

When the Contractor asserts or intends to assert a claim for damages or additional compensation, or believes that it is or will be entitled to damages or additional compensation, the Contractor shall notify the Engineer in writing of its intent to claim such damages or additional compensation. Such notice shall be given so that the Department may, in its discretion, assess the situation, make an initial determination as to who is responsible, and institute appropriate changes or procedures to resolve the matter. Any Notice of Potential Claim that is submitted to the Department may be denied by the Department at any time after submission. Any Notice of Potential Claim shall contain at a minimum the following information:

a. The nature of the claim and the underlying factual basis

b. The nature of the work affected or to be affected

c. The date of the event or circumstance giving rise to the claim

d. To the extent then available, the expected number of days of delay or impact, if any

e. To the extent then available, all other information or documents set forth in Section 105.13.F.

D. Weekly Meetings.

1. On a weekly basis after submitting a Notice of Potential Claim for delay damages, at the time and place designated by the Engineer, on Monday or the first work day of each week following the date of submitting a Notice of Potential Claim, the Contractor shall meet in person or through any virtual internet platform with the Department’s representative and present the records for the preceding week as detailed in Section 105.13.D.2.

2. At each weekly meeting, the Contractor shall prepare and submit to the Engineer written reports providing the following information:

   a. Potential effect to the schedule caused by the delay.

   b. Identification of all operations that have been delayed or will be delayed.

   c. Explanation of how the Department’s act or omission delayed each operation, and estimation of how much time is required to complete the project.

   d. Itemization of all damages and extra costs incurred and to be incurred, including but not limited to:

      i. An explanation as to how those damages and extra costs relate to the delay and how they are being calculated and measured.

ii. Identification of all labor costs asserted and to be asserted in the claim, including the name of each project employee for whom costs are being compiled.

iii. Identification of all costs of materials, supplies, and equipment asserted or to be asserted in the claim, including manufacturer's numbers of all items of equipment for which costs are being compiled.

3. Weekly Meetings shall continue for the duration of the claim period. Once the event, circumstance, or issue that caused the claim stated in the Notice of Potential Claim has been mitigated or no longer affects the progress of the Work, the Contractor may submit in writing a request to the Department to discontinue weekly meetings.

4. Records: Upon filing a Notice of Potential Claim, the Contractor shall keep daily records of all labor, material, and equipment costs incurred for operations affected. These daily records shall identify each operation affected and the specific locations where work is affected. The Department will also keep any records it may create concerning labor, material, and equipment used on operations affected. If the Contractor's records indicate costs greater than those kept by the Department, the Department will present its records to the Contractor. The Contractor shall notify the Engineer in writing within three (3) work days of any inaccuracies noted in, or disagreements with, the Department's records. Refusal or repeated failure by the Contractor to attend these weekly meetings and present its records will constitute a waiver by the Contractor of any objections as to the accuracy of the Department's records. When the Contractor makes an objection as to the accuracy of the Department's records, the Engineer shall review the matter and correct any inaccuracies found in the Department's records. For purposes of computing damages, the Department's records will control. In the event the Contractor wishes to contest the accuracy of the Department's records, it may file a petition pursuant to Rule 672-1-.05 of the Official Rules and Regulations of the Department of Transportation. The decision of the Engineer, or, if contested, the decision of the Agency, will be final and binding upon the parties as to any objections to the accuracy of the Department's records, subject to the Contractor's right to judicial review under O.C.G.A. Section 50-13-19.

E. Certification of Claims

1. After complying with Sections 105.13.C and D, if Contractor continues to believe it is entitled to damages or additional compensation, the Contractor shall submit to the Department a certified claim in writing certifying under oath in accordance with the formalities required by Georgia law. The Contractor shall use the CERTIFICATE OF CLAIM form, attesting to the following:

   a. That the claim is made in good faith;

   b. That supportive data is accurate and complete to the best of the Contractor's knowledge and belief; and

   c. That the amount of the claim accurately reflects what the Contractor in good faith believes to be the Department's liability.

2. Required Contents of Certified Claim. All certified claims shall be submitted in writing and shall be sufficient in detail to enable the Engineer to ascertain the basis and the amount of each claim. All information submitted to the Department under this Section 105.13.E will be used exclusively for analyzing the claim, attempting to resolve the claim, or for any litigation that might arise from the claim. At a minimum, the certified claim must include the following information:

   a. A description of the operations that were delayed, the cause of the delay, how the operations were delayed, including the report of all scheduling experts or other consultants, if any. (Not applicable for claims other than delay claims.)

b. An as-built chart, CPM chart, or other diagram depicting in graphic form how the operations were adversely affected. (Not applicable for claims other than delay claims except when an extension of time is sought.)

c. A detailed factual statement of the claim describing all significant events and circumstances giving rise to the claim and providing all necessary dates, locations, and items of work affected by the claim.

d. The date on which actions resulting in the claim occurred or conditions resulting in the claim became evident.

e. A copy of the Notice of Potential Claim submitted for the specific claim by the Contractor.

f. The name, function, and activity of each Department official or employee involved in or knowledgeable about facts that gave rise to such claim.

g. The name, function, and activity of each Contractor or Subcontractor agent or employee involved in or knowledgeable about facts that gave rise to such claim.

h. The identification of any pertinent documents and the substance of any material oral communication relating to such claim.

i. A statement as to whether the damages or additional compensation or extension of time sought is based on the provisions of the Contract or an alleged breach of Contract.

j. The specific provisions of the Contract that support the claim, and a statement of the reasons why such provisions support the claim.

k. The amount of additional compensation sought and a breakdown of that amount into the categories specified as payable under Section 105.13.A.7, above.

l. If an extension of time is also sought, a statement indicating (i) the provisions of Section 108.07.E have been satisfied and (ii) the specific days for which it is sought and the basis for such request.

F. Auditing of Claims

All claims filed against the Department shall be subject to audit at any time following the submission of such claim, whether or not such claim is the subject of a pending lawsuit. The audit may be performed by employees of the Department or by an independent auditor on behalf of the Department. The audit may begin after ten days' notice to the Contractor. The Contractor and, if applicable, its Subcontractors or Suppliers shall make a good faith effort to cooperate with the auditors. Failure to cooperate with the auditor shall constitute a waiver by the Contractor of the claim in its entirety. Failure of the Contractor or its Subcontractors or Suppliers to maintain and retain sufficient records to allow the Department's auditor to verify the claim shall constitute a waiver of that portion of such claim that cannot be verified and shall bar recovery therefor. If the claim is or becomes part of a pending suit, the questions of whether the Contractor has cooperated with the auditor or failed to maintain and retain sufficient records to allow the auditor to verify the claim shall be questions for determination by a judge without the assistance of a jury.
Without limiting the generality of the foregoing, and as a minimum, the Contractor and its Subcontractors and Suppliers will provide the following documents:

1. Daily time sheets and foreman's daily reports.

2. Project payroll register.

3. Profit and loss statements for the project.

4. Payroll tax returns.

5. Material invoices, purchase orders, and all material and supply acquisition contracts for the project.
6. Material cost distribution worksheet for the project.
7. Equipment records (list of company equipment, rates, etc.).
8. Vendor rental agreements and subcontractor invoices.
9. Subcontractor payment certificates.
10. Canceled checks (payroll and vendors) for the project.
11. Job cost report for the project, both detailed and summary.
12. Job payroll ledger for the project.
13. General ledger, general journal (if used), and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals.
14. Cash Disbursements journal for the project.
15. Certified financial statements for all years reflecting the operations on the project.
16. Depreciation records on all company equipment whether such records are maintained by the company involved, its accountant, or others.
17. If a source other than depreciation records is used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment, all such other source documents.
18. All documents which relate to each and every claim together with all documents that support the amount of damages as to each claim
19. Worksheets used to prepare the claim establishing the cost components for items of the claim including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, and all documents that establish the time periods, individuals involved, and the hours and the rates for such individuals.

G. Mediation

After compliance by the Contractor with Sections 105.13.B, C, D, E, and, if applicable, F and if the Contractor's claim has been disallowed in whole or in part then the Contractor may, within 30 calendar days after receipt of the ruling of the Engineer, make a written request to the Engineer that the claim or claims be referred to mediation.

If requested in accordance with this section, mediation shall be granted by the Department. If granted, within 30 days after receipt by the Department of the Contractor's request for mediation, the Contractor and the Department will select a mediator. The mediator will then schedule the mediation at a place, time, and earliest date agreeable to the Contractor and the Department.

The Contractor and the Department mutually agree that mediation shall be a condition precedent to the filing of any lawsuit concerning claims or alleged breaches of the Contract. The costs and expenses of the mediator, selected by mutual agreement of the parties, will be divided equally between the Department and the Contractor. Each party to the mediation shall bear its own costs of preparing for and participating in the mediation.

H. Remedies Exclusive

In the event any legal action is instituted against the Department by the Contractor on account of any claim for damages or additional compensation, whether on account of delay, acceleration, breach of contract, extra work, changed work, unforeseen conditions, or otherwise, the Contractor agrees that the Department's liability will be limited to those items which are specifically identified as payable in Section 105.13.

105.14 Maintenance During Construction

The Contractor shall maintain the project during construction and until the Project is accepted. This maintenance shall constitute the continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that all areas of the project are kept in satisfactory condition at all times.

The Contractor's area of responsibility for maintenance is confined to the physical construction limits plus any areas affected by the Contractor's activities. Once maintenance acceptance or final acceptance has been made, the Contractor is no longer responsible for damage to the Work other than that attributable to the Contractor's actions or inadequate construction.

In case of separate contracts, each Contractor shall be responsible for any damage to the completed work of others caused by his actions or negligence. Where the work of one Contractor has been accepted by the Department, the Contractor performing subsequent work in the area shall be responsible for the maintenance and protection of all work previously completed.

If separate bridge contracts are let within the limits of a Roadway Project and the Bridge Contractor completes his Contract before the Roadway Contractor, the Bridge Contract may be accepted, and the Roadway Contractor will be responsible for maintenance of the new bridge until it is opened to traffic. If the Roadway Contractor hauls materials across the bridge the Roadway Contractor shall protect the end posts, deck surface, deck edges, joints, and all other vulnerable features of the bridge by use of adequate timber or earth cushions as directed by the Engineer. The Roadway Contractor shall repair all damage caused by such use, including resealing of joints and rerubbing of finish at his own expense.

All cost of maintenance work during construction and before the Project is accepted shall be included in the Unit Prices Bid on the various Pay Items and the Contractor will not be paid an additional amount for such work except as provided in Subsection 104.05.B.

The Contractor shall not allow vegetative growth at any time to obstruct signs, delineation, traffic movements, or sight distance. The Contractor shall at intervals not to exceed six months, clean up and remove litter and debris; remove weeds from around guardrail, barrier, poles, standards, utility facilities, and other structures; and cut or trim trees, bushes or tall grass. These requirements shall apply to all areas within the project termini and lateral limits.

105.15 Failure to Maintain Roadway or Structures

If at any time, the Contractor fails to comply with the provisions of Subsection 105.14, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy the unsatisfactory maintenance within 48 hours after receipt of such notice, the Engineer may immediately proceed to maintain the Work, and the entire cost of this maintenance will be deducted from monies due or to become due the Contractor under the Contract. As an alternative to the Engineer's maintaining the Work, all the Items and quantities of work done, but not properly maintained, may be deducted from the current progress estimate, even if such Items have been paid for in a previous estimate.

105.16 Final Inspection and Acceptance

A. Corrective list

Excluding resurfacing projects, no less than 60 (Sixty) calendar days prior to the Contract completion date the Engineer will hold a closing conference and perform an inspection of the Work. Any items found unsatisfactory during this inspection will be detailed as necessary remedial work and provided to the Contractor in the form of a Corrective list. A Corrective list is intended to facilitate timely completion of the Work. Resurfacing projects necessitate the Engineer commence a closing conference and inspection no less than 14 calendar days to the Contract completion date unless otherwise arranged and agreed to by the Contractor.

The Contractor is encouraged to request additional inspections earlier in the project as major portions of the Work appear complete.

Production of a Corrective list does not, in any way, represent a Final Inspection having been performed.

B. Final Inspection

Upon receipt of due written notice from the Contractor of completion of the entire project, the Engineer will schedule and make an inspection for acceptance within 7-business days. No time charges shall be applied to the Contractor for the Engineer’s inability to meet the 7-business day allowance. If all construction provided for and contemplated by the Contract is found completed to the Engineer’s satisfaction and all documents required in connection with the project have been submitted by the Contractor, the Engineer will consider this the Final Inspection. The Engineer will subsequently make the Final Acceptance and notify the Contractor in writing of this acceptance. The Engineer will have the final decision on when the project is complete.

If, however, the Inspection discloses any work, in whole or part, as being unsatisfactory, the Engineer will detail the remedial work required to achieve acceptance and provide the Contractor the necessary instructions for correction of same. Only one list of instructions will be generated by the Engineer. The Contractor shall immediately comply with and execute such instructions. Subsequent inspections will be made on the remedial work until the Engineer accepts all work. Such subsequent inspections are only for the purpose of assessing completion of the instructions provided. When all construction provided for and contemplated by the Contract is found completed to the Engineer’s satisfaction, including submission of all documents required in connection with the project with the exception of final documents as defined in Section 108.07, the Engineer will make the Final Acceptance and notify the Contractor in writing of this acceptance.

When the Contractor has finished a major portion of the Contract, the Contractor may request that a semi-final inspection be made. At the discretion of the Engineer, who shall be sole judge as to making the inspection, if the Work is satisfactory, as described in the first paragraph of this Section, that portion of the Contract may be accepted, opened to traffic, if not already carrying traffic, and the Contractor relieved of the maintenance obligations as described elsewhere in these Specifications.

Such partial acceptance shall in no way relieve the Contractor of responsibility for satisfactory completion of the Contract, or for failure of any portion of the accepted work prior to Final Acceptance of the project.

Section 108—Prosecution and Progress

Replace Section 108 with the following:

108.01 Subletting of Contract

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the Contract or Contracts, or any portion thereof, or of his/her right, title, or interest therein, without written consent of the Engineer. For Subcontracts, consent of the Engineer will not be considered until after award of the Contract.

In case such consent is given, the Contractor will be permitted to sublet a portion thereof, but shall perform, with his/her own organization, work amounting to not less than thirty percent (30%) of the total Contract cost, including materials, equipment, and labor.

As further exception, any items designated as Specialty Items may be performed by Subcontract and the cost of any such Specialty Items so performed by Subcontract may be deducted from the total cost before computing the amount of work required to be performed by the Contractor with his/her own organization.

Purchase of materials by the Prime Contractor for use by a Subcontractor will not be allowed when computing the 30% requirement.

No Subcontracts, or transfer of Contract, shall in any case release the Prime Contractor of his/her liability under the Contract and Bonds. No Subcontractor shall commence work in advance of the written approval of the Subcontract by the Department. Except for certain items exempted by the State Transportation Board, each Subcontractor shall be prequalified or registered with the Department. Each Subcontract for a Registered Subcontractor shall not exceed $2,000,000.00 and Subcontracts for Prequalified Contractors shall not exceed their current capacity. Prequalified or Registered Subcontractors shall be qualified or registered with the Department in accordance with Chapter 672-5 of the Rules and Regulations Governing the Prequalification of Prospective Bidders adopted by the State Transportation Board.

In the event any portion of a Subcontract is further sublet, all of the provisions governing subletting, including registration and written approval by the Engineer, shall apply.

This Sub-Section shall not apply to Contracts between the Department and counties, municipalities, or other State agencies.

All subcontract agreements between the Prime Contractor and subcontractor shall be in writing and shall contain all of the Federal-Aid requirements and pertinent provisions of the Prime Contract. The Prime Contractor shall, upon request by the Engineer, furnish copies of any subcontract agreement to the Department within ten (10) days of such request. This provision applies to all subcontracts, including second or multi-tier subcontracts.

According to the provisions stated above, the following items are designated Specialty Items for general transportation system construction and building construction whenever they appear in the Contract:

<u>General Transportation System Contracts</u>

- Grassing items
- Fencing items
- Highway lighting items
- Sign items
- Guardrail items (except bridge handrail)
- Utility items
- Comfort and convenience items in rest areas

- Landscaping items
- Pressure grouting, slab removal and replacement
- Permanent traffic markings
- Signal systems
- Railroad track work above sub-ballast

General Transportation System Contracts (continued)

- Drilled caisson foundations
- Construction layout
- Asphaltic concrete leveling and asphalt concrete patching (when used on surface treatment and slurry seal resurfacing contracts)

Building Contracts

- Structural Steel
- Plumbing
- Heating, ventilation, and air conditioning (HVAC)
- Electrical
- Telephone service
- Masonry
- Glass work
- Drywall
- Ceiling installation
- Roofing
- Carpentry
- Floor covering
- Raised flooring
- Landscaping
- Security system
- Fire protection
- Gutters
- Painting
- Insulation
- Doors
- Elevators
- Construction layout

The Contractor's cost for Construction Layout shall be fully documented prior to deduction from the original Contract amount.

108.02 Notice to Proceed

The delivery to the Contractor of a notice, stating that construction is authorized, constitutes Notice to Proceed. The Contractor shall do no work under the Contract until receipt of the Notice to Proceed, and the Department will not be obligated to pay for work done prior to receipt of the Notice to Proceed.

Within 10 calendar days after the Notice to Proceed has been issued, the Contractor shall begin The Work. Contract Time charges for Available Day and Calendar Day projects will begin on the date the Contractor starts to work, or 10 days after the Notice to Proceed, whichever occurs first. For completion date projects contract time charges shall begin on the day after the Notice to Proceed.

Where the Contractor's access to part of the right-of-way is restricted, either the special provisions in the Contract or the conditional Notice to Proceed will indicate such restrictions. The Department may, at its option, issue a conditional Notice to Proceed if, in the opinion of the Engineer, a sufficient portion of the right-of-way is available to the Contractor to allow construction to proceed.

108.03 Prosecution and Progress

The Contractor shall provide sufficient materials, equipment, and labor to guarantee the completion of the Project in accordance with the Plans and Specifications within the time set forth in the Proposal. Unless otherwise required by the Engineer, each operation shall begin as soon after the Contract is awarded as conditions will permit. Each class of work will be expected to continue from the date it is begun until it is completed.

The Contractor shall furnish the Engineer, for approval, a progress schedule immediately following the receipt of the Notice to Proceed. Unless otherwise specified, the schedule shall be prepared on forms furnished by the Department or an acceptable critical path schedule will be used as the basis for establishing the controlling items of work and as a check on the progress of The Work. This schedule will not be required on resurfacing projects.

Approval of the progress schedule shall not be construed to imply approval of any particular method or sequence of construction or to relieve the Contractor of providing sufficient materials, equipment, and labor to guarantee the completion of the project in accordance with the plans, specifications, and special provisions within the time set forth in the proposal. Contract time as shown in the proposal is the allowable time. The Contractor's proposed progress schedule may indicate a completion date in advance of the Contract specified completion date; however, the Department will not be liable in any way for the Contractor's failure to complete the project prior to the Contract specified completion date.

At least 48 hours before commencing the work, the Contractor shall notify the Engineer of his intention to begin so that proper inspection may be provided. Should the prosecution of the work be discontinued for any reason, the Contractor shall notify the Engineer at least 24 hours in advance of resuming operations.

If the Contractor's operations are materially affected by changes in the plans or in the amount of work, or if he has failed to comply with the approved schedule, the Contractor shall submit a revised progress schedule, if requested by the Engineer, which schedule shall show how he proposes to prosecute the balance of the work. The Contractor shall submit the revised progress schedule within 10 days after the date of the request. The Contractor shall incorporate into every progress schedule submitted, any contract requirements regarding the order of performance of portions of the work.

No payments will be made to the Contractor while he is delinquent in the submission of a progress schedule or a revised progress schedule.

108.04 Limitation of Operations

The Contractor shall conduct the work at all times in such a manner and in such sequence as will assure the least interference with traffic and shall provide for smooth and safe traffic flow. It shall be the decision of the Engineer as to what will assure the least interference with traffic and smooth, safe traffic flow. Also, the Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

108.05 Character of Workers, Methods and Equipment

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by these Specifications.

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

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

Should the Contractor fail to remove such person or persons as required above or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

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

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

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

108.06 Temporary Suspension of Work

The Engineer has the authority to suspend the work wholly or in part, for as long as he may deem necessary, because of unsuitable weather, or other conditions considered unfavorable for continuing the work, or for as long as he may deem necessary by reason of failure of the Contractor to carry out orders given, or to comply with any provisions of the Contract. No additional compensation will be paid the Contractor because of suspension. If it becomes necessary to stop the work for an indefinite period, the Contractor shall store all materials in such a way that they will not impede the traveling public unnecessarily or become damaged in any way, and he shall take every precaution to prevent damage or deterioration of the work done; provide suitable drainage of the roadway, and erect temporary structures where necessary. The work shall be resumed when conditions are favorable or when corrective measures satisfactory to the Engineer have been applied; when, and as ordered by the Engineer in writing. The Contractor shall not stop the work without authority.

If the work is stopped by any temporary or permanent injunction, court restraining order, process or judgment of any kind, directed to either of the parties hereto, then such period or delay will not be charged against the Contract Time nor shall the Department be liable to the Contractor on account of such delay or termination of work

108.07 Determination of Contract Time

The definition of Contract time and when Contract time officially begins is stated in Subsection 101.19. After the Contract has been signed by all parties, Contract time becomes the specified period of time, agreed upon by the Contractor, the Surety, and the Department, during which all Items and quantities of work set forth in the Proposal and included in the original Contract will be completed.

A. Available Day Contracts

An available day is defined in Subsection 101.04. The Engineer will furnish the Contractor a written monthly statement showing the total number of available days charged through the preceding month. The Contractor will be allowed one week in which to file a written protest setting forth in what respect said statement is incorrect, otherwise the statement shall be deemed to have been accepted by the Contractor as correct.

B. Calendar Day Contracts

When the Contract time is on a calendar day basis it shall consist of the number of calendar days stated in the Contract counting from the date Contract time starts as defined in Subsection 108.02, including all Sundays, holidays, and non-work days.

C. Completion Day Contracts

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

D. Settlement Periods

Settlement periods shall be computed in calendar days unless otherwise stated in the contract documents.

E. Extension of Contract Time

If satisfactory fulfillment of the Contract requires performance of work in greater quantities than those set forth in the Proposal, the Contract time allowed for performance shall be extended on a basis commensurate with the amount and difficulty of the added work as determined by the Engineer, whose decision shall be final and conclusive.

If the estimated time for the consolidation of embankments at bridge ends is extended, the Contract time will be extended as provided in Subsection 208.3.05.B.3.

If the normal progress of the work is delayed for reasons beyond his control, the Contractor shall, within 15 days after the start of such delay, file a written request to the Engineer for an extension of time setting forth therein the reasons and providing complete documentation for the delay which he believes will justify the granting of his request. The Contractor’s plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer finds that the work was delayed because of conditions beyond the control and without the fault of the Contractor, he may extend the time for completion in such amount as the conditions justify.

Any authorized extension of the Contract Time will be in full force and effect the same as though it was the original Contract time.

F. Suspension of Time Charges

If the Engineer suspends the work by reason of failure of the Contractor to carry out written orders given, or to comply with any provision of the Contract, time charges will continue through the period of such suspension.

If the Contractor is declared in default, time charges will continue.

Except on completion date Contracts, time charges will not be made against the Contract when the only remaining controlling items of work are shut down by the Engineer because of seasonal limitations or temperature controls.

G. When Time Charges Cease

Time charges will cease when all work on Contract Items have been completed to the satisfaction of the Engineer. The only exceptions to this requirement are that a satisfactory growth of vegetative cover, application(s) of nitrogen and Final Documentation will not be required when time charges are stopped. Final documentation includes final DBE Report, Reflectivity testing Report, and NPDES Notice of Termination. Filling of all washes and repairs to planted areas have to be accomplished as a prerequisite of vegetative cover and nitrogen condition. Maintenance of planted areas in order to produce a satisfactory growth after time charges have stopped will be performed without assessment of liquidated damages provided this work is diligently prosecuted. If, during this waiting period, maintenance of any part of the project is inadequate, the Engineer may resume time charges 10 days after written notification to the Contractor and will continue time charges until the unsatisfactory conditions are corrected. If final documentation associated with the project is not received within fifty (50) days of the final inspection, the Engineer may resume time charges 10 days after written notification to the Contractor and will continue time charges until necessary documentation is received.

108.08 Failure or Delay in Completing Work on Time

Time is an essential element of the Contract, and any delay in the prosecution of the work may inconvenience the public, obstruct traffic, or interfere with business. In addition to the aforementioned inconveniences, any delay in completion of the work will always increase the cost of engineering. For this reason, it is important that the work be pressed vigorously to completion. Should the Contractor or, in case of default, the Surety fail to complete the work within the time stipulated in the Contract or within such extra time that may be allowed, charges shall be assessed against any money due or that may become due the Contractor in accordance with the following schedule:

Schedule of Deductions for Each Day of Overrun in Contract Time			
Original Contract Amount		Daily Charges	
From More Than	To and Including	Available Day	Calendar Day or Completion Date
$0	$2,000,000	$298	$213
$2,000,000	$4,000,000	$893	$638
$4,000,000	$7,000,000	$1,636	$1,169
$7,000,000	$12,000,000	$2,826	$2,019
$12,000,000	$20,000,000	$4,759	$3,399
$20,000,000	$30,000,000	$7,436	$5,311
$30,000,000	$40,000,000	$8,328	$5,949
$40,000,000	$50,000,000	$10,707	$7,648
$50,000,000		$11,897	$8,498

When the Contract time is on either the calendar day or completion date basis, the schedule for calendar days shall be used. When the Contract time is based on an available day basis, the schedule for available days shall be used.

For each calendar day or available day, as specified, that any work shall remain uncompleted after the contract time specified for the completion of the work required by the Contract, the sum specified in the Contract will be deducted from any money due the Contractor, not as a penalty, but as liquidated damages; provided however, that due account shall be taken of any adjustment of the contract time for completion of the work granted under the provisions of Subsection 108.07.E.

The Department may waive such portions of the liquidated damages as may accrue after the work is in condition for safe and convenient use by the traveling public.

A. Liquidated Damages

The amount of such charges is hereby agreed upon as fixed liquidated damages due the Department after the expiration of the time for completion specified in the Contract. The Contractor and his Surety shall be liable for liquidated damages in excess of the amount due the Contractor on the final payment.

These fixed liquidated damages are not established as a penalty but are calculated and agreed upon in advance by the Department and the Contractor due the uncertainty and impossibility of making a determination as to the actual and consequential damages which are incurred by the Department, the State, and the general public as a result of the failure on the part of the Contractor to complete the work on time.

1. **Deduction from Partial Payments:** Liquidated damages, as they accrue, will be deducted from periodic partial payments.
2. **Deduction from Final Payment:** The full amount of liquidated damages will be deducted from final payment to the Contractor and/or its Surety.
3. **No Liquidated Damages Charged for Delay by the Department:** In case of default of the Contract and the subsequent completion of the work by the Department as hereinafter provided, the Contractor and his Surety shall be liable for the liquidated damages under the Contract, but no liquidated damages shall be chargeable for any delay in the final completion of the work by the Department due to any unreasonable action, negligence, omission, or delay of the Department. In any suit for the collection of or involving the assessment of liquidated damages, the reasonableness of the amount shall be presumed. The liquidated damages referred to herein are intended to be and are cumulative and shall be in addition to every other remedy now or hereafter enforceable at law, in equity, by statute, or under the Contract.

B. No Waiver of Department's Rights

Permitting the Contractor to continue and finish The Work or any part of it after the expiration of the time allowed for completion or after any extension of time, shall not operate as a waiver of the rights of the Department under the Contract.

108.09 Default of Contract

If the Contractor fails to begin the work within the time specified, or fails to perform the work with sufficient workers, equipment, or materials to ensure its prompt completion, or performs the work unsuitably, or neglects or refuses to remove materials or perform anew such work as shall be rejected as defective and unsuitable, or discontinues the prosecution of the work, or from any other cause whatsoever does not carry on the work in an acceptable manner, or becomes insolvent or is adjudicated a bankrupt, or commits any act of bankruptcy or insolvency, or allows any final judgement to stand against him unsatisfied for a period of 10 days, or makes an assignment for the benefit of creditors, or fails to comply with the contract requirements regarding wage payments or EEO requirements, or fails to sign the standard release form as stipulated in Subsection 109.08 *Final Payment*, the Engineer may give notice in writing by registered or certified mail to the Contractor and the Surety, stating the nature of the deficiencies and directing that The Work including its progress be remedied and made satisfactory.

If, within 10 days after such notice, the Contractor or its Surety does not proceed in satisfactory way to remedy the faults specified in said notice, the Engineer will notify the Contractor and its Surety by registered or certified mail that the Contractor is in default and, by the same message, direct the Surety to take over the work including all of the obligations pertaining to the Contract. If the Surety takes over the work in a satisfactory way within 10 days after such notice of default, the Department will thenceforth pay to the Surety the amounts due and to become due under the Contract, less all deductions provided herein including liquidated damages. The Department shall not be liable for any sums not due under the Contract and shall not be made a party to any dispute between the Contractor and the Surety.

If the Contractor is declared in default and the work and other Contract obligations are taken over by the Surety as required by its Bond, and when all parts of the work have been completed and found to be satisfactory by the Engineer, as provided for in Subsection 105.16 *Final Inspection and Acceptance*, the said Surety is hereby constituted the attorney in fact of the Contractor for the purpose of executing such final releases as may be required by the Department or to do any other act or thing, including the execution of any documents, necessary to the completion of the Contract and a final settlement of same, including but not limited to those documents required by the provisions regarding final payment and release as set forth in Subsection 109.08.

For all purposes, as herein set out and defined, including the execution of documents necessary to the final completion and settlement of the Contract, the Surety, under such circumstances, is hereby authorized and directed by the Contractor to perform such acts and execute such documents as fully and completely as though the same were performed or executed by such contractor, and to be lawfully binding upon such Contractor as though such acts had been performed or such documents executed by him in person.

If the Surety does not take over The Work in a satisfactory way within 10 days after the notice of default, or does not proceed to finish The Work according to the Contract, the Department shall have full power and authority, without impairing the obligation of the Contract or the Contract Bond, to take over the completion of The Work; to appropriate or use any or all material and equipment on the ground that may be suitable, to enter into agreements with others for the completion of the Contract according to the terms and provisions thereof; or to use such other methods as may be required for the completion of the Contract. In so assuming the obligations of the Contractor, the Department does so as the agent of the Contractor. Assumption of these duties and obligations by the Department will not act as a release of the Contractor or its Surety from any of the provisions of this Contract. The Contractor and its Surety shall be liable for all costs incurred by the Department in completing the work and also for all liquidated damages in conformity with the terms of the Contract. If the sum of such liquidated damages and the expense so incurred by the Department is less than the sum which would have been payable under this Contract if it had been completed by the Contractor or its Surety, the Contractor, or its Surety, shall be entitled to receive the difference; and if the sum of such expense and such liquidated damages exceeds the sum that would have been payable under the Contract, the Contractor and its Surety shall be liable and shall pay to the Department the amount of such excess. Notice to the Contractor shall be deemed to have been served when delivered to the person in charge of any office used by the Contractor, its representative at or near the work or by registered or certified mail addressed to the Contractor at the last known place of business.

Time charges shall continue through a period of a default in compliance with the provisions of Subsection 108.07.F.

108.10 Termination of Contractor’s Responsibility

Except as specified in the Contract Bond and in Subsection 107.20, the Contractor’s responsibility for the work shall terminate upon final acceptance of the work by the Department.

Section 109—Measurement and Payment

Replace Section 109 with the following:

109.01 Measurement and Quantities

The method of measurement and computations to be used in determination of quantities of material furnished and of work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made along the surface, and no deductions will be made for individual fixtures having an area of 9 $ft.^2$ (1 m^2) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

Where payment is to be made by the square yard (square meter) for a specified thickness, the length will be measured on the surface along the centerline and the pay width shall be that width specified on the plans for the Final surface of the completed section. Intermediate courses shall be placed at a width sufficient to support successive courses with no detriment to the stability of the successive courses. The width of material required beyond the pay width will not be eligible for payment and shall be considered incidental to the work.

Structures will be measured according to neat lines shown on the Plans or as altered to fit field conditions.

All items which are measured by the linear foot (linear meter), such as pipe culverts, guard rail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the plans.

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

The term “gage,” when used in connection with the measurement of steel plates, will mean the U.S. Standard Gage.

When the term “gage” refers to the measurement of electrical wire it will mean the wire gage specified in the National Electrical Code.

The term “ton” will mean the short ton consisting of 2,000 pounds avoirdupois. The term “megagram” will mean one metric ton, equivalent to 1,000 kg. Any commodity paid for by weight shall be weighed on scales that have been approved as specified below and which are furnished at the expense of the Contractor or Supplier. Weighing and measuring systems including remote controls shall be subject to type-approval by the Department of Transportation. The manufacture, installation, performance, and operation of such devices located in Georgia shall conform to, and be governed by, the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act, the Georgia Weights and Measures Regulations, as amended and adopted, the current edition of the National Bureau of Standards Handbook 44, and these specifications. Weighing and measuring systems located outside Georgia which are utilized for weighing materials to be used in Department work shall be manufactured, installed, approved, and operated in accordance with applicable laws and regulations for the state in which the scales are located.

All weighing, measuring, and metering devices used to measure quantities for payment shall be suitable for the purpose intended and will be considered to be *commercial devices*. Commodity scales located in Georgia shall be certified before use for accuracy, condition, etc., by the Weights and Measures Division of the Georgia Department of Agriculture, or its authorized representative. Scales located outside Georgia shall be certified in accordance with applicable laws and regulations for the state in which the scales are located. This certification shall have been made within a period of not more than one year prior to date of use for weighing commodity.

All equipment and all mechanisms and devices attached thereto or used in connection therewith shall be constructed, assembled, and installed for use so that they do not facilitate the perpetration of fraud. Any scale component or mechanism, which if manipulated would alter true scale values (including manual zero setting mechanisms) shall not be accessible to the scale operator. Such components and mechanisms that would otherwise be accessible to the scale operator shall be enclosed. Provisions shall be made for security seals where appropriate on equipment and accessories. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Scale or accessory devices shall not be used if security seals have been broken or removed.

Any certified scale or scale component which has been repaired, dismantled, or moved to another location shall again be tested and certified before it is eligible for weighing.

Whenever materials that are paid for based on weight are from a source within the State, the scales shall be operated by and the weights attested to by signature and seal of a duly authorized Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted. When such materials originate from another state that has a certified or licensed weigher program, the scales shall be operated by a weigher who is certified by that state in accordance with applicable laws, and weight ticket recordation shall be in accordance with Standard Operating Procedure 15.

When materials are paid for based on weight and originate from another state which has no program for certifying or licensing weighers, the materials shall be weighed on scales located in the State of Georgia by a Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted.

No scale shall be used to measure weights greater than the scale manufacturer’s rated capacity. A digital recorder shall be installed as part of any commodity scale. The recorder shall produce a printed digital record on a ticket with the gross, tare, and net weights of the delivery trucks, along with the date and time printed for each ticket. Provisions shall be made so that the scales or recorders may not be manually manipulated during the printing process. The system shall be so interlocked as to allow printing only when the scale has come to rest. Either the gross or net weight shall be a direct scale reading. Printing and recording systems that are capable of accepting keyboard entries shall clearly and automatically differentiate a direct scale weight value from any other weight values printed on the load ticket.

All scales used to determine pay quantities shall be provided to attain a zero-balance indication with no load on the load receiving element by the use of semi-automatic zero (push-button zero) or automatic zero maintenance.

Vehicle scales shall have a platform of sufficient size to accommodate the entire length of any vehicle weighed and shall have sufficient capacity to weigh the largest load. Adequate drainage shall be provided to prevent saturation of the ground under the scale foundation.

The Engineer, at his discretion, may require the platform scales to be checked for accuracy. For this purpose, the Contractor shall load a truck with material of his choosing, weigh the loaded truck on his scales, and then weigh it on another set of certified vehicle scales. When the difference exceeds 0.4 percent of load, the scales shall be corrected and certified by a registered scale serviceman registered in the appropriate class as outlined in the Georgia Weights and Measures Regulations or in accordance with applicable requirements of the state in which the scales are located. A test report shall be submitted to the appropriate representative of the Department of Agriculture.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined. All vehicles shall be loaded to their water level capacity as determined by the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined.

Cement and lime will be measured by the ton (megagram). Whenever cement or lime is delivered to the project in tank trucks, a certified weight shall be made at the shipping point by an authorized Certified Public Weigher who is not an employee of the Department. Whenever cement and lime are from a source within the State, the scales shall be operated by the weights attested to by signature and seal of a duly authorized Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted. When such materials originate from another state that has a certified or licensed weigher program, the scales shall be operated by a weigher who is certified by that state in accordance with applicable laws, and the weight ticket recordation shall be in accordance with Standard Operating Procedure 15. When cement and lime originate from another state that has no program for certifying or licensing weighers, the materials shall be weighed on scales located in the State of Georgia by a Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted.

The shipping invoice shall contain the certified weights and the signature and seal of the Certified Public Weigher. A security seal shall also be affixed to the discharge pipe cap on the tank truck before leaving the shipping point. The number on the security seal shall also be recorded on the shipping invoice. The shipping invoice for quicklime shall also contain a certified lime purity percentage. Unsealed tank trucks will require reweighing by a Certified Public Weigher.

Timber will be measured by the thousand feet board measure (MFBM) (cubic meter) actually incorporated in the structure. Measurements will be based on nominal widths and thickness and the actual length in place. No additional measurement will be made for splices except as noted for overlaps as shown on the plans.

The term "*Lump Sum*" when used as an item of payment will mean complete payment for the work described in the Contract.

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

Rental of equipment will be measured as defined in Subsection 109.05.B.4.

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

109.02 Measurement of Bituminous Materials

By Weighing the Material

The Department prefers this method whenever it is practicable. This method will be considered acceptable under the following conditions:

1. **Weighed on Project:** If the weights of the bituminous materials delivered by tank trucks are to be determined on the Project, weights shall be determined on scales that have been previously checked by the Department with standard weights for accuracy. The scale platform shall be large enough to accommodate the entire vehicle at one time. Under no conditions will truck scales be used to measure weights greater than their rated capacity. All weights not determined in the presence of an authorized representative of the Department shall be made by a Certified Public Weigher who is not an employee of the Department of Transportation and who is in good standing with the Georgia Department of Agriculture. The weight tickets shall carry both the signature and seal of the Certified Public Weigher.
2. **Weighed at Shipping Point:** A certified weight made at the shipping point by an authorized Certified Public Weigher who is not an employee of the Department of Transportation and who is registered with the Georgia Department of Agriculture, will be acceptable provided all openings in the tank have been sealed by the producer and when, upon inspection on the Project, there is no evidence of any leakage. The shipping ticket in this case must carry the signature and seal of the Certified Public Weigher. If the tank is not completely emptied the amount of material remaining in the tank truck will be measured by either weight or volume and the amount so determined, as verified by the Engineer, will be deducted from the certified weight.
3. **By Extraction Analysis:** The weight of bituminous material used will be determined by extraction tests made by the field laboratory. The average asphalt content for each Lot will be used to compute the weight of the Asphalt Cement to be paid for in accordance with the following formula:

   English:

   $$P = \%\ AC \times T$$

   Where:

   P = Pay Tons of Asphalt Cement
   % AC = Lot average of % Asphalt Cement by weight of total mix as determined by extraction

T = Actual accepted tons of mixture as weighed

Metric:

P = % AC x T

Where:

P = Pay megagrams of Asphalt Cement
% AC = Lot average of % Asphalt Cement by weight of total mix as determined by extraction
T = Actual accepted megagrams of mixture as weighed

4. **By Digital Recording Device:** The amount of bituminous material as shown on the printed tickets will be the Pay Quantity.

By Volume

The volume will be measured and corrected for the difference between actual temperature and 60 °F (15 °C). Containers shall be level when measured, and one of the following methods shall be used, whichever is best suited to the circumstances:

1. **Tank Car Measurement:** If the material is shipped to the Project in railroad tank cars, the Contractor shall furnish the Engineer a certified chart showing the dimensions and volume for each inch (25 mm) of depth for each tank. The Engineer will make outage and temperature measurements before unloading is begun and after it is finished. The measurements will be taken when the bituminous material is at a uniform temperature and free from air bubbles. The Contractor shall not remove any bituminous material from any tank until necessary measurements have been made nor shall he release the car until final outage has been measured. The total number of gallons (liters) allowed for any tank car shall not be more than the U.S. Interstate Commerce Commission rating for that car, converted to gallons at 60 °F (15 °C).
2. **Truck Measurement:** If bituminous materials are delivered to the Project in tank trucks, distributor tanks, or drums, the Contractor shall not remove any bituminous material from the transporting vehicle or container until necessary measurements have been made, nor shall the transporting vehicle or container be released until final outage has been measured. If weighing is not convenient, the Contractor shall furnish the Engineer with a certified chart showing the dimensions and volume of each container together with a gauge or calibrated measuring rod which will permit the volume of the material to be determined by vertical measurement.
3. **Metering:** The volume may be determined by metering, in which case the metering device used and the method of using it shall be subject to the approval of the Engineer.
4. **Time of Deliveries:** The arrival and departure of vehicles delivering bituminous materials to the Project site shall be so scheduled that the Engineer is afforded proper time for the measurements of delivered volume and final outage. The Engineer will make the necessary measurements only during the Contractor's normal daily working hours.

Production for Multiple Projects

When a Contractor is producing Asphaltic Concrete from one plant, which is being placed on two or more jobs, public or private, the amount of bituminous material used may be determined by extraction tests in accordance with Subsection 109.02.A.3 or digital recording device in accordance with Subsection 109.02.A.4.

Tack Coat

When the same storage facility is utilized for Bituminous Materials to be used in Hot Mix Asphaltic Concrete, Bituminous Tack Coat, and/or Surface Treatment, the quantity used for Tack Coat shall be converted to tons (megagrams) and deducted from the quantities for the Bituminous Material used in the Hot Mix Asphaltic Concrete and Surface Treatment.

Corrections

When the volume and temperature have been determined as defined above, the volume will be corrected by the use of the following formula:

$$V_{English} = \frac{V1}{K(t-60)+1} \qquad V_{metric} = \frac{V1}{K(t-15)+1}$$

Where:

V = Volume of bituminous material at 60 °F (15 °C)
V1 = Volume of hot bituminous material
t = Temperature of hot bituminous material in degrees Fahrenheit (Celsius)
K= Coefficient of Expansion of bituminous material (correction factor)

The correction factors K for various materials are given below:

- 0.00035 (0.00063) per °F (°C) for petroleum oils having a specific gravity of 60 °F/60 °F (15 °C/15 °C) above 0.966
- 0.00040 (0.00072) per °F (°C) for petroleum oils having a specific gravity of 60 °F/60 °F (15 °C/15 °C) between 0.850-0.966
- 0.00030 (0.00054) per °F (°C) for Tar
- 0.00025 (0.00045) per °F (°C) for Emulsified Asphalt
- 0.00040 (0.00072) per °F (°C) for Creosote Oil

109.03 Scope of Payment

The Contractor shall receive and accept the compensation provided for in the Contract as full payment for furnishing all materials, labor, tools, equipment, superintendence and incidentals, and for performing all work contemplated and embraced under the Contract in a complete and acceptable manner, for any infringement of patent, trademark or copyright, for all loss or damage arising from the nature of the work, or from the action of the elements, for all expenses incurred by or in consequence of the suspension or discontinuance of the work, or from any unforeseen difficulties which may be encountered during the prosecution of the work and for all risks of every description connected with the prosecution of the work until its final acceptance by the Engineer, except as provided in Subsection 107.16.

The payment of any partial estimate prior to final acceptance of the project as provided in Subsection 105.16 shall in no way affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damages due to such defects.

109.04 Payment and Compensation for Altered Quantities

When alteration in plans or quantities of work not requiring Supplemental Agreements as herein before provided for are ordered and performed, the Contractor shall accept payment in full at the Contract Unit Bid Prices for the actual quantities of work done, and no allowance will be made for increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor, resulting either directly from such alterations, or indirectly from unbalanced allocation among the Contract Items of overhead expense on the part of the Bidder and subsequent loss of expected reimbursement therefore, or from any other cause.

Compensation for alterations in plans or quantities of work requiring Supplemental Agreements shall be as stipulated in such agreement, except that when the Contractor proceeds with The Work without change of price being agreed upon, he shall be paid for such increased or decreased quantities at the Contract Unit Prices Bid in the Proposal for the Items of the work.

109.05 Extra Work

Extra work, as defined in Subsection 101.27, when ordered in accordance with Subsection 104.04, will be authorized in writing by the Engineer. The authorization will be in the form of a Supplemental Agreement or a Force Account.

A. Supplemental Agreement

In the case of a Supplemental Agreement, the work to be done will be stipulated and agreed upon by both parties prior to any extra work being performed.

Payment based on Supplemental Agreements shall constitute full payment and settlement of all additional costs and expenses including delay and impact damages caused by, arising from or associated with the work performed.

B. Force Account

When no agreement is reached for extra work to be done at lump sum or unit prices, such work may be authorized by the Department to be done on a Force Account basis. A Force Account estimate that identifies all anticipated costs shall be prepared by the Contractor on forms provided by the Engineer. Work shall not begin until the Force Account is approved. Payment for Force Account work will be in accordance with the following:

1. **Labor:** For all labor, equipment operators and supervisors, excluding superintendents, in direct charge of the specific operations, the Contractor shall receive the rate of wage agreed upon in writing before beginning work for each and every hour that said labor, equipment operators and supervisors are actually engaged in such work.

   The Contractor shall receive the actual costs paid to, or in behalf of, workers by reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits, or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work.

   An amount equal to 15% of the sum of the above items will also be paid the Contractor.

2. **Bond, Insurance, and Tax:** For property damage, liability, and worker's compensation insurance premiums, unemployment insurance contributions, and Social Security taxes on the Force Account work, the Contractor shall receive the actual cost, to which cost no percentage will be added. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax.

3. **Materials:** For materials accepted by the Engineer and used, the Contractor shall receive the actual cost of such material incorporated into the work, including Contractor paid transportation charges (exclusive of machinery rentals as hereinafter set forth), to which cost 10% will be added.

4. **Equipment:** For any machinery or special equipment (other than small tools) including fuel and lubricant, plus transportation costs, the use of which has been authorized by the Engineer, the Contractor shall receive the rental rates indicated below for the actual time that such equipment is in operation on the work or the time, as indicated below, the equipment is directed to stand by.

   Equipment rates shall be based on the latest edition of the *Rental Rate Blue Book for Construction Equipment* or *Rental Rate Blue Book for Older Construction Equipment*, whichever applies, as published by *Equipment Watch* using all instructions and adjustments contained therein and as modified below.

   Allowable Equipment Rates shall be established as defined below:

   - Allowable Hourly Equipment Rate = Monthly Rate/176 x Adjustment Factors.
   - Allowable Hourly Operating Cost = Hourly Operating Cost.
   - Allowable Rate Per Hour = Allowable Hourly Equipment Rate + Allowable Hourly Operating Cost.
   - Standby Rate = Allowable Hourly Equipment Rate x 35%

NOTE: The monthly rate is the basic machine plus any attachments.

Standby rates shall apply when equipment is not in operation and is directed by the Engineer to standby for later use. In general, Standby rates shall apply when equipment is not in use but will be needed again to complete the work and the cost of moving the equipment will exceed the accumulated standby cost. Payment for standby time will not be made on any day the equipment operates for 8 or more hours. For equipment accumulating less than 8 hours operating time on any normal workday, standby payment will be limited to only that number of hours which, when added to the operating time for that day equals 8 hours. Standby payment will not be made on days that are not normally considered workdays.

The Department will not approve any rates in excess of the rates as outlined above unless such excess rates are supported by an acceptable breakdown of cost.

Payable time periods will not include:

- Time elapsed while equipment is broken down
- Time spent in repairing equipment, or
- Time elapsed after the Engineer has advised the Contractor the equipment is no longer needed

If a piece of equipment is needed which is not included in the above *Blue Book* rental rates, reasonable rates shall be agreed upon in writing before the equipment is used. All equipment charges by persons or firms other than the Contractor shall be supported by invoices.

Transportation charges for each piece of equipment to and from the site of the work will be paid provided:

- The equipment is obtained from the nearest approved source
- The return charges do not exceed the delivery charges
- Haul rates do not exceed the established rates of licensed haulers, and
- Such charges are restricted to those units of equipment not already available and not on or near the project

No additional compensation will be made for equipment repair.

5. **Miscellaneous:** No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.
6. **Compensation:** The Contractor's representative and the Engineer shall compare records and agree on the cost of work done as ordered on a Force Account basis at the end of each day on forms provided by the Department.
7. **Subcontract Force Account Work:** For work performed by an approved Subcontractor or Second-tier Subcontractor, all provisions of this Section (109.05) that apply to the Prime Contractor in respect to labor, materials and equipment shall govern. The prime Contractor shall coordinate the work of his Subcontractor. The prime Contractor will be allowed an amount to cover administrative cost equal to 5% of the Subcontractor's amount earned but not to exceed $5,000.00 per Subcontractor. Markup for Second-tier Subcontract work will not be allowed.

   Should it become necessary for the Contractor or Subcontractor to hire a firm to perform a specialized type of work or service which the prime Contractor or Subcontractor is not qualified to perform, payment will be made at reasonable invoice cost. To each invoice cost a markup to cover administrative cost equal to 5% of the total invoice but not to exceed $5,000.00 will be allowed the Contractor or Subcontractor but not both.
8. **Statements:** No payment will be made for work performed on a Force Account basis until the Contractor has furnished the Engineer with duplicate itemized statements of the cost of such Force Account work detailed as follows:
   a. Name, classification, date, daily hours, total hours, rate, and extension for each laborer, equipment operator, and supervisor, excluding superintendents.
   b. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
   c. Quantities of materials, prices, and extensions.
   d. Transportation of materials.

e. Cost of property damage, liability, and worker's compensation insurance premiums, unemployment insurance contributions, and Social Security tax.

Statements shall be accompanied and supported by invoices for all materials used and transportation charges. However, if materials used on the Force Account work are not purchased specifically for such work but are taken from the Contractor's stock, then, in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from his stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

Payment based on Force Account records shall constitute full payment and settlement of all additional costs and expenses including delay and impact damages caused by, arising from or associated with the work performed.

109.06 Eliminated Items

Should any Items contained in the Proposal be found unnecessary for the proper completion of the work, the Engineer may, upon written order to the Contractor, eliminate such Items from the Contract, and such action shall in no way invalidate the Contract. When a Contractor is notified of the elimination of Items, he will be reimbursed for actual work done and all costs incurred, including mobilization of materials prior to said notifications.

109.07 Partial Payments

A. General

At the end of each calendar month, the total value of Items complete in place will be estimated by the Engineer and certified for payment. Such estimate is approximate only and may not necessarily be based on detailed measurements. Value will be computed on the basis of Contract Item Unit Prices or on percentage of completion of lump sum Items.

When so requested by the Contractor and approved by the Engineer, Gross Earnings of $500,000.00 or more for work completed within the first 15 days of any month will be certified for payment on a semi-monthly basis subject to the conditions and provisions of Subsection 109.07.A, Subsection 109.07.B.6, Subsection 109.07.C, Subsection 109.07.D, Subsection 109.07.E, and Subsection 109.07.F.

B. Materials Allowance

Payments will be made on delivered costs, or percentage of bid price if otherwise noted, with copies of paid invoices provided to the Department for the materials listed below which are to be incorporated into the Project provided the materials:

- Conform to all specification requirements.
- Are stored on the project Right-of-Way or, upon written request by the Contractor and written approval of the Engineer, they may be stored off the Right-of-Way, but local to the project, provided such storage is necessary due to lack of storage area on the Right-of-Way, need for security, or need for protection from weather.

As a further exception to on-project storage, upon written request by the Contractor, the Engineer may approve off-the-project storage items uniquely fabricated or precast for a specific Project, such as structural steel and precast concrete, which will be properly marked with the Project number and stored at the fabrication or precast facility.

The Engineer may approve out-of-state storage for structural steel and prestressed concrete beams uniquely fabricated for a specific Project stored at the fabrication facility.

1. Paid invoices should accompany the materials allowance request, but in no case be submitted to the project Engineer later than 30 calendar days following the date of the progress payment report on which the materials allowance was paid.

In case such paid invoices are not furnished within the established time, the materials allowance payment will be removed from the next progress statement and no further materials allowance will be made for that item on that project.

2. Materials allowances will be paid for those items which are not readily available, and which can be easily identified and secured for a specific project and for which lengthy stockpiling periods would not be detrimental. Some exclusions are as follows:
   a. No payments will be made on living or perishable plant materials until planted.
   b. No payments will be made on Portland Cement, Liquid Asphalt, or grassing materials.
   c. No payment will be made for aggregate stockpiled in a quarry. Payment for stockpiled aggregate will be made only if the aggregate is stockpiled on or in the immediate vicinity of the project and is held for the exclusive use on that project. The aggregate must be properly secured. If the aggregate stockpiled is to be paid for per-ton (megagram) it must be reweighed on approved scales at the time it is incorporated into the project.
   d. No payments will be made on minor material items, hardware, etc.
3. No materials allowance will be made for materials when it is anticipated that those materials will be incorporated into The Work within 30 calendar days.
4. No materials allowance will be made for a material when the requested allowance for such material is less than $25,000.
5. Where a storage area is used for more than one project, material for each project shall be segregated from material for other projects, identified, and secured. Adequate access for auditing shall be provided. All units shall be stored in a manner so that they are clearly visible for counting and/or inspection of the individual units.
6. Materials allowance for prestressed concrete and structural steel bridge members may be processed for uncast or unfabricated members upon the Engineer’s receipt of a true copy of the binding order for the members required by the plan. Such copy shall be sealed and notarized by both the contractor placing the order and the supplier therein identified to cast or fabricate said members. All orders shall demonstrate conformance to the approved plans and specifications regarding beam type, size, length, material quantities and shall not exceed the approved plan quantity. The materials allowance applied to uncast prestressed concrete members will be made in amount equal to 40 percent of the invoice for the respective member(s) to the contractor. The materials allowance applied to unfabricated structural steel bridge members will be made in amount equal to 55 percent of the invoice for the respective member(s) to the contractor. An additional material allowance may be requested separately upon completion of the casting or fabricating for a maximum 90 percent of the invoice for the member(s) provided there is adherence to all other provisions of this specification.
7. The Commissioner may, at his discretion, grant waiver to the requirements of this Section when, in his opinion, such waiver would be in the public interest.

   Subsequently, in the event the material is not on-hand and in the quantities for which the materials allowance was granted, the materials allowance payment will be removed from the next progress statement and no further materials allowance will be made for those items on that project. If sufficient earnings are not available on the next progress statement, the Contractor agrees to allow the Department to recover the monies from any other Contract he may have with the Department, or to otherwise reimburse the Department.

   Excluding item 6 above, payments for materials on hand shall not exceed the invoice price or 75 percent of the bid prices for the pay items into which the materials are to be incorporated, whichever is less.

C. Minimum Payment

No partial payment will be made unless the amount of payment is at least $1000.00.

D. Liquidated Damages

Accrued liquidated damages will be deducted in accordance with Subsection 108.08.

E. Other Deductions

In addition to the deductions provided for above, the Department has the right to withhold any payments due the Contractor for items unpaid by the Contractor for which the Department is directly responsible, including, but not limited to, royalties (see Section 106).

F. Amount of Payment

The balance remaining after all deductions provided for herein have been made will be paid to the Contractor. Partial estimates are approximate and are subject to correction on subsequent progress statements. If sufficient earnings are not available on the subsequent progress statement, the Contractor agrees to allow the Department to recover the monies from any other Contract he may have with the Department, or to otherwise reimburse the Department. The Engineer is responsible for computing the amounts of all deductions herein specified, for determining the progress of the Work and for the items and amounts due to the Contractor during the progress of the work and for the final statement when all work has been completed.

G. Interest

Under no circumstances will any interest accrue or be payable on any sums withheld or deducted by the Department as authorized by Subsection 109.07.A, Subsection 109.07.B.6, Subsection 109.07.C, Subsection 109.07.D, Subsection 109.07.E, and Subsection 109.07.F.

H. Insert the Following in Each Subcontract

The Contractor shall insert the following in each Subcontract entered into for work under this Contract:

"The Contractor shall not withhold any retainage on Subcontractors. The Contractor shall pay the Subcontractor 100 percent of the gross value of the completed work by the Subcontractor as indicated by the current estimate certified by the Engineer for payment."

Neither the inclusion of this specification in the Contract between the Department and the Prime Contractor nor the inclusion of the provisions of this specification in any Contract between the Prime Contractor and any of his Subcontractors nor any other specification or provision in the Contract between the Department and the Prime Contractor shall create, or be deemed to create, any relationship, contractual or otherwise, between the Department and any Subcontractor.

109.08 Final Payment

When Final Inspection and Final Acceptance have been made by the Engineer as provided in Subsection 105.16, the Engineer will prepare the Final Statement of the quantities of the various classes of work performed. All prior partial estimates and payments shall be subject to correction in the Final Statement. The District Engineer will transmit a copy of the Statement to the Contractor by registered or certified mail. The Contractor will be afforded 35 days in which to review the Final Statement in the District Office before it is certified for payment by the Engineer. Any adjustments will be resolved by the District Engineer or in case of a dispute referred to the Chief Engineer whose decision shall be final and conclusive. After approval of the Final Statement by the Contractor, or after the expiration of the 35 days, or after a final ruling on disputed items by the Chief Engineer, the Final Statement shall be certified to the Treasurer by the Chief Engineer stating the project has been accepted and that the quantities and amounts of money shown thereon are correct, due and payable.

The Treasurer, upon receipt of the Engineer's certification, shall in turn furnish the Contractor with the Department's Standard Release Form to be executed in duplicate. The aforesaid release form, showing the total amount of money due the Contractor, shall be sent to the Contractor by registered or certified mail, to be delivered to such Contractor upon the signing of a return receipt card, to be returned to the Department in accordance with the provision of Federal law in respect to such matters and such return receipt card shall be conclusive evidence of a tender of said sum of money to the Contractor. Upon receipt of the properly executed Standard Release Form, the Treasurer shall make final payment jointly to the Contractor and his Surety. The aforesaid certification, executed release form, and final payment shall be evidence that the Commissioner, the Engineer, and the Department have fulfilled the terms of the Contract, and that the Contractor has fulfilled the terms of the Contract except as set forth in his Contract Bond.

The Standard Release Form is to be executed by the Contractor within 45 days after delivery thereof, as evidenced by the registered or certified mail return receipt. Should the Contractor fail to execute the Standard Release Form because he disputes the Final Payment as offered, or because he believes he has a claim for damages or additional compensation under the Contract, the Contractor shall, within 45 days after delivery to the Contractor of the Standard Release Form, as evidenced by the registered or certified mail return receipt, enter suit in the proper court for adjudication of his claim. Should the Contractor fail to enter suit within the aforesaid 45 days, then by agreement hereby stipulated, he is forever barred and stopped from any recovery or claim whatsoever under the terms of this Contract.

Should the Contractor fail to execute the Standard Release Form or file suit within 45 days after delivery thereof, then the Surety on the Contractor's Bond is hereby constituted the attorney-in-fact of the Contractor for the purpose of executing such final releases as may be required by the Department, including but not limited to the Standard Release Form, and for the purpose of receiving the Final Payment under this Contract.

The Department reserves the right as defined in Subsection 107.20, should an error be discovered in any estimates, to claim and recover from the Contractor or its Surety, or both, such sums as may be sufficient to correct any error of overpayment. Such overpayment may be recovered from payments due on current active Projects or from any future State work done by the Contractor.

The foregoing provisions of this Section shall be applicable both to the Contractor and the Surety on its Bond; and, in this respect, the Surety shall be bound by the provisions of Subsection 108.09 of these Specifications in the same way and manner as the Contractor.

A. Interest

In the event the Contractor fails to execute the Standard Release Form as prepared by the Treasurer because he disputes the amount of the final payment as stated therein, the amount due the Contractor shall be deemed by the Contractor and the Department to be an unliquidated sum and no interest shall accrue or be payable on the sum finally determined to be due to the Contractor for any period prior to final determination of such sum, whether such determination be by agreement of the Contractor and the Department or by final judgement of the proper court in the event of litigation between the Department and the Contractor. The Contractor specifically waives and renounces any and all rights it may have under Section 13-6-13 of the Official Code of Georgia and agrees that in the event suit is brought by the Contractor against the Department for any sum claimed by the Contractor under the Contract, for delay damages resulting from a breach of contract, for any breach of contract or for any extra or additional work, no interest shall be awarded on any sum found to be due from the Department to the Contractor in the final judgement entered in such suit. All final judgements shall draw interest at the legal rate, as specified by law. Also, the Contractor agrees that notwithstanding any provision or provisions of Chapter 11 of Title 13 of the Official Code of Georgia that the provisions of this contract control as to when and how the Contractor shall be paid for The Work. Further, the Contractor waives and renounces any and all rights it may have under Chapter 11 of Title 13 of the Official Code of Georgia.

B. Termination of Department's Liability

Final payment will be in the amount determined by the statement as due and unpaid. The acceptance of the final payment or execution of the Standard Release Form or failure of the Contractor to act within 45 days as provided herein after tender of payment, or final payment to the Contractor's Surety in accordance with the provisions stipulated herein, shall operate as and be a release to the Department, the Commissioner, and the Engineer from all claims of liability under this contract and for any act or neglect of the Department, the Commissioner, or the Engineer.

109.09 Termination Clause

A. General

The Department may, by written notice, terminate the Contract or a portion thereof for the Department's convenience when the Department determines that the termination is in the State's best interest, or when the Contractor is prevented from proceeding with the Contract as a direct result of one of the following conditions:

1. An Executive Order of the President of the United States with respect to the prosecution of war or in the interest of national defense.
2. The Engineer and Contractor each make a determination, that, due to a shortage of critical materials required to complete the Work which is caused by allocation of these materials to work of a higher priority by the Federal Government or any agency thereof, it will be impossible to obtain these materials within a practical time limit and that it would be in the public interest to discontinue construction.
3. An injunction is imposed by a court of competent jurisdiction which stops the Contractor from proceeding with the Work and causes a delay of such duration that it is in the public interest to terminate the Contract and the Contractor was not at fault in creating the condition which led to the court's injunction.

   The decision of the Engineer as to what is in the public interest and as to the Contractor's fault, for the purpose of Termination, shall be final.
4. Orders from duly constituted authority relating to energy conservation.

B. Implementation

When, under any of the conditions set out in Subsection A of this Section, the Contract, or any portion thereof, is terminated before completion of all Items of Work in the Contract, the Contractor shall be eligible to receive some or all of the following items of payment:

1. For the actual number of units of Items of Work completed, payment will be made at the Contract Unit Price.
2. Reimbursement for organization of the Work and moving equipment to and from the job will be considered where the volume of work completed is too small to compensate the Contractor for these expenses under the Contract Unit Prices. However, the Engineer's decision as whether or not to reimburse for organization of the Work and moving equipment to and from the job, and in what amount, shall be final.
3. Acceptable materials, obtained by the Contractor for the work, that have been inspected, tested, and accepted by the Engineer, and that are not incorporated in the work will, at the request of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer. This will include any materials that have been delivered to the project site or that have been specifically fabricated for the project and are not readily usable on other projects. It will not include materials that may have been ordered, but not delivered to the project site and that are readily usable on other projects (e.g., guard rail, stone, lumber, etc.).
4. For Items of work partially completed, payment adjustments including payments to afford the Contractor a reasonable profit on work performed, may be made as determined by the Engineer based upon a consideration of costs actually incurred by the Contractor in attempting to perform the Contract.
5. No payment will be made, and the Department will have no liability, for lost profits on work not performed. In particular, the Department will not be liable to the Contractor for all profits the Contractor expected to realize had the Project been completed, nor for any loss of business opportunities, nor for any other consequential damages.

6. In order that the Department may make a determination of what sums are payable hereunder, the Contractor agrees that, upon termination of the Contract, it will make all of its books and records available for inspection and auditing by the Department.

   To be eligible for payment, costs must have been actually incurred, and must have been recorded and accounted for according to generally accepted accounting principles and must be items properly payable under Department policies. Where actual equipment costs cannot be established by the auditors, payment for unreimbursed equipment costs will be made in the same manner as is provided in Subsection 109.05 for Force Account work. Idle time for equipment shall be reimbursed at standby rates. In no case will the Contractor be reimbursed for idle equipment after the Engineer has advised the Contractor the equipment is no longer needed on the job. Refusal of the Contractor to allow the Department to inspect and audit all of the Contractor's books and records shall conclusively establish that the Department has no liability to the Contractor for any payment under this provision and shall constitute a waiver by the Contractor of any claim for damages allegedly caused by breach or termination of the Contract. The amount payable under this provision, if any, is to be determined by the Engineer, whose determination will be final and binding.
7. The sums payable under this Subsection shall be the Contractor's sole and exclusive remedy for termination of the Contract.

C. Termination of a Contract

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

109.10 Interest

In the event any lawsuit is filed against the Department alleging the Contractor is due additional money because of claims or for any breach of contract, the Contractor hereby waives and renounces any right it may have under O.C.G.A. Section 13-6-13 to prejudgment interest. Also, the Contractor agrees that notwithstanding any provision or provisions of Chapter 11 of Title 13 of the Official Code of Georgia that the provisions of this contract control as to when and how the Contractor shall be paid for The Work. Further, the Contractor waives and renounces any and all rights it may have under Chapter 11 of Title 13 of the Official Code of Georgia.

109.11 Price Adjustments

A. Asphalt Cement Price Adjustments will be computed on a monthly basis in accordance with the following:

PA = Price Adjustment.

APM = the "Monthly Asphalt Cement Price (Georgia Base Asphalt Price)" for the month the hot mix asphalt/bituminous tack/bituminous surface treatment is placed.

APL = the "Monthly Asphalt Cement Price (Georgia Base Asphalt Price)" for the month which the project was let.
TMT = Total Monthly Tonnage of asphalt cement computed by the Engineer based on the Hot Mix Asphaltic Concrete of the various types per ton (megagram)//Total Monthly Tonnage of asphalt cement used for bituminous tack coat (asphalt cement tack coat only, emulsified bituminous materials for tack coat are excluded) converted from gallons to tons (megagrams) by the Engineer//Total Monthly Tonnage of asphalt cement used for bituminous surface treatment (total gallons of asphalt emulsion used, as measured from distributors, will be multiplied by a factor of 0.65 to determine the quantity in gallons of asphalt cement used) converted from gallons to tons (megagrams) by the Engineer and certified for payment.

1. If the asphalt cement price for the month is greater than the asphalt cement price for the month in which the project was let to contract, the contractor will be paid an amount calculated in accordance with the following formula:

   PA = [((APM-APL)/APL)] x TMT x APL

2. If the asphalt cement price for the month is less than the asphalt cement price for the month in which the project was let to contract, the Department will deduct an amount calculated in accordance with the following formula:

   PA = [((APM-APL)/APL)] x TMT x APL

   a. "Monthly Asphalt Cement Price"

      The Department will determine the "Monthly Asphalt Cement Price" based on the following formulas:

      Monthly Asphalt Cement Price = 100% Georgia Base Asphalt Price; Where;

      GBAP = "Georgia Base Asphalt Price", (in dollars/ton) is based on the arithmetic average posted price of PG asphalt cement as specified in Section 820, from the Department's monthly survey obtained from approved asphalt cement suppliers of bituminous materials to the Department projects Free on Board (F.O.B.) the supplier's terminal. However, the highest price and the lowest price are excluded from the calculation of price, GBAP.

   b. "Asphalt Cement Quantity Calculation":

      The calculation of asphalt cement quantity for each mix type will be based on the asphalt cement content (AC%) of the approved Job Mix Formula (JMF) as specified in Subsection 400.1.03.C. The following calculation formula will be used to determine asphalt cement quantity:

      Asphalt Cement Quantity = Hot Mix Asphaltic Concrete monthly total in tons (megagrams) per mix type certified for the payment x AC (%)

      The Total Monthly Tonnage (TMT) of asphalt cement computed by the Engineer will be calculated as follows:

      TMT = Sum of all asphalt cement quantities, including polymer modified asphalt binder and non- modified asphalt cement, based on the Hot Mix Asphaltic Concrete of the various mix types per ton (megagram)/ Sum of all asphalt cement quantities used as bituminous tack coat converted from gallons to tons (megagrams)/Sum of all asphalt cement quantities used for bituminous surface treatment (total gallons of asphalt emulsion used, as measured from distributors, will be multiplied by a factor of 0.65 to determine the quantity in gallons of asphalt cement used) converted from gallons to tons (megagrams) by the Engineer certified for payment.

      Asphalt Cement Price for the Month (APM) will be adjusted monthly. Price adjustments (PA) will be made monthly and all calculations for Price Adjustments shall be performed by the Engineer as specified in the *Guidelines for Asphalt Cement Price Adjustment* located on the Department web site.

B. Price Adjustment Trigger

No price adjustment will be made on any project with less than 366 Calendar Days from the Contract Letting Date to the specified completion date. If the original Contract contains 366 Calendar Days or more, the Price Adjustment shall be made on quantities placed from the Contract Letting Date to the specified completion date.

C. Monthly Asphalt Cement Price

The Department will publish a *Monthly Asphalt Cement Price* based on the formula contained within this specification.

D. Other Restrictions

1. No asphalt cement price adjustment will be made for cut-back, and emulsified asphalt when used for bituminous tack coat with Hot Mix Asphaltic Concrete Construction.
2. There is a cap of 60 percent above the APL for any price adjustment.
3. Unless specifically provided for by Supplemental Agreement or Contract Amendment, no positive Price Adjustments Asphalt Cement that result in a payment to the Contractor will be made after the original Contract Time has expired. Irrespective of any other provisions in the Contract, for purposes of this specification, *Contract Time* does not include any time extensions or Supplemental Agreements which affect the completion of the Contract. Negative Price Adjustments for Asphalt Cement for any work placed after the original Contract Time expires resulting in a return of funds to the Department will be made and shall be computed based on the Monthly Asphalt Cement Price at the time the Contract Time has expired or the Monthly Asphalt Cement Price at the time the Contract was let, whichever is less.

E. Final Adjustment

If there are differences between the final audited quantities and the sum of the quantities used to determine the asphalt cement adjustment, the Engineer will make a pro-rated increase or decrease in the price adjustment.

Payment for Price Adjustment will be made under:

Item No. 109	Price Adjustment- Asphalt Cement	$ (+/-)

Section 110 — Electronic Delivery Management System (e-Ticketing)

Replace Section 110 with the following:

110.1 General Description

This work shall consist of incorporating an Automated Electronic Ticketing (e-Ticketing) System for asphalt, concrete, and aggregate delivered to the project in order to monitor, track status, report location at material source and project delivery site and report loads of material during the construction processes from the point of measurement and load-out to the point of incorporation to the project. This work shall also include the submittal of electronic source documentation and certifications for other materials incorporated into the Work.

110.2 Construction Requirements

No fewer than 30 days prior to delivery or placement activities, the Contractor shall submit to the Engineer for approval an Automated Electronic Ticketing (e-Ticketing) System supplier that can provide a qualified representative for on-site technical assistance and training during the initial setup, pre-construction verifications, and data management and processing as needed during the project.

110.2.01 Equipment

Contractor shall provide operator settings, user manuals, and required viewing/export software for review, and ensure the equipment will meet the following:

- **A.** The Automated Electronic Ticketing (e-Ticketing) system shall include a method that is capable of tracking loading and placement of materials in all vehicles such as dump trucks, belly dumps, side-load dumps, pavers, materials transfer vehicles, or any other equipment used, for placement or delivery of weighted material on the project. The system will be required for all delivery vehicles and one material receiving equipment for each placement operation. Department personnel shall have the ability to access load information through the use of a state-furnished mobile device such as a tablet, smartphone, etc.
- **B.** The Automated Electronic Ticketing (e-Ticketing) system shall be fully integrated with the Contractor's Load Read-Out scale system at the material source site.
- **C.** The Automated Electronic Ticketing (e-Ticketing) system shall have the ability to provide location of vehicles and their contents at the material source and at the project delivery site. The system shall have offline capabilities to store load information due to loss of power or GPS connectivity.

Material source and delivery location sites shall have a reliable, stable internet connection. If necessary, contractor shall provide a local internet connection device in project areas with poor or no cell service. If a contractor can demonstrate that internet connection is not available, the Engineer may request that a paper tickets be supplied for validation of material delivered. The Engineer shall give one (1) day notice to receive paper tickets. All other submittals as described in Section 110.2.02 A and C are still required. The electronic ticket will be used for payment and the calculation of material quantities delivered, and the paper ticket will serve as an on-site validation of material delivered to the site.

Contractor shall install and operate equipment in accordance with the manufacturer's specifications. Contractor shall also verify the GPS is working within the requirements of this Specification.

110.2.02 Submittals

Contractor shall provide to the Engineer a means in which to gather report summaries by way of iOS App, Android app, and web pages. The Engineer may request data at any time during operations.

A. Asphalt

1. Delivery Load Information

- **a.** Provide the Engineer summary information on each delivery load for each truck:

(1) Name of Contractor and material producer
(2) Certified Weigher Number
(3) Project Number and County
(4) Truck Number
(5) Description of material
(6) Net Weight of material being transported (to the nearest 0.01 ton)
(7) Running Daily Total of Net Weight of material being transported (to the nearest 0.01 ton)

b. Provide individual fields for Inspector input of the following:

(1) Material Temperature
(2) Material waste – material waste shall be shown in summary and subtracted from total quantity delivered
(3) Comments

2. Daily Summary

The following summary of information shall be provided to the Engineer electronically in spreadsheet format and PDF by 12:00 p.m. the next working day following delivery of the material.

a. For each Material

(1) List of Individual Loads
(2) Contractor Name and material producer
(3) Description of material
(4) Project Number and County
(5) Truck Number
(6) Net Weight for Payment (nearest 0.01 tons)
(7) Date Placed
(8) Time Loaded
(9) Time accepted
(10) Delivery Location (Latitude/Longitude within 25 foot of actual placement)

b. For each Item

(1) Total Quantity Wasted (nearest 0.01 tons)
(2) Total Quantity for Payment (nearest 0.01 tons

B. Aggregaate

1. Delivery Load Information

a. Provide the Engineer summary information on each delivery load for each truck:

(1) Name of Contractor and material producer
(2) Certified Weigher Number
(3) Project Number and County
(4) Truck Number
(5) Description of material
(6) Net Weight of material being transported (to the nearest 0.01 ton)
(7) Running Daily Total of Net Weight of material being transported (to the nearest 0.01 ton)

b. Provide individual fields for Inspector input of the following:

(1) Material waste – material waste shall be shown in summary and subtracted from total quantity delivered
(2) Comments

2. **Daily Summary**

The following summary of information shall be provided to the Engineer electronically in spreadsheet format and PDF by 12:00 p.m. the next working day following delivery of the material.

a. For each Material
   (1) List of Individual Loads
   (2) Contractor Name and material producer
   (3) Description of material
   (4) Project Number and County
   (5) Truck Number
   (6) Net Weight for Payment (nearest 0.01 tons)
   (7) Date Placed
   (8) Time Loaded
   (9) Time accepted
   (10) Delivery Location (Latitude/Longitude within 25 foot of actual placement)

b. For each Item paid for by weight
   (1) Total Quantity Wasted (nearest 0.01 tons)
   (2) Total Quantity for Payment (nearest 0.01 tons

c. For each item paid for by volume or area
   (1) Number of trucks delivered
   (2) Status of delivery
      i. Stockpile
      ii. Incorporated into work

C. Concrete

1. **Delivery Load Information**

a. Provide the Engineer summary information on each delivery load for each truck:
   (1) Name of Contractor and material producer
   (2) Project Number and County
   (3) Truck Number
   (4) Description of material
   (5) Cubic Yard of material being transported (to the nearest 0.1 CY
   (6) Running Daily Total of Cubic Yard of material being transported (to the nearest 0.1 CY)
   (7) Time material loaded
   (8) Electronic copy of source material
   (9) Material Source for all ingredients

b. Provide individual fields for Inspector input of the following:
   (1) Water Added
   (2) Air
   (3) Slump
   (4) Revolutions at arrival
   (5) Revolutions at completion of pour
   (6) Revolutions at mixing speed
   (7) Comments

2. **Daily Summary**

The following summary of information shall be provided to the Engineer electronically in spreadsheet format and PDF by 12:00 p.m. the next working day following delivery of the material.

a. For each Material

(1) List of Individual Loads
(2) Contractor Name and material producer
(3) Description of material
(4) Project Number and County
(5) Truck Number
(6) Cubic Yard Nearest (0.1 CY)
(7) Date Placed
(8) Time Loaded
(9) Time accepted
(10) Delivery Location (Latitude/Longitude within 25 foot of actual placement or Structure)

b. For each Item

(1) Any loads rejected
(2) Total Quantity delivered (nearest 0.1 CY

D. For all Materials Listed Above– Real-Time Truck Status

Provide the Engineer the following information in real-time with a web-based system compatible with iOS and windows environments.

a. At Source – include scale location

b. At Destination – include:

(1) Project location
(2) Point of Delivery

c. In Route

d. Time of last status change

E. All other material

Provide invoices or material source as required by the specifications or the Qualified Product List (QPL) in PDF format to the Engineer.

110.3 Measurement

The following section details measurement for payment for the work described in this Section:

A. Except as provided herein, there will be no measurement for payment for the work covered by this Section.

B. Where required by the Plans, Automated Electronic Ticketing (e-Ticketing) system will be used.

C. This specification will be in effect for all asphaltic concrete pavement material delivered to the project under Sections 400, 402, 404, 409, 410, and 415 and for all material source verification covered by 110.2.E.

110.4 Payment

Except as provided for herein, the Department will not make separate payment for Automated Electronic Ticketing (e-Ticketing) system. The cost is included in the contract price for the material specified in the contract.

Payment for Electronic Delivery Management System will be full compensation for all costs related to providing the Automated Electronic Ticketing (e-Ticketing) system, equipped plants, pavers, and transfer vehicles, and any other equipment required for the construction and reporting process. All quality control procedures including the Automated Electronic Ticketing (e-Ticketing) systems representative's technical support and on-site training shall be included in the cost.

Delays due to GPS satellite reception of signals to operate equipment will not be considered justification for any adjustment to the "Basis of Payment" for any construction items or to Contract Time.

When shown in the Schedule of Items in the Proposal, the following item will be paid for separately for the material specified.

Payment will be made under:

Item No. 110	Electronic Delivery Management System	Per lump sum

Section 153—Field Engineer's Office

Replace Section 153 with the following:

153.1 General Description

This work includes providing, furnishing, and maintaining field office buildings, when the Contract requires, before beginning construction and according to this Specification. The Contractor shall possess the building while the Department uses it. See Subsection 153.3.07, *Contractor Warranty and Maintenance*.

The Engineering personnel will use the building exclusively for as long as they consider necessary, but no longer than the date of Final Acceptance of the project.

153.1.01 Definitions

General Provisions 101 through 150.

153.1.02 Related References

A. Standard Specifications

Section 636—Highways Signs

Section 643—Fence

Section 910—Sign Fabrication

Section 911—Sign Posts

Section 912—Sign Blanks and Panels

Section 913—Reflectorizing Materials

B. Referenced Documents

NFPA-10A

153.1.03 Submittals

Before installing Project Office signs, submit a signage plan for this work to the Engineer for approval.

153.2 Materials

Ensure that all materials are of commercial grade. Sampling and testing are not required.

153.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

153.3 Construction Requirements

153.3.01 Personnel

General Provisions 101 through 150.

153.3.02 Equipment

General Provisions 101 through 150.

153.3.03 Preparation

General Provisions 101 through 150.

153.3.04 Fabrication

Install a sign at the Department of Transportation Project Office in the format shown in Figure 1. This sign shall be plainly visible from the Project roadway. Fabricate and install the sign according to Section 636, Section 910, Section 911, Section 912, and Section 913.

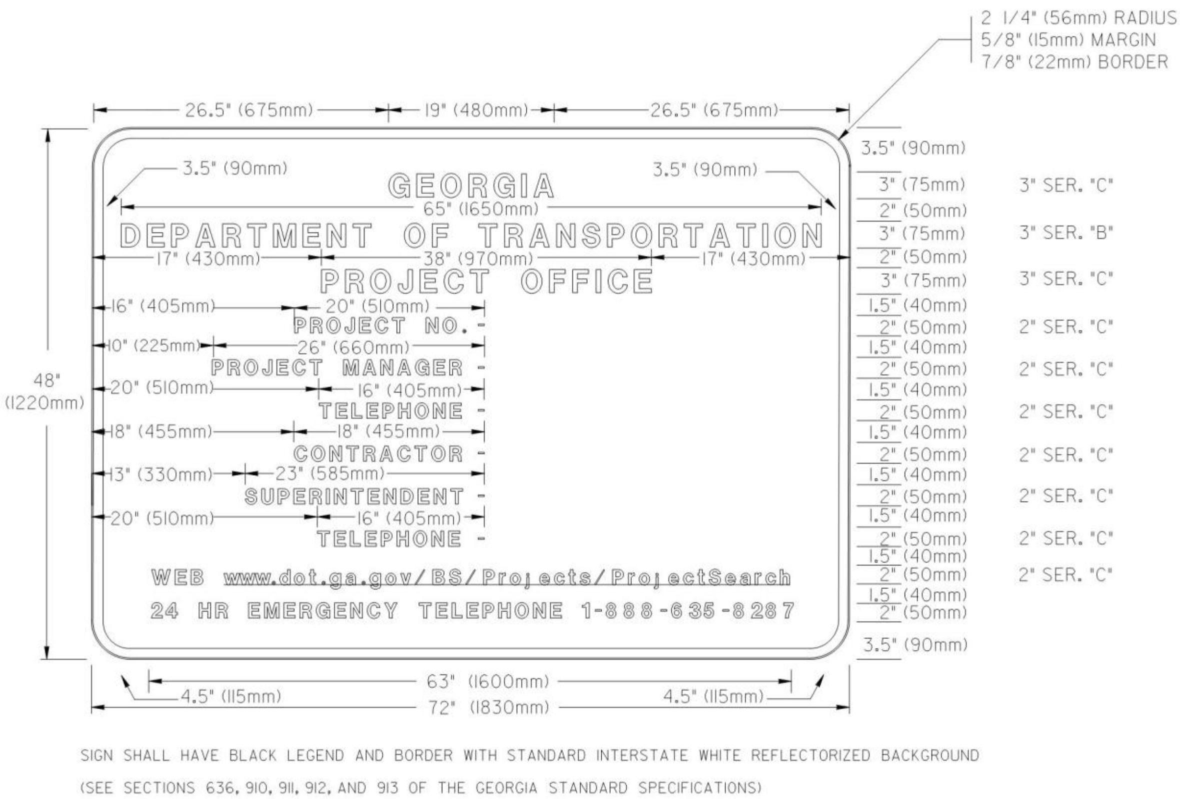


FIGURE 1

If the Project Office is not located adjacent to the Project roadway, install a second sign on the Project according to these specifications and as directed by the Engineer and enough guide signs to direct the traveling public to the Project Office.

Guide signs shall be 24 in. (600 mm) high by 42 in. (1050 mm) wide with 4 in. (100 mm) high lettering and shall include a directional arrow. The guide sign shall have a white legend with a blue background. Refer to Figures 2 and 3.

Before installing the signs, submit a signage plan to the Engineer for this work.

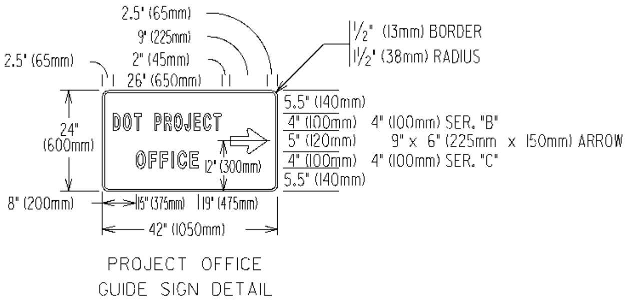


FIGURE 2

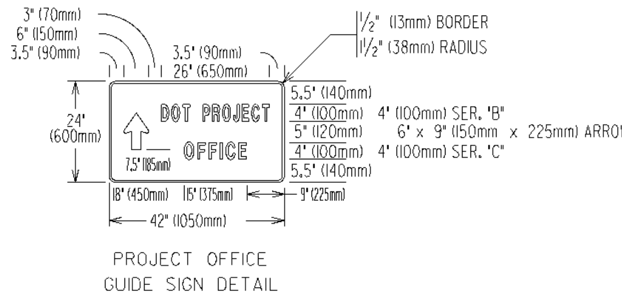


FIGURE 3

153.3.05 Construction

A. Field Engineer's Office Location

Current field office buildings are designated as Type 3. Type 1 and Type 2 field offices are obsolete.

Office Building Type 3: Place this office either within the Project limits or near the Project at the Engineer's direction. Place the building within 1000 ft. (300 m) of a power line if possible. If power lines are farther than 1000 ft. (300 m) away, payment shall be made according to Subsection 153.5.

The preferred location for the field office is within the project limits. Whether the field office is placed within the project limits or not, all locations shall meet all Federal, State, and Local laws and environmental codes and regulations. Field office request shall be submitted in writing to the Department for review prior to placement. The contractor shall be responsible for verifying that the location is not in an environmental sensitive area. The contractor shall be responsible for obtaining all permits.

B. Building Requirements

The Field Engineer's office may be a building, house, mobile office, or trailer if it is approved and conforms closely to this specification. Ensure that the office building meets the following minimum requirements:

1. **Dimensions:** All measurements shown are clear inside dimensions.

	Constructed on Project			Commercially Produced		
	In Linear Feet (Meters)			In Linear Feet (Meters)		
Building	Width	Length	Head-room	Width	Length	Head-room
Type 3	12 (3.66)	50 (15.24)	8 (2.44)	11.5 (3.51)	49.5 (15.09)	7 (2.13)

2. **Doors and Windows:** Ensure that each building has at least two standard height solid entrance doors with locks. Provide the Department 6 sets of entry keys. At least one of the doors shall have a covered entranced.

   Each wall, unless predominately occupied by a door, shall have at least one hinged, jalousied, or sliding window that is glazed, screened, and fitted with venetian blinds. Each window shall measure at least 6.5 ft.^{2} (0.6 m^2), except the window in the toilet area which may be 3.25 ft.^{2} (0.3 m2). Each Type 3 building shall have at least 8 windows.

3. **Walls and Roof:** If the building is constructed on the Project, construct the walls and roofs of all building types with studs and rafters measuring 2 in. by 4 in. (38 mm by 89 mm).

   Include in the walls and ceilings insulating material that is at least 1 1/4 in. (32 mm) thick and made of rock wool, fiberglass, or other non-flammable material. Ensure that this material is in all inner wall and ceiling cavities.

a. Walls: Cover both sides of the walls with 3/8 in. (10 mm) plywood (exterior grade on the outside). No open cracks or knotholes are permitted. Standard wall construction is accepted if the walls are commercially produced.

b. Roof: Ensure that the roof is watertight and has a minimum slope of 1:12 in one direction, away from the door. Ensure that the roof's eaves are at least 12 in. (300 mm). If the building is commercially produced, an arched roof without eaves is acceptable.

4. **Ceiling:** Cover the ceiling on all building types on the inside of the roof rafters with 3/8 in. (10 mm) plywood if constructed on the project. A standard ceiling will be accepted if the building is commercially produced.

5. **Floor:** Ensure that the floor is a minimum of 12 in. (300 mm) above the ground on 2 in. by 6 in. (38 mm by 152 mm) joists. The floor may be timber. No open cracks or knotholes are permitted.

6. **Heater:** Provide an oil fired, gas, or electric heater. But ensure that the heater can maintain an inside minimum temperature of 72 °F (22 °C).

   Properly vent oil and gas units to the outside, provide adequate outside fuel storage, and connect with suitable feed lines.

   Gas units may be connected to a commercial gas main, if available.

7. **Worktables:** Provide a minimum of four (4) standard dimension desks. They shall be provided with a minimum of 1 1/8 in. (28mm) wood grain laminated tops with 23 in. (575mm) deep files and heavy-duty steel ball bearing drawers and locking center drawer and keys. Provide one (1) 5 ft. by 3 ft. (1500mm by 900mm) adjustable from 0 to 45 degree and 38 in. (950mm) high drafting table. Provide two (2) 6 ft. by 2.5 ft. (1800mm by 750mm) standard height folding tables.

8. **Chairs and Stools:** Provide one (1) posture stool with supportive backrest, waterfall edge seat and instant height lever (26 in. to 30 in.) (650mm to 750mm). Provide a minimum of six (6) fully braced stackable full 2 in. (50mm) thick 16 in. X 15 in. (400mm by 375mm) seats with armrests and chrome frames. Provide six (6) standard folding metal chairs. Provide a minimum of four (4) swivel chairs with arms and a 19 in. X 19 in. (475mm X 475mm) foam cushion and upholstered seat adjustable from 16 ½ in. to 20 in. (415mm to 500mm) high.

9. **Miscellaneous Storage Shelves:** Provide 6 linear ft. (1800 linear mm) of storage shelves for books, etc. on each end of the building. If two 3 ft. (900 mm) shelves are furnished, place them at least 1 ft. (300 mm) apart vertically.

10. **Toilet Facilities:** Provide indoor toilet facilities that meet local sanitary codes. Provide consumable and non-consumable goods (toilet paper, paper towels, hand soap, bathroom cleaning supplies, toilet brush, plunger, etc.) for the life of the project.

11. **Utilities:** Connect all utilities including water, sewage, gas, electricity, and telephone service to their service source, ready for use, before the Engineer's occupancy. Process and pay the monthly bills for all utility services.

12. **Electric Service:** Provide 120/240-volt electric service that meets code.

13. **Hot Water:** Provide hot water to the bathroom sink.

14. **Air Conditioner:** Provide an air conditioning unit capable of cooling the building to maintain an inside temperature at least 20 °F (7 °C) cooler than the outside temperature.

15. **Fire Extinguisher:** Equip each building with at least one approved fire extinguisher that meets the following requirements:

    - Multipurpose dry chemical type extinguisher
    - Underwriters Laboratory rating 4A-40BC

Mount the extinguisher(s) in a convenient and conspicuous location that is easily accessible from any part of the building.

Maintain the extinguisher(s) according to the requirements of NFPA–10A.

16. **Telephone:** Provide two voice lines, with rollover capabilities, connected to two handsets (located on either end of the office). Install and maintain these lines for the life of the project. Provide telephone access to the Local Area Telephone Service (LATS) only for outgoing, credit card, collect and toll-free calls. Ensure that the telephones can receive incoming non-collect long-distance calls.

    Provide the telephone with conference call capabilities; provide an automatic answering system that can give a greeting message, record incoming messages, and activate remotely.
17. **Project Sign:** Complete as shown in Subsection 153.3.04, *Fabrication*. Install at the Department of Transportation Project Office at a location plainly visible from the project roadway.
18. **Locking File Cabinets:** Provide two (2) four-drawer, letter size, steel, fireproof, lockable, and must have at least two keys.
19. **Plan Racks:** Provide rack(s) capable of holding one complete sets of project plans (not more than 100 sheets per hanger).
20. **Enclosed Closet:** Provide one closet at least 3 ft. by 3 ft. (900 mm by 900 mm) with a lockable door and at least two keys.
21. **Potable Water:** Provide potable drinking water by a water cooler or bottled water.
22. **Garbage:** Provide 6 office trash cans. Provide dumpster, or exterior garbage cans, with pickup for a minimum of twice monthly.
23. **Outside Electrical Receptacle:** Provide a weather-proof, exterior 220-volt electrical receptacle attached to a power source.
24. **Chain Link Fence:** Field office compound to be fenced in for the sole use and purpose for the Department’s field Engineer’s Office. Provide a minimum of 600 ft. (180 m) of 6 ft. (1.8 m) high chain link fence with an extension arm and barbed wire as specified in Section 643. Equip the fence with matching gates and meeting the requirements of Section 643 and consisting of a double 7 ft. (2.1 m) by 6 ft. (1.8 m) and a single 4 ft. (1.2 m) by 6 ft. (1.8 m) gate. Include a positive-type locking devices, padlock and a minimum of two keys for each gate. Ensure the fence encompasses the entire compound.
25. **Security Light:** Provide two 150-watt high-pressure sodium, or LED equivalent, security lights with photoelectric controls. Place as directed by the Engineer.
26. **Aggregate Surface Course:** Place and spread 250 tons (225 Mg) of aggregate surface course on the Office grounds where indicated by the Engineer to facilitate parking. Remove aggregate and grass the area upon completion of the project or leave-in-place if property owner accepts the placed material as-is and provides an appropriate release waiver.
27. **Office Support:** The Office shall be supported with concrete blocks with mortar joints, and it shall be anchored with ten storm-tie-down anchors. Enclose the area between the ground and the bottom of the Office with a vinyl skirting that matches the Office’s siding.
28. **Alarm System:** Install an alarm system that includes the following items and maintain in good operating condition:
    - SRN-2000 Enforced Bisonic with NAPCO Magnum Alert 850 – control box or Honeywell Vista-10P Master Control Panel with Honeywell 6150RF keypad or equivalent. System shall be connected to a monitoring system via a telephone line, or via wireless connectivity.
    - All doors and windows with contacts.
    - Outside sirens with contacts.

- Tamper-proof box with contacts.
- Inside sirens with contacts.
- Two smoke and heat detectors.

Tie all of the above equipment to a 24-hour control monitoring system (BRK –2812TH or equivalent).

Process and pay the monthly bills for the alarm system and monitoring.

29. Information Technology:

Provide technology meeting the following minimum requirements:

a. Copying Machine / Printer:

Furnish the Field Office with one copying machine/printer with network printing abilities to be installed and maintained for the life of the Project. Furnish machine having the capability of scanning, printing, emailing, and copying letter-size (8 ½" x 11"), legal-size (8 ½"x 14"), ledger-size (11" x 17"), two-sided copies, at least thirty copies per minute, and possess an auto-feed feature. Furnish all consumable and non-consumable supplies for the life of the Project.

b. Uninterruptible Power Supply:

American Power Conversion Corporation Back-UPS BE750G or Cyberpower OR750PFCLCD or equivalent (minimum 5 receptacles).

c. Cable, 4G/LTE Broadband, or DSL Internet Service:

Provide Cable, 4G/LTE Broadband, or DSL Internet Service with static IP address as approved by GDOT IT Infrastructure. 4G/LTE modem shall be compatible with Mobile Broadband Router. This must be a turn-key solution that includes ISP modem/router capable of handoff to an unmanaged 16 port switch

d. Office to be punched-out and wired for CAT6:

CAT6 network jacks should be installed approximately every 10 feet along the walls of the trailer (restroom excluded), with a minimum of 4 network jacks per side office, and a minimum of 6 network jacks in the main room. CAT6 cables will be run from the CAT6 network jacks back to field office closet and terminate into a patch panel. All network jacks shall be terminated, tested, toned, and labeled. Contractor to provide a 16-port unmanaged gigabit switch and cables to connect patch panel to switch. Contractor shall also provide a shelf to support the equipment 5 feet off the floor, and a power source in the closet to power network equipment.

e. Available subnets for network:

Subnets configured must not overlap internal GDOT corporate subnets. The below subnets are what GDOT currently uses for their corporate networks.

· 10.28.0.0/16	· 10.10.255.0/24	· 10.10.52.0/24	· 10.201.0.0/16
· 10.38.0.0/16	· 10.11.255.0/24	· 10.10.51.0/24	· 10.202.0.0/16
· 143.100.0.0/16	· 192.168.0.0/16	· 10.2.105.0/24	· 10.110.0.0/16
· 10.90.0.0/15	· 10.0.105.0/24	· 10.251.0.0/16	· 10.160.0.0/16
· 10.99.0.0/15	· 10.1.105.0/24	· 10.255.0.0/16	· 10.220.0.0/16
· 10.100.0.0/16	· 10.2.205.0/24	· 10.252.0.0/15	· 10.10.0.0/16
· 172.20.0.0/16			

f. A minimum of one, thirty six (36) inch computer monitor with wall mounting to be provided. Monitor shall be mounted to the wall as directed by the Engineer. Monitor shall have HDMI and USB-C connectivity. The monitor shall have minimum resolution capability of 1920x1080p. A minimum of one 10 ft' HDMI 2.0 cable and 10 ft USB-C to USB-C cable to be supplied with the monitor.

30. Concrete Cylinder Curing Box: Furnish a Concrete Curing Box for any project that requires the placement of concrete. The curing box and its components shall be constructed of non-corroding materials and shall be capable of storing a minimum of 22 test cylinders, 6 in. by 12 in. (150 mm by 300 mm) stored vertically with the lid closed. Additional capacity may be required on large projects at the direction of the Engineer. The curing box shall be equipped with heating/cooling capabilities, automatic temperature control, and a maximum/minimum (high/low) temperature readout. The curing box shall be capable of meeting the moisture and temperature requirements of AASHTO T 23.

For projects that require a concrete cylinder curing box, furnish an outside water faucet and a water hose long enough to reach the curing box.

C. Installation timeframe

The Field Engineer's Office location shall be submitted to the Engineer within 10 days of receiving the Notice to proceed. Upon approval of the location by the Department, the complete installation of the Field Engineer's Office shall occur within 60 days of the location approval.

153.3.06 Quality Acceptance

General Provisions 101 through 150.

153.3.07 Contractor Warranty and Maintenance

Whether the building is owned, leased, or rented, the Contractor who provides the building retains possession of each office building. Contractor shall provide regular maintenance to the facility, to include weed control and pest control.

The Engineer will control the use, location, relocation, and removal of the building. When the building is no longer needed, remove each building from the Project at the Engineer's direction.

Retain possession of all items that are required as part of the Field Office when the Engineer determines that these items are no longer needed.

153.4 Measurement

Field Engineer's offices Type 3, as required by the Engineer, will be paid for per each; provided each was moved to or constructed on the Project according to the Specifications.

153.4.01 Limits

The offices are measured for payment on each project one time only regardless of the number of times they are moved at the Engineer's direction.

153.5 Payment

The use of each office building eligible for payment is paid for at the Contract Unit Price bid. Payment is full compensation for the cost of the location, materials, design, construction, furnishings, maintenance, fuel, water, sewage disposal, garbage service, electricity, telephone service, movements within the Project, and movement to and from the Project. Failure to completely install or maintain the Field Engineer's Office may result in the Department withholding progress payments on the project.

The cost of necessary transformers is included in the price bid for Type 3 office buildings. Any cost incurred for carrying electric current over 1000 ft. (300 m) from a power line is paid for by Force Account.

Payment for each Field Engineer's office is made in two installments:

- 65 percent of the Contract Price is paid when the office is completely installed and ready for occupancy.
- 35 percent is paid when the Department has finished using the office.

Payment will be made under:

Item No. 153	Field Engineer's Office Type 3	Per each

Section 163—Miscellaneous Erosion Control Items

Replace Section 163 with the following:

163.1 General Description

This work includes constructing and removing:

- Silt control gates
- Temporary erosion control slope drains shown on the Plans or as directed
- Temporary sediment basins
- Sediment barriers and check dams
- Rock filter dams
- Stone filter berms
- Stone filter rings
- Temporary sediment traps
- Other temporary erosion control structures shown on the Plans or directed by the Engineer

This work also includes applying mulch (e.g., straw, hay, erosion control compost), and temporary grass.

163.1.01 Related References

A. Standard Specifications

Section 109—Measurement and Payment

Section 161—Control of Soil Erosion and Sedimentation

Section 171—Silt Fence

Section 500—Concrete Structures

Section 576—Slope Drain Pipe

Section 603—Rip Rap

Section 700—Grassing

Section 711—Turf Reinforcement Matting

Section 716—Erosion Control Mats (Slopes)

Section 720 – Triangular Silt Barrier

Section 800—Coarse Aggregate

Section 801—-Fine Aggregate

Section 822—Emulsified Asphalt

Section 845—Smooth Lined Corrugated Polyethylene (PE) Culvert Pipe

Section 860—Lumber and Timber

Section 863—Preservative Treatment of Timber Products

Section 881—Fabrics

Section 890—Seed and Sod

Section 893—Miscellaneous Planting Materials

B. Referenced Documents

AASHTO M252

AASHTO M294

163.1.02 Submittals

Provide written documentation to the Engineer as to the average weight of the bales of mulch.

163.2 Materials

Provide materials shown on the Plans, such as pipe, spillways, wood baffles, and other accessories including an anti-seep collar, when necessary. The materials shall remain the Contractor's property after removal, unless otherwise shown on the plans.

Materials may be new or used; however, the Engineer shall approve previously used materials before use.

Materials shall meet the requirements of the following specifications:

Material	Section
Mulch	893.2.02
Temporary Silt Fence	171
Concrete Aprons and Footings shall be Class A	500
Rip Rap	603
Temporary Grass	700
Triangular Silt Barrier	720
Coarse Aggregate	800
Lumber and Timber	860.2.01
Preservative Treatment of Timber Products	863.1
Corrugated Polyethylene Temporary Slope Drain Pipe	845

163.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

163.3 Construction Requirements

163.3.01 Personnel

General Provisions 101 through 150.

163.3.02 Equipment

General Provisions 101 through 150.

163.3.03 Preparation

General Provisions 101 through 150.

163.3.04 Fabrication

General Provisions 101 through 150.

163.3.05 Construction

Equivalent devices, as accepted by GDOT, shall be installed as accepted by GSWCC and shown in the Equivalent BMP List on the GSWCC Document List page.

A. Silt Control Gates

If silt control gates are required or are directed by the Engineer, follow these guidelines to construct them:

1. Clear and grade only that portion of the roadway within the affected drainage area where the drainage structure will be constructed.
2. Construct or install the drainage structure and backfill as required for stability.
3. Install the silt control gate at the inlet of the structure. Use the type indicated on the plans.
4. Vary the height of the gate as required or as shown on the plans.
5. Finish grading the roadway in the affected drainage area. Grass and mulch slopes and ditches that will not be paved. Construct the ditch paving required in the affected area.
6. Keep the gate in place until the work in the affected drainage area is complete and the erodible area is stabilized.
7. Remove the Type 1 silt gate assembly by sawing off the wood posts flush with the concrete apron. Leave the concrete apron between the gate and the structure inlet in place. The gate shall remain the property of the Contractor.

B. Temporary Slope Drains

If temporary slope drains are required, conduct the roadway grading operation according to Section 161 and follow these guidelines:

1. Place temporary pipe slope drains with inlets and velocity dissipaters (straw bales, silt fence, or aprons) according to the plans.
2. Securely anchor the inlet into the slope to provide a watertight connection to the earth berm. Ensure that all connections in the pipe are leak proof.
3. Place temporary slope drains at a spacing of 350 ft. (105 m) maximum on a 0% to 2% grade and at a spacing of 200 ft. (60 m) maximum on steeper grades, or more frequently as directed by the Engineer. Keep the slope drains in place until the permanent grass has grown enough to control erosion.
4. Remove the slope drains and grass the disturbed area with permanent grass. However, the temporary slope drains may remain in place to help establish permanent grass if approved by the Engineer.

C. Temporary Sediment Basins

Construct temporary sediment basins according to the Plans at the required locations, or as modified by the Engineer.

1. Construct the unit complete as shown, including:
   - Grading
   - Drainage
   - Riprap
   - Spillways
   - Anti-seep collar
   - Temporary mulching and grassing on internal and external slopes

- Accessories to complete the basin

2. When the sediment basin is no longer needed, remove and dispose of the remaining sediment.
3. Remove the sediment basin. Grade to drain and restore the area to blend with the adjacent landscape.
4. Mulch and permanently grass the disturbed areas according to Section 700.

D. Sediment Barriers

Construct sediment barriers according to the Plan details.

The following items may be used for sediment barriers

1. Type A Silt Fence.
2. Type C Silt Fence.
3. Rectangular, mechanically produced and standard-sized baled wheat straw.
4. Triangular Silt Barrier.
5. Synthetic Fiber: Use synthetic fiber bales of circular cross section at least 18 in. (450 mm) in diameter. Use synthetic bales of 3 ft. or 6 ft. (0.9 m or 1.8 m) in length that are capable of being linked together to form a continuous roll of the desired total length. Use bales that are enclosed in a geotextile fabric and that contain a pre-made stake hole for anchoring.
6. Coir: Use coir fiber bales of circular cross section at least 16” (400mm) in diameter. Use coir bales of 10 ft., 15 ft., or 20 ft. (3 m, 4.5 m, or 6 m) in length. Use coir baled with coir twine netting with 2 in. X 2 in. (50 mm X 50 mm) openings. Use coir bales with a dry density of at least 7 $lb/ft.^3$ (112 kg/m^3). Anchor in place with 2 in. X 4 in. (50 mm X 100 mm) wooden wedges with a 6 in. (150 mm) nail at the top. Place wedges no more than 36 in. (900 mm) apart.
7. Excelsior: Use curled aspen excelsior fiber with barbed edges in circular bales of at least 18 in. (450 mm) in diameter and nominally 10 ft. (3 m) in length. Use excelsior baled with polyester netting with 1 in. X 1 in. (25 mm by 25 mm) triangular openings. Use excelsior bales with a dry density of at least 1.4 $lb/ft.^3$ (22 kg/m^3). Anchor in place with 1 in. (25 mm) diameter wooden stakes driven through the netting at intervals of no more than 2 ft. (600 mm).
8. Compost Filter Sock: Use general use compost (see Subsection 893.2.02.A.5.b) in circular bales at least 18 in. (450 mm) diameter. Use compost baled with photo-degradable plastic mesh 5 mils thick with a maximum 0.38 in X 0.38 in (10 mm X 10 mm) openings. Anchor in place with 1 in. (25 mm) diameter wooden stakes driven through the netting at intervals of no more than 2 ft. (600 mm) in concentrated flow applications and no more than 5 ft. (1500 mm) in sheet flow applications. The sock shall be dispersed on site when no longer required, as determined by the Engineer. Do not use Compost Filter Socks in areas where the use of fertilizer is restricted.
9. Compost Filter Berm: Use erosion control compost (see Subsection 893.2.02) to construct an non-compacted 1.5 ft. to 2 ft. (450 mm to 600 mm) high trapezoidal berm which is approximately 2 ft. to 3 ft. (600 mm to 1 m) wide at the top and minimum 4 ft. (1.2 m) wide at the base. Do not use Compost Filter Berms in areas where the use of fertilizer is restricted.

   The construction of the compost filter berm includes the following:

   a. Keeping the berm in a functional condition.
   b. Installing additional berm material when necessary.
   c. Removing the berm when no longer required, as determined by the Engineer. At the Engineer’s discretion, berm material may be left to decompose naturally, or distributed over the adjacent area.

E. Other Temporary Structures

When special conditions occur during the design stage, the plans may show other temporary structures for erosion control with required materials and construction methods.

F. Temporary Grass

Use a quick-growing species of temporary grass such as rye grass, millet, or a cereal grass suitable to the area and season.

Use temporary grass in the following situations:

- When required by the Specifications or directed by the Engineer to control erosion where permanent grassing cannot be planted.
- To protect an area for longer than mulch is expected to last (60 calendar days), plant temporary grass as follows:
  1. Use seeds that conform to Subsection 890.2.01, *Seed*. Perform seeding according to Section 700; except use the minimum ground preparation necessary to provide a seed bed if further grading is required.
  2. Prepare areas that require no further grading according to Subsection 700.3.05.A, *Ground Preparation*. Omit the lime unless the area will be planted with permanent grass without further grading. In this case, apply the lime according to Section 700.
  3. Apply mixed grade fertilizer at 400 lbs./acre (450 kg/ha). Omit the nitrogen. Mulch (with straw or hay) temporary grass according to Section 700. (Erosion control compost Mulch will not be allowed with grassing.)
  4. Before planting permanent grass, thoroughly plow and prepare areas where temporary grass has been planted according to Subsection 700.3.05.A, *Ground Preparation*.
  5. Apply Polyacrylamide (PAM) to all areas that receive temporary grassing.
  6. Apply PAM (powder) before grassing or PAM (emulsion) to the hydroseeding operation.
  7. Apply PAM according to manufacturer specifications.
  8. Use only anionic PAM.

For projects that consist of shoulder reconstruction and/or shoulder widening, refer to Section 161.3.05H for Wood Fiber Blanket requirements.

G. Mulch

When staged construction or other conditions prevent completing a roadway section continuously, apply mulch (straw or hay or erosion control compost) to control erosion. Mulch may be used without temporary grassing for 60 calendar days or less. Areas stabilized with only mulch (straw/hay) shall be planted with temporary grass after 60 calendar days.

Apply mulch as follows:

9. Mulch (Hay or Straw) - Without Grass Seed
   a. Uniformly spread the mulch over the designated areas from 2 in. to 4 in. (50 mm to 100 mm) thick.
   b. After spreading the mulch, walk in the mulch by using a tracked vehicle (preferred method), empty sheep foot roller, light disking, or other means that preserves the finished cross section of the prepared areas. The Engineer will approve of the method.
   c. Place temporary mulch on slopes as steep as 2:1 by using a tracked vehicle to imbed the mulch into the slope.
   d. When grassing operations begin, leave the mulch in place and plow the mulch into the soil during seed bed preparation. The mulch will become beneficial plant food for the newly planted grass.
10. Erosion control compost - Without Grass Seed
   a. Uniformly spread the mulch (erosion control compost) over the designated areas 2 in. (50 mm) thick.
   b. When rolling is necessary, or directed by the Engineer, use a light corrugated drum roller.
   c. When grassing operations begin, leave the mulch in place and plow the mulch into the soil during seed bed preparation. The mulch will become beneficial plant food for the newly planted grass.
   d. Plant temporary grass on area stabilized with mulch (erosion control compost) after 60 calendar days.
   e. Do not use Erosion Control Compost in areas where the use of fertilizer is restricted.

H. Miscellaneous Erosion Control Items Not Shown on the Plans

When conditions develop during construction that were unforeseen in the design stage, the Engineer may direct the Contractor to construct temporary devices such as but not limited to:

- Bulkheads
- Sump holes
- Half round pipe for use as ditch liners
- U-V resistant plastic sheets to cover critical cut slopes

The Engineer and the Contractor will determine the placement to ensure erosion control in the affected area.

I. Diversion Channels

When constructing a culvert or other drainage structure in a live stream that requires diverting a stream, construct a diversion channel.

J. Check Dams

Check dams are constructed of the following materials;

- Stone plain riprap according to Section 603 (Place woven plastic filter fabric on ditch section before placing riprap.)
- Sand bags as in Section 603 without Portland cement
- Baled wheat straw
- Compost filter socks
- Fabric (Type C silt fence)

Check dams shall be constructed according to plan details and shall remain in place until the permanent ditch protection is in place or being installed and the removal is approved by the Engineer.

K. Construction Exits

Locate construction exits at any point where vehicles will be leaving the project onto a public roadway. Install construction exits and tire wash area at the locations shown in the plans and in accordance with plan details.

Construction exit tire cleaning station shall be installed when conditions dictate additional tire cleaning measures are necessary to assist in protecting public roadways. Tire cleaning station shall consist of two pressure washers, water source and necessary labor and materials to clean tires of exiting vehicles. When conditions warrant the use of the tire cleaning station or as directed by the Engineer, the Department will pay $750 dollars per day for the use. The Contractor may submit other construction exit tire wash assembly and sediment storage methods for review and approval by the Engineer.

L. Retrofits

Add the retrofit device to the permanent outlet structure as shown on the plan details.

When all land disturbing activities that would contribute sediment-laden runoff to the basin are complete, clean the basin of sediment and stabilize the basin area with vegetation.

When the basin is stabilized, remove the retrofit device from the permanent outlet structure of the detention pond.

M. Inlet Sediment Traps

Inlet sediment traps consist of a temporary device placed around a storm drain inlet to trap sediment. An excavated area adjacent to the sediment trap will provide additional sediment storage.

Inlet sediment traps may be constructed of Type C silt fence, plastic frame and filter, hay bales, baffle box, or other filtering materials approved by the Engineer. Construct inlet sediment traps according to the appropriate specification for the material selected for the trap. Place inlet sediment traps as shown on the plans or as directed by the Engineer.

N. Rock Filter Dams

Construct rock filter dams of the material selected as shown in the approved erosion and sediment control plan. Construct and place this item in accordance with the approved erosion control construction detail(s) and Standard Specification Section 603.

Rock filter dams shall remain in place until the permanent ditch protection is in place or is being installed and their removal is approved by the Engineer.

O. Stone Filter Berms

Construct stone filter berms of the material selected as shown in the approved erosion and sediment control plan. Construct and place this item in accordance with the approved erosion control construction detail(s) and Standard Specification Section 603.

Stone filter berms shall remain in place until the permanent slope protection is in place or is being installed and their removal is approved by the Engineer.

P. Stone Filter Rings

Construct stone filter rings of the material selected as shown in the approved erosion and sediment control plan. Construct and place this item in accordance with the approved erosion control construction detail(s) and Standard Specification Section 603.

A stone filter ring shall remain in place until final stabilization of the area which drains toward it is achieved and its removal is approved by the Engineer.

Q. Temporary Sediment Traps

Construct temporary sediment traps of the material selected as shown in the approved erosion and sediment control plan. Construct and place this item in accordance with the approved erosion control construction detail(s) and Standard Specification Section 603.

A temporary sediment trap shall remain in place until final stabilization of the area which drains toward it is achieved and its removal is approved by the Engineer.

163.3.06 Quality Acceptance

General Provisions 101 through 150.

163.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

163.4 Measurement

Equivalent devices shall be measured in the same manner as the device to which they are equivalent.

A. Silt Control Gates

Silt control gates are measured for payment by the entire structure constructed at each location complete in place and accepted. Silt control gates constructed at the inlet of multiple lines of drainage structures are measured for payment as a single unit.

B. Temporary Slope Drains

Temporary slope drains are measured for payment by the linear foot (meter) of pipe placed. When required, the inlet spillway and outlet apron and/or other dissipation devices are incidental and not measured separately.

C. Temporary Sediment Basins

Temporary sediment basins are measured for payment by the entire structure complete, including construction, maintenance, and removal. Temporary grassing for sediment basins is measured separately for payment. Measurement also includes:

- Earthwork
- Drainage
- Spillways
- Baffles
- Riprap
- Final cleaning to remove the basin

D. Sediment Barriers

Sediment barriers are measured by the linear foot (meter).

E. Other Temporary Structures

Other temporary structures are not measured for payment. Costs for the entire structure complete, including materials, construction (including earthwork), and removal is included in the price bid for the drainage structure or for other Contract items.

F. Temporary Grass

Temporary grass is measured for payment by the acre (hectare). Lime, when required, is measured by the ton (megagram). Mulch and fertilizer are measured separately for payment.

G. Mulch

Mulch (straw or hay, or erosion control compost) is measured for payment by the ton (megagram).

H. Miscellaneous Erosion Control Items Not Shown on the Plans

These items are not measured for payment. The cost for construction, materials, and removal is included in the price bid for other contract items.

I. Diversion Channels

Diversion channels are not measured for payment. The cost for the entire structure complete, including materials, construction (including earthwork), and removal is included in the price bid for the drainage structure or for other contract items.

J. Check Dams

Stone, sand bags, baled wheat straw, and compost filter sock check dams are measured per each, which includes all work necessary to construct the check dam including woven plastic filter fabric placed beneath stone check dams. Fabric check dams are measured per linear foot.

K. Construction Exits

Construction exits are measured per each which will include all work necessary to construct the exit including the required geotextile fabric placed beneath the aggregate.

Construction exit tire cleaning station are measured per day when added to an existing construction exit. Measurement includes all work necessary to construct the construction exit tire cleaning station including equipment, material, water source, and removal.

L. Retrofits

Retrofit will be measured for payment per each. The construction of the detention pond and permanent outlet structure will be measured separately under the appropriate items.

M. Inlet Sediment Traps

Inlet sediment traps, regardless of the material selected, are measured per each which includes all work necessary to construct the trap including any incidentals and providing the excavated area for sediment storage.

N. Rock Filter Dams

Rock filter dams are measured for payment per each required. This includes the entire structure at each location and all the work necessary for construction.

O. Stone Filter Berms

Stone filter berms are measured for payment per linear foot (meter) required. This includes the entire structure at each location and all the work necessary for construction.

P. Stone Filter Rings

Stone filter rings are measured for payment per each required. This includes the entire structure at each location and all the work necessary for construction.

Q. Temporary Sediment Traps

Temporary sediment traps are measured for payment per each required. This includes the entire structure at each location and all the work necessary for construction.

163.4.01 Limits

General Provisions 101 through 150.

163.5 Payment

Equivalent devices shall be paid for in the same manner as the device to which they are equivalent.

A. Silt Control Gates

The specified silt control gates are paid for at the Contract Unit Price per each. Payment is full compensation for:

- Furnishing the material and labor
- Constructing the concrete apron as shown on the Plans
- Excavating and backfilling to place the apron
- Removing the gate

B. Temporary Slope Drains

Temporary slope drains are paid for by the linear foot (meter). Payment is full compensation for materials, construction, removal (if required), inlet spillways, velocity dissipaters, and outlet aprons.

When temporary drain inlets and pipe slope drains are removed, they remain the Contractor's property and may be reused or removed from the Project as the Contractor desires. Reused pipe or inlets are paid for the same as new pipe or inlets.

C. Temporary Sediment Basins

Temporary sediment basins, measured according to Subsection 163.4,C *Measurement*, are paid for by the unit, per each, for the type specified on the plans. Price and payment are full compensation for work and supervision to construct, and remove the sediment basin, including final clean-up.

D. Sediment Barriers

Sediment barriers are paid by the linear foot (meter). Price and payment are full compensation for work and supervision to construct, and remove the sediment barrier, including final clean-up.

E. Other Temporary Structures

Other temporary structures are not measured for payment. Costs for the entire structure complete, including materials, construction (including earthwork), and removal is included in the price bid for the drainage structure or for other Contract items.

F. Temporary Grass

Temporary grass is paid for by the acre (hectare). Payment is full compensation for all equipment, labor, ground preparation, materials, wood fiber mulch, polyacrylamide, and other incidentals. Lime (when required) is paid for by the ton (megagram). Mulch and fertilizer are paid for separately.

G. Mulch

Mulch is paid for by the ton. Payment is full compensation for all materials, labor, maintenance, equipment and other incidentals.

The weight for payment of straw or hay mulch will be the product of the number of bales used and the average weight per bale as determined on certified scales provided by the Contractor or state certified scales. Provide written documentation to the Engineer stating the average weight of the bales.

The weight of erosion control compost mulch will be determined by weighing each loaded vehicle on the required motor truck scale as the material is hauled to the roadway, or by using recorded weights if a digital recording device is used. The Contractor may propose other methods of providing the weight of the mulch to Engineer for approval.

H. Miscellaneous Erosion Control Items Not Shown on the Plans

These items are not paid for separately. They are included in the price bid for other contract items.

I. Diversion Channel

Diversion channels are not paid for separately. They are included in the price bid for other contract items.

J. Check Dams

Payment is full compensation for all materials, construction, and removal. Stone plain riprap, sand bag, baled wheat straw, or compost filter socks check dams are paid for per each. The required woven filter fabric required under each stone check dams is included in the bid price. Fabric check dams are paid for per linear foot.

K. Construction Exits

Construction exits are paid for per each. Payment is full compensation for all labor and materials including the required geotextile, construction, and removal.

Construction exit tire cleaning stations are paid for per day when added to an existing construction exit. Payment is full compensation for all labor, equipment, materials, water source, and removal.

L. Retrofits

This item is paid for at the Contract Unit Price per each. Payment is full compensation for all work, supervision, materials (including the stone filter), labor and equipment necessary to construct and remove the retrofit device from an existing or proposed detention pond outlet structure.

M. Inlet Sediment Traps

Inlet sediment traps are paid for per each. Payment is full compensation for all materials, construction, and removal.

N. Rock Filter Dams

Rock filter dams are paid for per each. Payment is full compensation for all materials, construction, and removal for each. Clean reused stone Type 3 riprap and #57 stone are paid for on the same basis as new items. Plastic woven filter fabric is required under rock filter dams and is included in the price bid for each.

O. Stone Filter Berms

Stone filter berms are paid for per linear foot (meter). Payment is full compensation for all materials, construction, and removal for each. Clean reused stone Type 3 riprap and #57 stone are paid for on the same basis as new items. Plastic woven filter fabric is required under rock filter berms and is included in the price bid for linear foot (meter).

P. Stone Filter Rings

Stone filter rings are paid for per each. Payment is full compensation for all materials, construction, and removal for each. Clean reused stone Type 3 riprap and #57 stone are paid for on the same basis as new items. Plastic woven filter fabric is required under stone filter rings and is included in the price bid for each.

Q. Temporary Sediment Traps

Temporary sediment traps are paid for payment per each required. This includes the entire structure at each location and all the work necessary for construction.

The items in this section (except temporary grass and mulch) are made as partial payments as follows:

- When the item is installed and put into operation the Contractor will be paid 75 percent of the Contract price.
- When the Engineer instructs the Contractor that the item is no longer required and is to remain in place or is removed, whichever applies, the remaining 25 percent will be paid.

Temporary devices may be left in place at the Engineer's discretion at no change in cost. Payment for temporary grass will be made based on the number of acres (hectares) grassed. Mulch will be based on the number of tons (megagrams) used.

Payment is made under:

Item No. 163	Construct and remove silt control gates	Per each
Item No. 163	Construct and remove temporary pipe slope drains	Per linear foot (meter)
Item No. 163	Construct and remove temporary sediment barriers	Per linear foot (meter)
Item No. 163	Construct and remove sediment basins	Per each
Item No. 163	Construct and remove check dams except fabric dams	Per each
Item No. 163	Construct and remove fabric check dams	Per linear foot (meter)
Item No. 163	Construct and remove construction exits	Per each
Item No. 163	Construction exit tire cleaning station	Per day
Item No. 163	Construct and remove retrofits	Per each
Item No. 163	Construct and remove rock filter dams	Per each
Item No. 163	Construct and remove stone filter berms	Per linear foot (meter)
Item No. 163	Construct and remove stone filter rings	Per each
Item No. 163	Construct and remove inlet sediment traps	Per each
Item No. 163	Construct and remove temporary sediment traps	Per each
Item No. 163	Temporary grass	Per acre (hectare)
Item No. 163	Mulch	Per ton (megagram)

163.5.01 Adjustments

General Provisions 101 through 150.

Section 165—Maintenance of Temporary Erosion and Sedimentation Control Devices

Replace Section 165 with the following:

165.1 General Description

This work consists of providing maintenance on temporary erosion and sediment control devices, including but not limited to the following:

- Silt control gates
- Temporary erosion control slope drains shown on the Plans or as directed
- Temporary sediment basins
- Silt control gates
- Check dams
- Sediment barriers
- Rock filter dams
- Stone filter berms
- Stone filter rings
- Temporary sediment traps

It also consists of removing sediment that has accumulated at the temporary erosion and sedimentation control devices.

165.1.01 Definitions

General Provisions 101 through 150.

165.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

General Provisions 101 through 150.

165.1.03 Submittals

General Provisions 101 through 150

165.2 Materials

General Provisions 101 through 150.

165.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

165.3 Construction Requirements

165.3.01 Personnel

General Provisions 101 through 150.

165.3.02 Equipment

General Provisions 101 through 150.

165.3.03 Preparation

General Provisions 101 through 150.

165.3.04 Fabrication

General Provisions 101 through 150.

165.3.05 Construction

As a minimum, clean sediment from all temporary erosion control devices (except as noted in the standard construction details) installed on the project when one-half the capacity by volume, as measured by depth, has been reached. All other devices as noted in the standard construction details shall be cleaned when one-third the capacity of the storage volume has been reached.

Handle excavated sediment from any erosion or sediment control device in one of the following ways:

- Remove sediment from the immediate area and immediately stabilize it to prevent the material from refilling any erosion or sediment control device.
- Place and mix it in the roadway embankment or waste it in an area approved by the Engineer.

Repair or replace at no cost to the Department any erosion or sediment control device that is not functioning properly or is damaged due to negligence or abuse.

A. Temporary Silt Fence

Maintenance of temporary silt fence consists of furnishing all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0 % filled). Also included is the removal of sediment accumulations (“filtercake”) on the fabric by tapping the fabric on the downstream side. Maintenance of silt fence also includes the removal and replacement of any deteriorated filter fabric reducing the effectiveness of the silt fence on any properly installed silt fence.

B. Silt Control Gates

Maintenance of temporary silt control gates consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). When applicable, this item will include the removal of sediment accumulations on the fabric by tapping the fabric on the downstream side.

C. Check Dams (all types)

Maintenance of temporary erosion control check dams shall consist of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). This item also includes the removal of any material deposited in sump holes. When applicable, this item will include the removal of sediment accumulations on the fabric by tapping the fabric on the downstream side, or from the baled straw by similar means.

D. Silt Retention Barriers

Maintenance of temporary silt retention barriers consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled).

E. Temporary Sediment Basins

Maintenance of temporary sediment basins consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original bottom of the basin. This also includes removing accumulated sediment from the rock filter and restoring the rock filter to its original specified condition and any work necessary to restore all other components to the pre-maintenance conditions.

F. Sediment Barriers

Maintenance of sediment barriers consists of furnishing all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0 % filled). Also included is the removal of sediment accumulations on the barriers by tapping.

G. Triangular Silt Barriers

Maintenance of triangular silt barriers consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled).

H. Retrofits

Maintenance of the retrofits device consists of all labor, tools, materials, equipment and necessary incidentals to remove and properly dispose of accumulated sediment in the permanent detention pond being utilized as a temporary sediment basin. This item also includes any maintenance that is required to ensure the retrofit device is maintained per Plan details and any maintenance of the stone filter to maintain its filtering ability, including cleaning and replacement.

I. Construction Exits

Maintenance of the construction exits consists of all labor, tools, materials, equipment and incidentals, including additional stone and geotextile fabric as required to prevent the tracking or flow of soil onto public roadways. This includes scarifying existing stone, cleaning existing stone, or placement of additional stone.

Maintenance of the construction exit tire wash area consists of all labor, tools, materials, and equipment and incidentals. It also includes the removal and disposal of accumulated sediment in the required approved sediment storage device down to the original ground line (0% filled).

Cleaning of the construction exit by scraping and/or brooming only will not be measured for payment.

J. Inlet Sediment Traps

Maintenance of inlet sediment traps consists of all labor, tools, materials, equipment, and necessary incidentals to remove and properly dispose of accumulated sediment in the trap and/or the excavated area adjacent to the trap. It also includes any maintenance that is required to remove sediment accumulations (“filtercake”) from the material selected to construct the inlet sediment trap.

K. Rock Filter Dams

Maintenance of rock filter dams consists of all labor, tools, materials, equipment, and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). This item also includes the removal of any material deposited in sump holes.

L. Stone Filter Berms

Maintenance of stone filter berms consists of all labor, tools, materials, equipment, and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). This item also includes the removal of any material deposited in sump holes.

M. Stone Filter Rings

Maintenance of stone filter rings consists of all labor, tools, materials, equipment, and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). This item also includes the removal of any material deposited in sump holes.

N. Temporary Sediment Traps

Maintenance of temporary sediment traps consists of all labor, tools, materials, equipment, and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). This item also includes the removal of any material deposited in sump holes.

165.3.06 Quality Acceptance

General Provisions 101 through 150.

165.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

165.4 Measurement

A. Temporary Silt Fence

Maintenance of temporary silt fence, Type A or C, is the actual linear feet (meter) of silt fence measured in place where sediment is removed or where the silt fence has become undermined due to no fault or negligence of the Contractor. Any deteriorated filter fabric reducing the effectiveness of the silt fence that needs to be removed and replaced will be measured as maintenance of temporary silt fence.

B. Silt Control Gates

Maintenance of temporary silt control gates, Type 1, 2, or 3, as specified on the plans is measured as a single unit.

C. Check Dams (All Types)

Maintenance of temporary erosion control check dams as specified on the plans is the actual linear feet (meter) of baled straw, or rip rap, measured in place, where sediment is removed.

D. Silt Retention Barriers

Maintenance of temporary silt retention barrier as specified on the plans is measured by the linear foot (meter) where sediment is removed.

E. Temporary Sediment Basins

Maintenance of temporary sediment basins as specified on the plans is measured as a single unit.

F. Sediment Barriers

Maintenance of sediment barriers is the actual linear feet (meter) measured in place where sediment is removed.

G. Triangular Silt Barriers

Maintenance of triangular silt barrier as specified on the plans is measured by the linear foot (meter) where sediment is removed.

H. Retrofits

Maintenance of retrofit devices at the location specified on the plans is measured per each.

I. Construction Exits

Maintenance of construction exits at the location specified on the plans, or as directed by the Engineer is measured per each.

Maintenance of construction exit tire wash area, including the required approved sediment storage device, at the location specified on the plans, or as directed by the Engineer are measured per each when added to an existing construction exit.

Each location will be measured as either maintenance of construction exit, or maintenance of construction exit tire wash assembly.

J. Inlet Sediment Traps

Maintenance of inlet sediment traps at the location specified on the plans, or as added by the Engineer is measured per each.

K. Rock Filter Dams

Maintenance of rock filter dams as specified on the plans is measured as a single unit.

L. Stone Filter Berms

Maintenance of stone filter berms as specified on the plans is measured per linear foot (meter).

M. Stone Filter Rings

Maintenance of stone filter rings as specified on the plans is measured as a single unit.

N. Temporary Sediment Traps

Maintenance of temporary sediment traps as specified on the plans is measured as a single unit.

165.4.01 Limits

General Provisions 101 through 150.

165.5 Payment

A. Temporary Silt Fence

Maintenance of temporary silt fence, Type A or C, is paid for at the contract unit price bid per linear foot (meter).

B. Silt Control Gates

Maintenance of temporary silt control gates, Type 1, 2, or 3, as specified on the plans is paid for at the contract unit price bid per each.

C. Check Dams

Maintenance of check dams as specified on the plans is paid for at the contract unit price bid per linear foot (meter).

D. Silt Retention Barriers

Maintenance of temporary silt retention barriers as specified on the plans is paid for at the contract unit price bid per linear foot (meter).

E. Temporary Sediment Basins

Maintenance of temporary sediment basins as specified on the plans is paid for at the contract unit price bid per each.

F. Sediment Barriers

Maintenance of sediment barriers as specified on the plans is paid for at the contract unit price bid per linear foot (meter).

G. Triangular Silt Barriers

Maintenance of triangular silt barriers as specified on the plans is paid for at the contract unit price bid per linear foot (meter).

H. Retrofits

Maintenance of the retrofit devices at the location specified on the plans is paid for at the contract unit price bid per each.

I. Construction Exits

Maintenance of the construction exits at the location specified on the plans or as added by the Engineer is paid for at the contract unit price per each.

Maintenance of construction exit tire wash assembly at the location specified on the plans or as added by the Engineer is paid for at the contract unit price per each when added to an existing construction exit.

J. Inlet Sediment Traps

Maintenance of the inlet sediment traps at the location specified on the plans or at the location specified by the Engineer is paid for at the contract unit price per each.

K. Rock Filter Dams

Maintenance of rock filter dams as specified on the Plans is paid for at the contract unit price bid per each.

L. Stone Filter Berms

Maintenance of stone filter berms as specified on the Plans is paid for at the contract unit price bid per linear foot (meter).

M. Stone Filter Rings

Maintenance of stone filter rings as specified on the plans is paid for at the contract unit price bid per each.

N. Temporary Sediment Traps

Maintenance of temporary sediment traps as specified on the plans is paid for at the contract unit price bid per each.

Payment will be made under:

Item No. 165	Maintenance of temporary silt fence	per linear foot (meter)
Item No. 165	Maintenance of silt control gates	per each
Item No. 165	Maintenance of check dams	per linear foot (meter)
Item No. 165	Maintenance of silt retention barriers	per foot (meter)
Item No. 165	Maintenance of temporary sediment basins	per each
Item No. 165	Maintenance of sediment barriers	per linear foot (meter)
Item No. 165	Maintenance of triangular silt barrier~~s~~	per linear foot (meter)
Item No. 165	Maintenance of retrofits	per each
Item No. 165	Maintenance of construction exit~~s~~	per each
Item No. 165	Maintenance of construction exit tire wash area	per each
Item No. 165	Maintenance of inlet sediment traps	per each
Item No. 165	Maintenance of rock filter dams	per each
Item No. 165	Maintenance of stone filter berms	per linear foot (meter)
Item No. 165	Maintenance of rock filter dams	per each
Item No. 165	Maintenance of temporary sediment traps	per each

165.5.01 Adjustments

General Provisions 101 through 150.

Section 167—Water Quality Monitoring

Replace Section 167 with the following:

167.1 General Description

This Specification establishes the Contractor's responsibility to meet the requirements of the current National Pollutant Discharge Elimination System (NPDES) Infrastructure Permit No. GAR100002 as it pertains to Part IV. Erosion, Sedimentation and Pollution Control Plan. In the case of differing requirements between this specification and the Permit, whichever is the more stringent requirement shall be adhered to.

167.1.01 Definitions

Certified Personnel— certified personnel are defined as persons who have successfully completed the appropriate certification course approved by the Georgia Soil and Water Conservation Commission. For Department projects the certified person must also have successfully completed the Department's Worksite Erosion Control Supervisor (WECS) certification course.

Water Quality Sampling – as used within this specification, the term "sampling" shall be inclusive of the acts of detecting, noting, discerning, monitoring, etc. for the purpose of gauging compliance with the NPDES General Permit GAR100002.

Qualifying Rainfall Sampling Event—as used within this specification, means that which is defined in the NPDES General Permit GAR100002, Part IV.D.6.d(3).

167.1.02 Related References

A. Standard Specifications

Section 161—Control of Soil Erosion and Sedimentation

B. Referenced Documents

NPDES Infrastructure Permit No. GAR100002

GDOT WECS seminar.

Environmental Protection Divisions Rules and Regulations (Chapter 391-3-7)

Georgia Soil and Water Conservation Commission Certification Level IA course

OCGA Sec 12-7-1 et seq.

Erosion, Sedimentation and Pollution Control Plan (ESPCP)

167.1.03 Submittals

General Provisions 101 through 150

167.2 Materials

General Provisions 101 through 150.

167.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

167.3 Construction Requirements

167.3.01 Personnel

Use GASWCC Level IA certified and WECS certified personnel to perform all monitoring, sampling, inspections, and rainfall data collection.

Use the Contractor-designated WECS or select a prequalified consultant from the Qualified Consultant List (QCL) to perform water quality monitoring, sampling, inspections, and rainfall data collection.

The Contractor is responsible for having a copy of the current GAR100002 Permit onsite at all times.

167.3.02 Equipment

Provide equipment necessary to complete the Work or as directed by the Engineer.

167.3.03 Preparation

General Provisions 101 through 150.

167.3.04 Fabrication

General Provisions 101 through 150.

167.3.05 Construction

A. General

Perform inspections, rainfall data collection, testing of samples, and reporting the test results on the project according to the requirements in Part IV of the NPDES Infrastructure Permit and this Specification. Take samples manually or use automatic samplers, according to the GAR100002 Permit. Note that the GAR100002 Permit requires the use of manual sampling or rising stage sampling for qualifying events that occur after the first instance of the automatic sampler not being activated during a qualifying event. Analyze all samples according to the Permit, regardless of the method used to collect the samples. If samples are analyzed in the field using portable turbidimeters, the monitoring results shall state they are being used and a digital readout of NTUs is what is provided. Submit bench sheets, work sheets, etc., when using portable turbidimeters. There are no exceptions to this requirement. Perform required inspections and submit all reports required by this Specification within the time frames specified. Failure to perform the inspections within the time specified will result in the cessation of all construction activities with the exception of traffic control and erosion control. Failure to submit the required reports within the times specified will result in non-refundable deductions as specified in Subsection 161.5.01.B.

B. Water Quality Inspections

The Department will provide one copy of the required inspection forms for use and duplication. Inspection forms may change during the contract to reflect regulatory agency needs or the need of the Department. Any costs associated with the change of inspection forms shall be considered incidental. Alternate formats of the provided forms may be created, used and submitted by the Contractor provided the required content and/or data fields and verbatim certification statements from the Department's current forms are included.

The Engineer shall inspect the installation and condition of each erosion control device required by the erosion control plan within seven days after initial installation. This inspection is performed for each stage of construction when new devices are installed. The WECS shall ensure all installation deficiencies reported by the Engineer are corrected within two business days.

Ensure the inspections of the areas listed below are conducted by certified personnel and at the frequencies listed. Document all inspections on the appropriate form provided by the Department.

1. Daily (when any work is occurring):
    a. Petroleum product storage, usage and handling areas for spills or leaks from vehicles or equipment.
    b. All locations where vehicles enter/exit the site for evidence of off-site sediment tracking.

Continue these inspections until a Notice of Termination (NOT) is submitted and use the daily inspection forms.

2. Weekly and after Rainfall Events:

   Conduct inspections on these areas every seven calendar days and within twenty-four hours after the end of a rainfall event that is 0.5 in (13 mm) or greater (unless such storm ends after 5:00 PM on any Friday or any non-working Saturday, non-working Sunday or any non-working Federal holiday in which case the inspection shall be completed by the end of the next business day and/or working day, whichever occurs first):

   a. Disturbed areas not permanently stabilized
   b. Material storage areas that are exposed to precipitation or stormwater and poses a risk to discharging pollutants
   c. Structural control measures, Best Management Practices (BMPs) to ensure they are operating correctly
   d. Water quality sampling locations and equipment
   e. Discharge locations or points, e.g., outfalls and drainage structures that are accessible to determine if erosion control measures are effective in preventing significant impacts to receiving waters

Continue these inspections until all temporary BMPs are removed and a NOT is submitted and use the EC-1 Form.

3. Monthly:

   Once per month, inspect all areas where final stabilization has been completed. Look for evidence of sediments or pollutants entering the drainage system and or receiving waters. Inspect all permanent erosion control devices remaining in place to verify the maintenance status and that the devices are functioning properly. Inspect discharge locations or points, e.g. outfalls, drainage structures, that are accessible to determine if erosion control measures are effective in preventing significant impacts to receiving waters.

   Continue these inspections until the Notice of Termination is submitted and use the monthly inspection form.

C. Water Quality Sampling

When the sampling location is a receiving water, the upstream and downstream samples are taken for comparison of NTU values. When the sampling location is an outfall, a single sample is taken to be analyzed for its absolute NTU value.

D. Reports

1. Inspection Reports:

   Summarize the results of inspections noted above in writing on the appropriate Daily, Weekly, Monthly, or

   EC-1 form provided by the Department and includes the following information:

   - Date(s) of inspection
   - Name of certified personnel performing inspection
   - Construction phase
   - Status of devices
   - Observations
   - Action taken in accordance with Part IV.D.4.a.(5) of the GAR100002 Permit
   - Signature of personnel performing the inspection
   - Any instance of non-compliance

   When the report does not identify any non-compliance instances, the inspection report shall contain a statement that the best management practices are in compliance with the Erosion, Sedimentation and Pollution Control Plan. (See the EC-1 form.)

   The reports shall be made and retained at the site or be readily available at a designated alternate location until the entire site or that portion of a construction project that has been phased has undergone final stabilization and a Notice of Termination is submitted to the Georgia Department of Natural Resources Environmental Protection Division (GAEPD). Such reports shall be readily available by the end of the second business day and/or working day and shall identify all incidents of best management practices that have not been properly installed and/or maintained as described in the plan. The inspection form certification sheet shall be signed by the project WECS and the inspector performing inspections on behalf of the WECS (if not the same person). Submit all inspection reports to the Engineer within twenty-four hours of the inspection. The Engineer will review the submitted reports to determine their accuracy. The Engineer will notify the certified personnel of any additional items that should be added to the inspection report.

Complete any items listed in the inspection report requiring routine maintenance within seventy–two (72) hours of notification or immediately during perimeter BMP failure emergencies. Deficiencies that interfere with traffic flow, safety, or downstream turbidity shall have immediate reasonable steps taken to address the deficiencies.

BMP(s) that has failed or is deficient beyond routine maintenance and has resulted in sediment deposition into waters of the State shall have immediate reasonable steps taken to address the condition, including but not limited to cleaning up any contaminated surfaces so the sediment material will not discharge in subsequent storm events. When the repair does not require a new or replacement BMP or significant repair, the BMP failure or deficiency must be corrected by the close of the next business day from the time of discovery. If the correction requires a new or replacement BMP or significant repair, the correction must be completed and operational within seven (7) days from the time of discovery. If seven (7) days is infeasible, the Contractor must document why the timeframe is infeasible and coordinate with the Engineer to schedule the correction as soon as feasible after the seven (7) day timeframe. The Department must be in agreement with the infeasibility assessment.

Assume responsibility for all costs associated with additional sampling as specified in Part IV.D.6.d.3.(c) of the NPDES GAR100002 Permit if either of these conditions arise:

- BMPs shown in the Plans are not properly installed and maintained, or
- BMPs designed by the Contractor are not properly designed, installed and maintained.

2. Sampling Reports

a. All sampling shall be performed in accordance with the requirements of the GAR100002 Permit for the locations identified in the ESPCP approved by the Department.

b. Report Requirements

Include in all reports, the following certification statement, signed by the WECS or consultant providing sampling on the project:

> “I certify under penalty of law that this report and all attachments were prepared under my direction or in accordance with a system designed to assure that certified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

When a rainfall event requires a sample to be taken, submit a report of the sampling results to the Engineer within seven working days of the date the sample was obtained. Include the following information in each report:

1) Date and time of sampling
2) Name of certified person(s) who performed the sampling and analyses.
3) Date the analyses were performed
4) Time the analyses were initiated
5) Rainfall amount on the sampling date (sampling date only)
6) References and written procedures, when available, for the analytical techniques or methods used.
7) Whether the samples were taken by automatic sampler, rising-stage sampler, or manually (grab sample)
8) The NTU of each sample, the results of the analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine the results
9) Location where each sample was taken (station number and left or right offset)
10) Identification of whether a sample is a receiving-water sample or an outfall sample
11) Project number and county
12) A clear note if a sample exceeds 1000 NTUs by writing “exceeds 1000 NTUs” prominently upon the report

c. Report Requirements with No Qualifying Rainfall Events

In the event a qualifying rainfall event does not produce a discharge to sample, or sampling is “impossible”, as defined in the GAR1000002 Permit, a written justification must be included in the report as required at Part IV.D.4.a.(6) of the GAR100002 Permit.

d. Sampling Results

Provide sampling results to the Project Engineer within 48 hours of the samples being analyzed. This notification may be verbal or written. This notification does not replace the requirement to submit the formal summary to the Engineer within 7 working days of the samples being collected. The Engineer will ensure submission of the sampling report to GAEPD by the 15th of the month following the sampling results as per the GAR100002 Permit. The WECS will be held accountable for delayed delivery to the Department which results in late submissions to GAEPD resulting in enforcement actions.

3. Rainfall Data Reports:

Record the measurement of rainfall within disturbed areas that have not met final stabilization once each 24-hour period, except for non-working Saturdays, non-working Sundays and non-working Federal Holidays until a Notice of Termination is submitted. If utilizing an electronic system for rainfall data collection in lieu of a simple rain gauge, the system shall be capable of measuring rainfall within ½ mile grid increments. Project rain gauges and those used to trigger the automatic samplers are to be emptied after every rainfall event. This will prevent a cumulative effect and prevent automatic samplers from taking samples even though the rainfall event is not a qualifying event. The daily rainfall data supplied by the WECS to the Engineer will be the official rainfall data for the project for compliance with the permit.

167.3.06 Quality Acceptance

General Provisions 101 through 150.

167.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

167.4 Measurement

Water Quality Inspections in accordance with the inspection and reports sub-sections will be measured for payment by the month up to the time the Contract Time expires. Required inspections and reports after Contract Time has expired will not be measured for payment unless a time extension is granted.

Water Quality Sampling is measured per each. “Each” means each qualifying rainfall sampling event, not each sampled site.

167.4.01 Limits

General Provisions 101 through 150. Submit the monitoring summary report to the Engineer within 7 working days

167.5 Payment

Payment for Water Quality Inspections and Water Quality Sampling will be made as follows:

Water Quality Inspections will be paid at the Contract Price per month. This is full compensation for performing the requirements of the inspection section of the NPDES Permit and this Specification, any and all necessary incidentals, and providing results of inspections to the Engineer, within the time frame required by the NPDES Infrastructure Permit, and this Specification.

Water Quality Monitoring and Sampling per each qualifying rainfall sampling event is full compensation for meeting the requirements of the monitoring sections of the NPDES Permit and this Specification, obtaining samples, analyzing samples, any and all necessary incidentals, and providing results of turbidity tests to the Engineer, within the time frame required by the NPDES Infrastructure Permit, and this Specification. This item is based on the rainfall events requiring sampling as described in Part IV.D.6 of the Permit. The Department will not pay for samples taken and analyzed for rainfall events that are not qualifying events as compared to the daily rainfall data supplied by the WECS.

Payment will be made under:

Item No. 167	Water quality inspections	Per month

Water Quality Monitoring and Sampling will be paid per each qualifying rainfall sampling event.

Payment will be made under:

Item No. 167	Water quality monitoring and sampling	Per each

167.5.01 Adjustments

General Provisions 101 through 150.

Section 171—Silt Fence

Replace Section 171 with the following:

171.1 General Description

This work includes furnishing, installing, and removing a water permeable filter fabric fence to remove suspended particles from drainage water.

171.1.01 Definitions

General Provisions 101 through 150.

171.1.02 Related References

A. Standard Specifications

Section 163—Miscellaneous Erosion Control Items

Section 700—Grassing

Section 862—Wood Posts and Bracing

Section 881—Fabrics

Section 894—Fencing

B. Referenced Documents

ASTM D 3786

ASTM D 4355

ASTM D 4632

ASTM D 4751

GDT 87

QPL 36

171.1.03 Submittals

General Provisions 101 through 150.

171.2 Materials

Materials shall meet the requirements of the following Specifications:

Material	Section
Fabrics	881
Fencing	894
Wood Posts and Bracing	862

Conditions during Project construction will affect the quantity of the silt fence to be installed.

The Engineer may increase, decrease, or eliminate the quantity at his or her direction. Variations in quantity are not changes in details of construction or in the character of the work.

For Type A, B, and C fences, use fabric as specified in Subsection 881.2.07, *Silt Fence Filter Fabric*.

171.2.01 Delivery, Storage, and Handling

During shipment and storage, wrap the fabric in a heavy-duty covering protecting the cloth from sunlight, mud, dust, dirt, and debris. Do not expose the fabric to temperatures greater than 140 °F (60 °C).

When installed, the Engineer will reject the fabric if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

171.3 Construction Requirements

171.3.01 Personnel

General Provisions 101 through 150.

171.3.02 Equipment

General Provisions 101 through 150.

171.3.03 Preparation

General Provisions 101 through 150.

171.3.04 Fabrication

General Provisions 101 through 150.

171.3.05 Construction

Install the silt fence according to this Specification, as shown on the plans, or as directed by the Engineer

A. Install Silt Fence

1. Install silt fence by either of the following methods:
    a. Excavated Trench Method

       Excavate a trench 4 to 6 in. (100 to 150 mm) deep using equipment such as a trenching machine or motor grader. If equipment cannot be operated on the site, excavate the trench by hand.

    b. Soil Slicing Method

       Create a mechanical slice in the soil 8 to 12 in. (200 to 300 mm) deep to receive the silt fence. Ensure the width of the slice is not more than 3 in. (75 mm). Mechanically insert the silt fence fabric into the slice in a simultaneous operation with the slicing ensuring consistent depth and placement.
2. Install the first post at the center of the low point (if applicable). Space the remaining posts a maximum of 6 ft. (1.8 m) apart for Types A and B fence and 4 ft. (1.2 m) apart for Type C fence.
3. Bury the posts at least 18 in. (450 mm) into the ground. If this depth cannot be attained, secure the posts enough to prevent the fence from overturning from sediment loading.
4. Attach the filter fabric to the post using wire, cord, staples, nails, pockets, or other acceptable means.
    a. Staples and Nails (Wood Posts): Evenly space staples or nails with at least five per post for Type A fence and four per post for Type B fence.
    b. Pockets: If using pockets and they are not closed at the top, attach the fabric to a wood post using at least one additional staple or nail, or to a steel post using wire. Ensure the additional attachment is within the top 6 in. (150 mm) of the fabric.
    c. Install the filter fabric so 6 to 8 in. (150 to 200 mm) of fabric is left at the bottom to be buried. Provide a minimum overlap of 18 in. (450 mm) at all splice joints.

d. For Type C fence:

1) Woven Wire Supported

- Steel Post: Use wire to attach the fabric to the top of the woven wire support fence at the midpoint between posts. Also, use wire to attach the fabric to the post.

2) Polypropylene Mesh Supported

- Wood Post: Use at least six staples per post. Use two staples in a crisscross or parallel pattern to secure the top portion of the fence. Evenly space the remaining staples down the post.
- Steel Post: Use wire to attach the fabric and polypropylene mesh to the post.

3) High Tensile Polypropylene Integrated Support Woven Fabric

- Wood Post: Use at least six staples per post. Use two staples in a crisscross or parallel pattern to secure the top portion of the fence. Evenly space the remaining staples down the post.
- Steel Post: Shall not be used with this type of C-system

5. Install the fabric in the trench so 4 to 6 in. (100 to 150 mm) of fabric is against the side of the trench with 2 to 4 in. (50 to 100 mm) of fabric across the bottom in the upstream direction.
6. Backfill and compact the trench to ensure flow cannot pass under the barrier. When the slice method is used, compact the soil disturbed by the slice on the upstream side of the silt fence first, and then compact the downstream side.
7. When installing a silt fence across a waterway producing significant runoff, place a settling basin in front of the fence to handle the sediment load, if required. Construct a suitable sump hole or storage area according to Section 163.

B. Remove the Silt Fence

1. Keep all silt fence in place unless or until the Engineer directs it to be removed. A removed silt fence may be used at other locations if the Engineer approves of its condition.
2. After removing the silt fence, dress-the area to natural ground, grass-and mulch the area according to Section 700.
3. The silt fence shall remain until the Project is accepted or until the fence is removed. Also, remove and dispose of the silt accumulations at the silt fence.
4. Remove and replace any deteriorated filter fabric reducing the effectiveness of the silt fence.

171.3.06 Quality Acceptance

Approved silt fence is listed in QPL 36. Approved fabrics must consistently exceed the minimum requirements of this Specification as verified by the Office of Materials and Research. The Office of Materials and Research will remove fabric failing to meet the minimum requirements of this specification from the QPL until the products' acceptability has been reestablished to the Department's satisfaction.

At the time of installation, the Engineer will reject the fabric if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

171.4 Measurement

The quantity of silt fence to be paid for is the actual number of linear feet (meters) of silt fence, measured in place from end post to end post of each separate installation. The silt fence must be complete and accepted.

171.4.01 Limits

General Provisions 101 through 150.

171.5 Payment

Silt fence Type A, B, or C measured as defined in Subsection 171.4, *Measurement*, is paid for at the Contract Unit Price bid per linear foot (meter).

Payment is full compensation for the following:

- Furnishing materials
- Erecting the fence
- Dressing and grassing, when required
- Removing the fence, when required

Payment for this Item is made as follows:

- Seventy-five percent of the Contract Price bid per linear foot (meter) is paid when each fence is
- complete in place.
- Twenty-five percent is paid at removal or acceptance.

If the silt fence must be repaired or removed, as the result of neglect or damage, perform the work at no additional cost to the Department.

Payment will be made under:

Item No. 171	Silt fence, type__	Per linear foot (meter)

171.5.01 Adjustments

General Provisions 101 through 150.

Section 210—Grading Complete

Replace Section 210 with the following:

210.1 General Description

This work includes:

- Excavating of all materials including ditches, undesirable material (including removal and replacement), and borrow (if required)
- Hauling
- Forming embankments
- Constructing shoulders and subgrades
- Finishing, dressing, and disposing of undesirable or surplus material
- Clearing and grubbing according to Section 201 and Section 202 unless these items are established as Pay Items in the Contract
- Removing and disposing of miscellaneous roadway items, including but not limited to curbs, drainage structures, and pavements (unless established as separate contract items)

Ensure that the completed grading work conforms to the horizontal and vertical alignment and typical cross- sections shown on the Plans or as directed by the Engineer.

210.1.01 Definitions

General Provisions 101 through 150.

210.1.02 Related References

A. Standard Specifications

Section 109—Measurement and Payment

Section 201—Clearing and Grubbing Right-of-Way

Section 202—Random Clearing and Grubbing

Section 204—Channel Excavation

Section 205—Roadway Excavation

Section 206—Borrow Excavation

Section 207—Excavation and Backfill for Minor Structures

Section 208—Embankments

Section 209—Subgrade Construction

B. Referenced Documents

General Provisions 101 through 150.

210.1.03 Submittals

General Provisions 101 through 150.

210.2 Materials

Use materials required for grading construction that conform to the requirements of Section 204, Section 205, Section 206, Section 207, Section 208, and Section 209.

210.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

210.3 Construction Requirements

210.3.01 Personnel

General Provisions 101 through 150.

210.3.02 Equipment

Use equipment approved by the Engineer that will not damage base, pavement, or other appurtenances to be retained.

210.3.03 Preparation

Before placing base material, finish the subgrade according to Subsection 209.3.05.E.

210.3.04 Fabrication

General Provisions 101 through 150.

210.3.05 Construction

Perform The Work according to the appropriate portions of Section 201, Section 202, Section 204, Section 205, Section 206, Section 207, Section 208, and Section 209 of the Specifications. Measurement and payment shall be according to the provisions of this Section. See Subsection 210.4 and Subsection 210.5, below.

210.3.06 Quality Acceptance

When the Engineer determines that the existing material in areas where fills are to be placed is undesirable, the Engineer may require the Contractor to remove the undesirable material and replace it with suitable material.

- Compact the replacement materials according to the applicable portions of Section 208.
- In cut areas, where the material below the template line is undesirable for subgrade or shoulders, undercut it to a depth established by the Engineer and replace it with suitable material.
- Compact the replacement materials as specified herein.

210.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

210.4 Measurement

A. Grading Complete

The Work under this Item is not measured separately for payment.

B. Grading Per Mile (Kilometer)

This Item is measured in linear miles (kilometers) along the centerline of the road or the median, including ramps where shown on the Plans.

C. Undercut Excavation

The amount of undercut excavation (when directed by the Engineer and not addressed in the Plans) measured for payment is the product of the length, width, and depth of excavation. Replacement material for undercut excavation is not measured for payment. There will be no separate payment for undercut excavation required by the Plans or rock excavation required under Subsection 205.3.

210.4.01 Limits

General Provisions 101 through 150.

210.5 Payment

A. Grading Complete

This Item completed and accepted will be paid for at the Lump Sum Price bid. Payment is full compensation for all work and material specified in this section.

The Contractor may initiate a partial payment process for the lump sum grading complete by submitting a written request to the Engineer. Unless the Engineer approves this request, this item, completed and accepted, will be paid for at the Lump Sum Price Bid according to the following schedule:

Clearing and Grubbing	Section 201 & 202	25%
Embankment/Heavy Grading/Rough Grading/Mass Grading	Section 204, 205, 206, 207, & 208	60%
Subgrade/Shoulder/Fine Grading	Section 209	10%
Dressing/Finish Grading	Section 208.3.05.E & 209.3.05.E	5%

B. Grading Per Mile (Kilometer)

This Item will be paid for at the Contract Unit Price per linear mile (kilometer) complete in place and accepted. This price is full compensation for furnishing the materials and performing the work specified in this Section.

C. Undercut Excavation

Undercutting areas not shown in the Plans when directed by the Engineer will be paid for at the rate of $18.00 per cubic yard ($21.50 per cubic meter) for quantities up to 750 yd^3 (575 m^3).

Quantities exceeding 750 yd^3 (575 m^3) will be considered Extra Work as defined in Subsection 109.05, and will be paid for accordingly. Payment is full compensation for excavating and disposing of undesirable material and supplying, placing, and compacting replacement material.

Payment will be made under:

Item No. 210	Grading complete	Per lump sum
Item No. 210	Grading per mile (kilometer)	Per mile (kilometer)
Item No. 210	Undercut excavation	Per cubic yard (meter)

210.5.01 Adjustments

General Provisions 101 through 150.

Section 300—General Specifications for Base and Subbase Courses

Replace Section 300 with the following:

300.1 General Description

This specification applies to all base and subbase courses, except asphaltic concrete. Additional requirements for each type of base and subbase are described in the appropriate sections for specific base and subbase type construction.

300.1.01 Definitions

General Provisions 101 through 150.

300.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials

Section 107—Legal Regulations and Responsibility to the Public

Section 109—Measurement and Payment

Section 150—Traffic Control

Section 152—Field Laboratory Building

Section 160—Reclamation of Material Pits and Waste Areas

Section 205—Roadway Excavation

Section 206—Borrow Excavation

Section 209—Subgrade Construction

Section 301—Soil-Cement Construction

Section 302—Sand-Bituminous Stabilized Base Course

Section 310—Graded Aggregate Construction

Section 316—Cement Stabilized Graded Aggregate Construction

Section 412—Bituminous Prime

Section 831—Admixtures

B. Referenced Documents

Form OMR-TM-141 Daily Truck Weights

Form 474 Tally Sheet

300.1.03 Submittals

General Provisions 101 through 150.

300.2 Materials

Find the specifications for materials to be used and the references for them under the appropriate section for each base and subbase type construction.

Ensure that each material meets the requirements for the type specified. Incorporate only materials that meet the Engineer's approval.

Admixtures meeting the requirements of Subsection 831.2.03 and approved for use in stabilized bases or subbases shall be governed by the requirements as outlined in Laboratory Standard Operating Procedure No. 5, Quality Control of Portland Cement and Blended Hydraulic Cements and Quality Control of Fly Ash and Granulated Blast-Furnace Slag.

A. Selecting Local Materials at the Source

The Engineer has the authority to classify materials at the source and require the materials to be excavated in the proper sequence so that each kind will reach its destination at the best location for that material in the finished work. The Engineer has the authority to reject any unsuitable materials.

B. Sources of Local Materials Outside the Right-of-Way

Follow the provisions of Subsection 106.10, *Local Material Sources* to obtain materials from local sources outside the right-of-way.

300.2.01 Delivery, Storage, and Handling

A. Storing at Central Mix Plants

Store material at a plant site with enough space for separate stockpiles, bins, or stalls for each size of aggregate. Keep aggregates separated until delivery to the plant feeders for proportioning. Keep the storage yard neat and the stockpiles, bins, and stalls accessible for obtaining samples.

300.3 Construction Requirements

300.3.01 Personnel

Supply all personnel and equipment necessary for obtaining samples from base plants and delivering them to the plant laboratory.

300.3.02 Equipment

Ensure that all equipment for constructing base and subbase courses is of an approved design and in satisfactory condition before construction begins. The equipment required for each type of base or subbase will be determined according to the construction method used.

A. Central Mix Plants

The central mixing plant will not be approved for proportioning, batching, or mixing unless a field laboratory meeting the requirements of Section 152 is available for the exclusive use of the Engineer or Inspector.

Design, coordinate, and operate plants so that the mixture is produced within the specified tolerances. The requirements are as follows.

1. Scales

   Before any mixture is delivered to the project, check all scales with standard weights for accuracy and for agreement with each other.

   If weight proportioning is used, provide accurate scales so all ingredients of the mixture can be weighed separately. Use scales that are accurate to within 0.5 percent of the measured load. Support scales with rigid supports so that vibration from the plant does not interfere with accurate readings.

a. Weight Box and Hopper Scales

Use springless dial scales of a standard make and design for weight boxes and hopper. Inspect and seal scales when the Engineer determines it necessary to assure accuracy. Ensure that at least ten 50 lb. (25 kg) weights are available for testing the scales.

b. Motor Truck Scales

With each plant, include a motor truck scale with a platform large enough to accommodate the entire length of any vehicle used. Ensure that the scale is certified according to Section 109 and is large enough to weigh the largest anticipated load. Do not measure weights greater than the rated capacity of the scales.

Ensure that the weights of the aggregate batches in the truck before delivery to the project are within two percent of the sum of the weights of the batch ingredients.

Complete Forms OMR-TM-141 (Daily Truck Weights) and Form 474 (Tally Sheet) for each day's production and submit them to the Engineer.

2. Mixer

Equip each central mix plant with an approved mixer.

If Portland cement is required, begin mixing immediately after the cement is added to the coarse aggregate and soil mortar. Continue mixing until a homogeneous and uniform mixture is produced.

If the equipment does not produce a homogeneous and uniform mixture that meets these specifications, the Engineer will require the Contractor to make the changes necessary to accomplish this result.

Any adjustments made to the charge in a batch mixer or the rate of feed to a continuous mixer must ensure a complete mix of all of the material.

Correct dead areas in the mixer where the material does not move or is not sufficiently agitated, by reducing the volume of material or by making other adjustments.

3. Mixture Proportioning

Add Portland cement, bituminous materials, aggregates, or other ingredients in such a manner that they are uniformly distributed throughout the mixture during the mixing operation.

4. Water Proportioning

In all plants, proportion water by weight. Provide a means for the Engineer to verify the amount of water per batch or the rate of flow for continuous mixing.

Use spray bars to evenly distribute moisture throughout the mixture.

5. Sampling

Use sampling equipment approved by the Engineer to obtain samples before combining them with other ingredients or introducing them into the mixer.

Use sampling equipment to provide an accurate representation of the furnished material.

6. Additional Requirements for Continuous-Mixing Plants

a. Feeder System

Continuous mixing plants shall use a feeder system that accurately proportions aggregate from each bin by weight.

Equip each feeder with a device that can change the quantity of material being fed. Use a feeder with adjustments that can be securely fastened.

Ensure that the plant has an interlocking system of feeders and conveyors that can be synchronized to supply a continuous flow of aggregate, including a positive flow of dry and liquid additives for mixing.

Provide an electronic belt-weighing device to monitor the combined aggregates. Ensure that there are meters for maintaining the aggregates and additives at varying production rates.

Use an electronic control package capable of tracking which accepts a signal from the belt-weighing device and signals to continuously vary the dry and liquid additive feeder speed and maintain the feed rate.

Proportion dry additives with a gravimetric (depleting weight) system meeting the following requirements:

- The dry additive gravimetric (depleting weight) system includes an isolation vessel supported by load cells independent of the fines silo.
- Use load cells in conjunction with an electronic scale package having remote digital display and the necessary controls. Continuously weigh the material being metered with a positive displacement feeder mounted on the discharge of the isolation vessel.

b. Control System

Use a control package that has a plant interlock shutdown capability. Plants must be able to shut down if actual flow rates differ from desired flow rates excessively. If the flow rate deviates excessively, an alarm shall sound at any of the aggregate, dry additive, or liquid additive metering devices.

Provide a monitoring station to control the entire operation that shows continuous quantitative data on the production and proportioning of the mix ingredients.

c. Portable Power Units

Equip plants that use portable electric power generators with a frequency meter (graduated and accurate to one hertz) and a voltmeter (graduated and accurate to two volts), installed in the power circuit.

d. Mixer

Use a mixer equipped with enough paddles or blades to produce a uniform and homogeneous mixture. Replace paddle blades that show more than 25 percent wear in the face area. Use paddles that can be adjusted to angular positions on the shafts and that can be reversed to retard the flow of the mix. Keep the mixer level.

e. Surge Hopper

Equip the mixer with a surge hopper. Use a surge hopper that automatically discharges the mixture when it reaches a predetermined level.

7. Additional Requirements For Batch-Mixing Plants

a. Weigh Box or Hopper

Use weigh boxes and hoppers that are suspended on scales, large enough to hold a full batch without spilling or needing hand raking, and equipped with a device for accurately weighing each size of aggregate.

Provide a convenient and accurate means of obtaining samples of aggregates from each bin before the material enters the mixing chamber. Equip each bin compartment with a bin level indicator that automatically stops weighing when a bin is empty.

b. Mixer

Include an approved, leak-proof batch mixer in the plant. Use a mixer fast enough or equipped with enough paddles or blades to produce a properly and uniformly mixed batch. Replace paddles and blades that show more than 25 percent wear in the face area.

c. Weighing Cement

Weigh cement on scales separate from the aggregate batching scales. Ensure that all scales meet the requirements of Section 109.

d. Proportioning Bituminous

Introduce bituminous material into the mixer through spray bars and weigh it on scales separate from the aggregate batching scales.

e. Control of Mixing Time

Use a time-locking device that automatically limits mixing time. Do not mix materials less than 30 seconds.

B. In-Place Mixers

For in-place mixing operations, use mixers that meet the following requirements:

1. Multiple Pass Mixers

   Use approved rotary-type multiple pass mixers with sufficient tines that mix cement, soil or soil-aggregate, and water uniformly for the full depth of the course.

2. Traveling Plant Mixers

   Use approved traveling mixing plants to pick up the aggregate, soil, or other materials from the windrow or roadway. Use plants equipped with a bottom shell or pan that pick up and mix the material while it is separated from the foundation material during at least 50 percent of the mixing cycle.

   Use plants that mix the material for the full depth of the section. Ensure that travelling plants move forward with successive increments the length and width of the roadbed so that the roadbed is compacted and finished in one operation. Ensure that none of the materials being mixed are lost or segregated.

   Use plants mounted on wheels or crawler tracks wide enough so that they will not rut or damage the mixed surface when loaded to capacity.

   Use plants with a pressurized metering device that introduces water during mixing.

   Ensure that devices for proportioning water and materials to be mixed accurately measures the specified amounts while the machine is in motion.

   For bituminous stabilization, use plants equipped with a metering device that accurately measures the bituminous material into the mixer within the tolerances specified in Section 302.3.05.B. Ensure that the meter indicator dial has a scale with divisions indicating gallons (liters).

   If mixing equipment does not produce a homogeneous and uniform mixture, make the changes necessary to produce this result, as required by the Engineer.

C. Mechanical Cement Spreader

When the material is to be mixed in-place, use an approved mechanical cement spreader to uniformly and accurately spread the cement. Do not use pneumatic tubes to transfer the cement from the tanker to the material to be stabilized.

D. Mixture Spreader

Use an approved mechanical spreader that meets the following requirements to uniformly spread the mixture:

- A height-adjustable strike-off plate to obtain the specified thickness of the finished base
- A self-propelled spreader with rollers to contact the truck tires and push the truck without skewing the spreader or truck
- A hopper large enough to prevent spilling or wasting the material

E. Static Rollers

Use static rollers that meet the following requirements. Use self-propelled static rollers on cement stabilized base.

1. Trench Roller

   In this context, “roller” describes a wheel made of a flat metal surface; “wheel” describes a rubber wheel of the automotive type.

   When base widening is specified, use at least one trench roller. Use a trench roller that has a guiding roller or wheel that operates in tandem with the compression roller on the area to be compacted or with the auxiliary wheel or roller.

   Ensure that the trench roller is equipped with an auxiliary wheel or roller, mounted on a height-adjustable axle. The contact surface of the auxiliary wheel or roller must be adjustable to at least 10 in. (250 mm) above and

2 in. (50 mm) below the rolling plane of the compression roller. If this adjustment is not sufficient to compact the subgrade to the Plan elevation, adjust the contact surface the necessary amount.

If the steering roller or wheel operates in tandem with the auxiliary wheel or roller, it does not need to be height-adjustable.

Ensure that the auxiliary wheel or roller operates on the surface of the pavement adjacent to the area to be compacted, and at a distance from the edge of the pavement that no damage occurs. Keep the height adjustment of the auxiliary wheel or roller such that the compression roller will develop a smooth, compacted surface true to crown.

Use gas-propelled trench rollers equipped with reversing, smooth operating friction clutches. Ensure that friction clutches have smooth operating brakes of ample capacity. Use either hand-powered or power-operated steering devices.

The compression per inch (25 mm) width of compression roller shall not be less than 300 lbs. (545 kg) and not greater than 365 lbs. (660 kg). If necessary, use a hollow compression roller and secure the minimum weight with liquid ballast. The trench roller must compact a minimum width of at least 15 in. (375 mm).

Fit rollers with adjustable spring scrapers that can scrape in both directions.

2. Steel-Wheel Rollers

Use three-wheel or tandem steel-wheel rollers. Use self-propelled rollers equipped with cleaning devices to prevent material from adhering to the wheels.

For base or subbase materials, use 3-wheel rollers on base or subbase materials that have a minimum weight of 10 tons (9 Mg) and a minimum compression of 325 pounds per inch (580 kg/100 mm) of width for the rear wheels.

Use steel wheel tandem rollers with a minimum weight of 10 tons (9 Mg) and a minimum compression of 225 pounds per inch (400 kg/100 mm) of width for the rear drum.

3. Pneumatic-Tire Rollers

Use pneumatic-tire rollers with a minimum contact pressure of 50 psi (345 kPa) per wheel.

Equip rollers to uniformly distribute the load between all wheels.

Use multiple axle, multiple wheel rollers with wheels staggered on the axles and spaces between each wheel to provide uniform compaction for the full compacting width of roller.

Ensure that the air pressure of any tire does not vary more than 5 psi (35 kPa) from the established pressure.

Operate rollers between 3 mph (5 kph) and 8 mph (13 kph), unless otherwise directed by the Engineer.

4. Sheepsfoot Rollers

Use vibratory or static compaction sheepsfoot rollers of sufficient size and weight to obtain the desired compaction.

F. Vibratory Rollers

Use an approved vibratory roller designed to activate the frequency of vibration and the roller movement separately. Ensure that the weight and amplitude of the roller can compact the surface to specifications with a minimum number of passes.

G. Bituminous Sampling Valve

Use bituminous transfer pumps that include a valve for sampling bituminous materials.

H. Fine Grading Machine

Specifications for the Fine Grading Machine are included in either a Special Provision or a Supplemental Specification in the proposal or in the current Supplemental Specification book.

300.3.03 Preparation

A. Alternate Methods

When alternate methods of construction are provided without restriction, the Contractor may select these alternate methods at will, provided the equipment and organization are suited to the method selected. Before starting construction, discuss the proposed method with the Engineer. The method selected must:

- Spread base or subbase material uniformly without damaging the subgrade, subbase, or the material being placed
- Mix the materials until they are homogeneous
- Use the specified water and cement or bitumen content
- Compact throughout the depth of the course to the density specified
- Complete the work within the specified time limits

Organize the work and equipment so that spreading, compacting, and finishing the base or subbase is a continuous operation. Do not exceed minimum or maximum time limits where the detailed Specifications require them, except in unusual cases where permitted by the Engineer.

B. Preparing the Pit Site

Remove grass, weeds, roots, and other debris from local materials pits. Adhere to the requirements of Subsection 107.23, *Environmental Considerations* when performing this work. Include the cost in the prices bid for the pertinent Pay Items. This work is not considered as clearing and grubbing.

C. Preparing the Subgrade

If the subgrade does not meet the requirements of Section 209 for surface, compaction, and stability, repair all defective portions until it meets the requirements of that Section. Remove unsuitable materials and replace with acceptable material, if necessary. Compact the subgrade as specified in Section 209.

Have enough prepared subgrade meeting the requirements of Section 209 for at least one day of base construction before beginning work.

D. Preparing the Subbase

If a subbase is required, prepare it according to the requirements for surface and compaction. Ensure that it is stable enough to support the equipment that will place the base material without rutting or pumping. Repair all defective portions and replace any unsuitable material with acceptable material, if the subbase does not meet the requirements of the specifications.

300.3.04 Fabrication

General Provisions 101 through 150.

300.3.05 Construction

A. Draining and Leaving Materials Pits

Keep materials pits well drained while materials are being removed from them. After removing materials, leave pits in the condition required by Section 106 and Section 160.

B. Mining and Mixing in a Pit

Mine all local materials pits within the pit boundaries and grid depths established by the Engineer.

Mine all materials from top to bottom. Mix materials in the pit before hauling to the roadbed or plant.

Place materials in windrows or stockpiles with a dragline or backhoe. Blend the gradation and moisture strata from each pit to a uniform mixture.

When a rim ditch is required and its depth exceeds the specified grid depth of soil-cement material, include only the material above the grid depth as base material. Use this material for the windrow or stockpile of material to be used for soil-cement base unless the Engineer determines that below-the-grid material is satisfactory.

Only use ladder pans and scrapers for stockpiling and windrowing in pits that are less than 18 in (450 mm) deep.

After the preliminary mixing, prevent the coarse materials from segregating from the fine materials with loading equipment that continues to blend the material.

C. Placing Materials

1. Mixture Control

The Engineer will determine the proportions of the materials to be used in compounding the base or subbase. The Engineer will determine the analysis basis of the components.

Change the mix, if required by the Engineer, to ensure that the finished base meets the requirements of these specifications.

2. Moisture Control

Control the moisture content according to the specified requirements for each type of base or subbase.

Add water uniformly, allow it to evaporate or aerate, and roll the materials as often as necessary, to control the moisture content within the limits specified.

3. Number of Courses

Because the maximum thickness of base or subbase materials to be mixed or spread in one course varies with the equipment used, it is subject to the Engineer's approval. Ensure that the thickness meets the requirements of Subsection 300.3.05.C.5, *Compaction*.

4. Widening Work

Ensure that widening work conforms to Section 150.

When widening in traffic areas, excavate an area that can be completed in the same day.

When widening pavement on which there is traffic on both sides, stagger operations to keep the widening trench open in one lane of traffic at a time.

5. Compaction

Compact the entire thickness of all bases and subbases to the specified maximum dry weight per cubic foot (meter), as determined by the method specified in the Section for each base or subbase.

If any base or subbase is more than 6 in. (150 mm) thick, construct according to the following table for layer thickness:

Material	Layer Thickness
Topsoil, Sand-Clay, or Chert	Two equal layers, or one layer not to exceed 8 in. (200 mm)
Graded Aggregate	Two equal layers, or one layer not to exceed 8 in. (200 mm)
Cement Stabilized Graded Aggregate	Two equal layers, or one layer not to exceed 8 in. (200 mm)
Cement Stabilized Soil Aggregate	Two equal layers, or one layer not to exceed 8 in. (200 mm)
Sand Bituminous	Two equal layers, or one layer not to exceed 8 in. (200 mm)
Soil-Cement	One layer not to exceed 10 in. (250 mm)

D. Meeting Surface Requirements

Produce a smooth, uniform surface that complies with these specifications.

Rebuild any areas that do not meet the requirements or remove or add material to the area until the Engineer approves of the work.

300.3.06 Quality Acceptance

A. Monitoring Quality Control

Ensure that the mixture and the materials used meet the following quality controls:

- Before producing any mixture for the project, calibrate the electronic sensors, devices, or settings for proportioning all mixture ingredients by scale weight. Calibrate in the presence of the Engineer, the proportioning of every ingredient for all rates of production.
- Maintain a dated, written record of the most recent calibration. Post the calibration at the base plant and make the record available for the Engineer's inspection at all times. Format records as graphs, tables, charts, or mechanically prepared data. If the material changes, the rate of production changes by more than +/- 20%, the plant is not producing base material for more than two weeks, or if a component affecting the ingredient proportions has been repaired, replaced, or adjusted, check and recalibrate the proportions.
- Verify the moisture of the mixture being produced. Perform checks on ingredient proportioning and verify truck weight as directed by the Engineer.

  Provide quality control personnel and all necessary equipment to perform and document moisture tests. Perform moisture tests at a frequency of at least one test per hour of base plant production.

B. Repairing Defects

During construction: If materials that do not meet these specifications are placed on the roadway at any time during construction, remove and replace them with acceptable materials as a part of the Pay Item for the base or subbase being constructed.

After construction: Promptly correct defects discovered in the surface finish, thickness, or compaction of the completed base or subbase before the work is accepted.

- If the base, subbase, or shoulders are deficient in thickness and it is determined that the subgrade elevation is high, remove the materials, lower the subgrade, and reconstruct the course, according to these specifications at no cost to the Department.
- If job conditions permit and the Engineer mandates, correct areas deficient in thickness by raising the elevation of the surface or adding material to the course.
- In other cases, the Engineer may determine that the defective portions must be entirely removed. Add, mix, spread, and compact new material according to the specifications and at no cost to the Department.
- If a surface is less than 3 in. (75 mm) deep, scarify the area to a depth of at least 3 in. (75 mm), except in the case of stabilized bases or subbases. Mix and compact the new and old materials.
- Repair stabilized bases or subbases according to Section 301, Section 302, Section 310, or Section 316, whichever is applicable.

300.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

300.4 Measurement

Base and Subbase courses will be measured in accordance with the specification section for the item.
Bituminous prime will not be measured for separate payment.

300.4.01 Limits

General Provisions 101 through 150.

300.5 Payment

Base and Subbase courses will be paid for in accordance with the specification section for the item. Include the cost of furnishing and applying bituminous prime in the Unit Price Bid for each individual Base Item according to the applicable provisions of Section 412.

No separate payment will be made for adding water or for aerating or rolling for the purpose of adding water. Include the cost of controlling moisture content in the prices bid for the pertinent Pay Items.

Separate payment will be made only for clearing and grubbing listed in the proposal or required in the plans and designated a Pay Item by the Engineer.

No separate payment will be made for stripping excavation unless shown on the plans and included in the proposal as a Pay Item.

300.5.01 Adjustments

If the Contractor for the subbase or base is responsible for the subgrade under another Pay Item, no additional payment will be made for any repairs made to the subgrade, except as provided in Section 209.

If another party (not the Contractor) is responsible for the subgrade, removing unsuitable materials will be paid for according to the Earthwork Item in the Contract.

Include compaction, scarification, and any other preparation necessary for the subgrade in the Unit Price Bid for the pertinent base course.

Section 301—Soil-Cement Construction

Replace Section 301 with the following:

301.1 General Description

This work includes constructing a base, subbase, or shoulder course composed of soil, or a mixture of soils, and stabilizing with Portland cement. Construct according to these Specifications and conform to the lines, grades, and typical sections shown on the plans or established by the Engineer.

Requirements for the mix design, quality control and quality acceptance testing will be controlled by Standard Operating Procedures 29 (SOP 29).

The provisions in Section 300 apply to this Item.

301.1.01 Definitions

Mixed in Place Construction - This method of construction is used when the Plans and Proposal indicate that the Work will be paid by the square yard (meter). The plans will indicate the method of construction and depth of base unless otherwise directed by the Engineer.

1. For Mixed in Place Construction, the Contractor will be required to submit a mix design for approval prior to construction. Requirements for the submittal will be controlled by SOP 29.
2. The Contractor testing will determine if the materials in the roadbed are suitable for use. If the Engineer approves, use materials in the roadbed without additional payment, except for the payment per square yard (meter) provided in Subsection 301.5.A, *Soil-Cement Material*.
3. If it is found necessary to add other materials to those in the roadbed to meet the desired thickness or to modify the physical properties of the existing materials, these materials will be paid for as soil-cement material.

Central Plant Mixed Construction - This method of construction is used when the plans and proposal indicate that the Work will be paid by the ton (megagram). The plans will indicate the method of construction and depth of base unless otherwise directed by the Engineer.

1. For Central Plant Mixed Construction, the Contractor shall be responsible for locating the source of soil material. Borrow pits will be sampled under the authority of the District Materials Engineer.
2. For Central Plant Mixed Construction, the Contractor will be required to submit a mix design for approval prior to construction. Requirements for the submittal will be controlled by SOP 29.
3. The Department testing will determine if the materials in the pit are suitable for use. If the Engineer approves, use materials in the pit without additional payment, except for the payment per square yard (meter) provided in Subsection 301.5.A, *Soil-Cement* Material.

Accreditations

1. AASHTO resource – The American Association of State Highway and Transportation Officials
2. CMEC – Construction Materials Engineering Council

SOP – Georgia Department of Transportation Standard Operating Procedures

301.1.02 Related References

A. Standard Specifications

Section 109—Measurement and Payment

Section 205—Roadway Excavation

Section 300—General Specifications for Base and Subbase Courses

Section 412—Bituminous Prime

Section 814—Soil Base Materials

Section 821—Cutback Asphalt

Section 822---Emulsified Asphalt

Section 824—Cationic Asphalt Emulsion

Section 830—Portland Cement

Section 880—Water

B. Referenced Documents

GDT 19

GDT 20

GDT 21

GDT 59

GDT 65

GDT 67

GDT 86

GSP 16

SOP 29

AASHTO T 134

AASHTO R18

301.1.03 Submittals

A. Construction Work Plan

Prior to construction, submit a written Construction Work Plan to the Engineer for approval which shall include the following:

1. Proposed starting date
2. Location of plant (Central Plant Mixed Construction)
3. Plant and or roadway equipment (type and size)

B. Mix Design Package

For both Mixed in Place and Central Plant Mixed Construction, the Contractor shall submit a mix design package to the Office of Materials and Testing for approval at least three weeks prior to construction. The Mix Design process shall be completed in accordance with GDOT Test Method 65/GDT 65 by an accredited materials laboratory. The sampling, testing, proportioning and documentation shall be completed by an accredited materials laboratory. The Contractor will be responsible for ensuring that appropriate traffic control measures are in place during the sampling operations. The Portland cement used in the design process must be from an approved source listed on GDOT's Qualified Products List/QPL3 and representative of the same material to be used in construction.

(Mixed in Place Construction). In-place samples of the road structure shall be taken at a minimum frequency of 1000 feet (300m) per two lanes; alternating the sample locations to achieve a sample every 500 lane-feet (152m). Additional samples may be needed to represent material changes and/or problem areas. Each sample shall contain at least 20 lbs. (14kg) of proportionally blended material from the roadway.

(Central Plant Mixed Construction) The Contractor shall be responsible for locating the source of soil material. The borrow pit is to be sampled in accordance with Georgia Sampling Procedure 16/GSP 16. Borrow pits will be under the authority of the District Materials Engineer.

The mix design package shall include the following:

1. Approximately 22 lbs. (10,000 grams) of proportionally blended material from all in-place samples taken from the roadway
2. Approximately 2 lbs. (900 grams) of cement that is same type and source that will be used in construction.
3. The water used in construction must be from a potable source

Note: Since the Mix Design is based on source specific materials, any changes to materials, sources, or types will render the design invalid.

301.2 Materials

Ensure that materials meet the requirements of the following specifications:

Material	Specification
Soil-Cement Material	Subsection 814.2.02
Portland cement (Type I or Type II)	Subsection 830.2.01
Water	Subsection 880.2.01
Cutback asphalt, RC-30, RC-70, RC-250 or MC-30, MC-70, MC-250	Subsection 821.2.01
Emulsified Asphalt, EAP, AEP	Subsection 822.2.01
Cationic Asphalt, CSS-1h, CRS-2	Subsection 824.2.01
Blotter Material (Sand)	Subsection 412.3.05.G.3

301.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

301.3 Construction Requirements

A. General

1. Weather Limitations

   Mix and place cement-treated base or subbase only when the weather permits the course to be finished without interruption in the time specified.

   Mix and place materials only when the moisture content of the soil to be used in the mixture meets the limits specified in this Subsection 301.3.05.B.7.c, *Moisture Control*.

   Begin mixing only when the air temperature is above 40 °F (4 °C) in the shade and rising.

Ensure that the temperature of the soil to be used in the mixture and the subbase or subgrade is above 50 °F (10 °C).

2. Interruption of Work

   If the work is interrupted for more than two hours after cement has been added, or if rain increases the cement's moisture content outside the limits specified in Subsection 301.3.05.B.7.c, *Moisture Control*, remove and replace the affected portion at no additional cost to the Department.

301.3.01 Personnel

General Provision 101 – 150

301.3.02 Equipment

Use equipment that meets the requirements of Subsection 300.3.02 and this subsection. The Engineer will approve equipment type and condition before construction begins.

Provide sufficient equipment in good working condition to do the following:

1. Allow continuous prosecution of the work.
2. In-Place Mixing
   a. Use a cyclone-type spreader or its equivalent to spread the cement uniformly across the coverage area and capable of metering the spread rate being placed.
   b. Use a rotary type mixer with sufficient tines which produces a uniform and homogenous blend of materials. The use of disk harrows will not be allowed for the mixed-in-place soil-cement base construction method. Mixer shall be inspected by the Engineer daily and tines with more than 25% wear must be replaced.
3. Central Plant Mixing
   a. Provide a plant capable of producing a uniform and homogenous blend of material. The mixing chamber should be inspected daily and tines with more than 25 percent wear must be replaced.
4. The type and size of equipment must be sufficient enough to mix, place, and compact within the time limits.
5. Use any applicable equipment specified in Subsection 412.3.02, *Equipment* for bituminous prime.

301.3.03 Preparation

A. Subgrade or Subbase Preparation

1. Prepare the subgrade or subbase as specified in Subsection 300.3.03.C, *Preparing the Subgrade* or Subsection 300.3.03.D, *Preparing the Subbase* if the base, subbase, or shoulders will be composed entirely of new materials, whether mixed-in-place or central plant mixed. In addition to the above requirements, ensure that the subgrade materials used underneath the soil-cement base meets the sulfates and PH requirements of Subsection 814.2.02.A. Place materials only on dry, thawed subgrade or subbase.

2. For Projects that require Central Plant mixed soil-cement base, the Subgrade or Subbase directly shall be graded with a fine grader as outlined in Subsection 300.3.02.H.

301.3.04 Fabrication

General Provisions 101 through 150.

301.3.05 Construction

A. In-Place Mixing

1. Soil

   If additional soil is needed on the roadbed, place and spread the soil uniformly to the proper depth to obtain the specified thickness.

2. Pulverization

Pulverize the roadbed materials as follows:

a. Loosen and pulverize roadbed materials to the width and depth to be stabilized without disturbing or damaging the underlying subgrade.
b. Continue pulverizing until 100 percent of roadbed material passes through a 1-1/2 in. (37.5 mm) sieve, and until at least 80 percent of the soil, excluding any stone or gravel, passes through a No. 4 (4.75 mm) sieve.
c. Add water to assist pulverization if necessary.
d. Remove all roots, sod, and rocks that exceed 3 in. (75 mm) in diameter.
e. Remove all other harmful materials.

3. Moisture Adjustments

Immediately before spreading cement, adjust the moisture content of the in-place material so it will stabilize to within 100 to 120 percent of optimum moisture (amount of moisture in the mixture at maximum dry density).

4. Cement

Spread cement as follows:

a. Uniformly spread the required amount of Portland cement with a cyclone-type mechanical spreader or its equivalent.
b. Apply the Portland cement at a rate that ensures the pounds spread are within ±10 percent of the amount specified. Furnish a square-yard cloth, scales and personnel for checking the spread rate of cement placed.
c. Apply cement on soils with a moisture content less than 120 percent of optimum.
d. Apply cement on days when wind will not interfere with spreading.
e. If the cement content is below the 10 percent limit in the mixing area, add additional cement to bring the affected area within the tolerance specified and recalibrate the mechanical spreader's spread rate. If the cement content is more than the 10 percent limit in the mixing area, the excess quantity will be deducted from the Contractor's pay for cement.
f. Regulate operations to limit the application of cement to sections small enough so that all of the compacting and finishing operations specified in Subsection 301.3.05.B.7, *Compacting and Finishing* can be completed within the required time limits.
g. Pass only spreading and mixing equipment over the spread cement. Operate this equipment so that it does not displace cement.
h. Replace damaged cement at no additional cost the Department when damage is caused by:
   - Hydration due to rain, before or during mixing operations
   - Spreading procedures contrary to the requirements mentioned above
   - Displacement by the Contractor's equipment or other traffic

5. Mixing

Mix the material as follows:

Begin mixing as soon as practical after the cement is spread and continue until a homogeneous and uniform mixture is produced. If the equipment does not produce a homogeneous and uniform mixture meeting these specifications, make any necessary changes to meet the Engineer's requirements.

6. Road Methods

i. Multiple Pass Mixing

Perform multiple pass mixing as follows:

1) After spreading the cement, mix it with the material to be treated.
2) Ensure that the material has been adjusted for moisture as stated in Subsection 301.3.05.B.7.c, *Moisture Control*.

3) Continue mixing with successive passes until a uniform mixture of cement and soil, or soil-aggregate is obtained.
4) Immediately after the preliminary mixing of cement and soil or soil-aggregate, add water as needed to maintain or bring the mixture to within the moisture requirements of Subsection 301.3.05.B.7.c, *Moisture Control*.
5) Uniformly mix the additional water to incorporate it into the full depth of the mixture.

7. Compacting and Finishing

Compact and finish according to Subsection 301.3.05.B.7, *Compacting and Finishing*.

B. Central Plant Mixing

1. Soil

Do the following:

a. Before introducing any soil into the mixer, pulverize it until 100 percent passes a 1-1/ 2 in. (37.5 mm) sieve.
b. Ensure that at least 80 percent of the soil, excluding any stone or gravel, passes through a No. 4 (4.75 mm) sieve.
c. Have enough stockpile material meeting the requirements of Subsection 300.3.05.B, *Mining and Mixing in a Pit* for at least one day of base construction before operations begin.

2. Cement

Do the following:

a. Measure cement by weight.

   Uniformly add cement into the mixture. The cement incorporated, per ton (megagram) of soil, shall be within ±5 percent of the amount prescribed by the Engineer.
b. Perform cement checks that compare the actual percent cement in the mixture with the required percent cement specified in the approved Mix Design for the Project on each of the first two tankers supplying cement to the plant. If these checks are within the specified tolerance, one cement check per day will be required.
c. Perform and make available to the Engineer a minimum of four daily comparison checks between the certified scales and the plant computer to ensure the proper percentage of cement is being incorporated into the mixture between cement checks.
d. When a cement check is out of the specified tolerance, at least two, passing one-tanker checks, are required before returning to a one cement check per day basis. When three consecutive cement checks fail to meet the specified tolerance, discontinue soil-cement plant production. Correct the problem, and recalibrate the plant as specified in Subsection 300.3.06.A *Monitoring Quality Control* before resuming the work.
e. When the cement content exceeds the specified tolerance, the Department will deduct the excess cement from the Contractor's pay for cement. When the cement content does not meet the specified tolerance, the Engineer will evaluate the strength of the affected area after 7 days.
f. Correct any areas of base with deficient strength as specified in the Strength Correction Chart at no additional cost to the Department, regardless of the percent of compaction. This correction also applies to the test section described in Subsection 301.3.05.B.7.a, *Test Section*.
g. Quantities of cement used in calibrating the plant will also be deducted from the Contractor's pay for cement.

3. Mixing

Do the following:

a. Measure proportions of soil, cement, and water separately and accurately before mixing.
b. Charge all materials into the mixer together. Begin mixing immediately.

c. Mix until a homogeneous and uniform mixture is produced. If the final blend of materials is not homogeneously mixed or does not meet the moisture range specified in Subsection 301.3.05.B.7.c, *Moisture Control*, cease plant operations until corrections are made in the plant or to the materials.

4. Hauling

Do the following:

a. Deliver soil-cement material to the project.

b. Spread soil-cement material so that compaction can begin within 45 minutes after the soil, cement, and water have been charged into the mixer.

c. Protect the mixture in transit by using a securely fastened waterproof cover large enough to extend down over the sides and the end of the bed of each haul vehicle.

5. Spreading

Spread the soil-cement mixture as follows:

a. Use an approved mixture spreader as specified in Subsection 300.3.02.D, *Mixture Spreader* to obtain the specified thickness. Spread the mixture the full width of the area to be covered.

b. Ensure that trucks and other construction equipment, including motor graders, do not travel over the material until compaction equipment has made initial passes over the mixture.

c. Ensure that less than 30 minutes elapse between the placement of cement-treated material in adjacent lanes at any location, unless longitudinal joints are specified.

6. Thickness of Course

Compact the soil-cement base to a maximum thickness of 10 in. (250 mm). Place the full thickness in one course only and compact as specified in Subsection 301.3.05.B.7, *Compacting and Finishing* below.

7. Compacting and Finishing

a. Test Section

Construct a test section as follows:

1) Use the first section of each constructed soil-cement base course as a test section.

2) Use a test section between 350 ft. (100 m) and 500 ft. (150 m) long for the designated width.

3) Before constructing a test section, submit a Construction Work Plan to the Engineer for approval. The Construction Work Plan must indicate proposed equipment and compaction procedures.

4) If the Construction Work Plan is approved, the Engineer will evaluate the Work Plan during test section construction. The Engineer will evaluate compaction, moisture, homogeneity of mixture, thickness of course, and laminations or compaction planes (scabbing).

5) If the Engineer determines that the Work Plan is not satisfactory, revise the compaction procedure and augment or replace equipment, as necessary, to complete work according to the specifications.

b. Time Limits

Observe the following time limits:

1) Begin compaction within 45 minutes of the time water is added to the soil-cement mixture.

2) Complete compaction within 2 hours.

3) Complete all operations in four hours, from adding cement to finishing the surface.

c. Moisture Control

Control moisture as follows:

1) During compaction, ensure a uniform moisture content of the mixture that is between 100 and 120 percent of the optimum moisture content.

2) If the moisture content exceeds the tolerance at any time, cease operations immediately and make the adjustments necessary to bring the moisture content within tolerance.

3) Do not use materials that “pump” under construction traffic, regardless of moisture content.

d. Additional Compaction Requirements

Perform the following additional compaction requirements:

1) Compact the soil-cement base, subbase, or shoulder course to at least 98 percent of the maximum dry density as determined in this Subsection.
2) Do not perform vibratory compaction on materials more than 1-1/2 hours old, measured from the time the cement was added to the mixture.
3) Uniformly compact the mixture and then fine-grade the surface to the line, grade, and cross-section shown on the Plans.
4) Loosened material accumulated during this process is considered waste and is to be removed from the Project. Do not use additional layers of cement-treated materials in order to conform to cross-sectional or grade requirements.
5) Use a pneumatic-tired roller to roll the finished surface until the surface is smooth, closely knit, free from cracks, and in conformance with the proper line, grade, and cross-section.

   If the Engineer requires, lightly apply water to the finished surface to aid in sealing the completed base and preparing the surface for priming.
6) At any place inaccessible to the roller, secure the required compaction with mechanical tampers approved by the Engineer. The same compaction requirements stated in the above subsection apply.

e. Additional Finishing Requirements

Perform the following additional finishing requirements:

1) Use the automatically controlled screed equipment when required by Subsection 300.3.03.H, *Fine Grading Machine* of the Specifications. Control fine-grading for this requirement with sensing wires or a taut string line. Furnish, install, and maintain this operation as a part of this Pay Item. When automatically controlled screed equipment is not required, fine-grading with motor graders is permitted.
2) Fine-grade the surface of the cement-stabilized subbase for Portland cement concrete pavement or the cement-stabilized base for asphaltic concrete pavement.
3) Fine-grade immediately after placement and compaction. Roll the subbase again according to this subsection.

8. Construction Joints

Form construction joints as follows:

a. Form a straight transverse joint at the end of each day’s construction or when the work is interrupted so that the material cannot be compacted within the time limit specified in this subsection.
b. Create the straight transverse joint by cutting back into the completed work to form a true vertical face free of loose or shattered material.
c. Form the joint at least 2 ft. (600 mm) from the point at which the strike-off plate of the spreader comes to rest at the end of the day’s work, or at the point of interruption.
d. Form a longitudinal joint as described above if the soil-cement mixture is placed over a large area where it is impractical to complete the full width during one day’s work. Use the procedure for forming a straight transverse joint. Ensure that waste material is removed from the compacted base.

9. Prime

Apply bituminous prime to the finished surface of the base course at the end of each day or as soon as the Engineer determines it is practical. Apply prime only to an entirely moist surface.

If weather delays prime application, apply prime as soon as the surface moisture is adequate. Apply prime according to Section 412.

Apply a single #89 surface treatment layer over the primed base course.

10. Opening to Traffic

No traffic or equipment is permitted to operate on the finished base, subbase, or shoulders until the prime has hardened enough so that it does not pick up under traffic. For the first seven days after priming, traffic is restricted to lightweight vehicles such as passenger cars and pickup trucks. Vehicles with an average axle load exceeding 20,000 pounds (9 Mg) will not be allowed on the finished base or subbase at any time.

Correct any failures caused by traffic at no additional cost to the Department.

11. Protection of Course

Maintain the base, subbase, or shoulder course constructed under these specifications until the Engineer determines that it has sufficiently cured and is ready to be covered with the next base or pavement course. Make repairs specified in Subsection 300.3.06.B, *Repairing Defects* whenever defects appear. This preservation action does not relieve the Contractor of his responsibility to maintain the work until final acceptance as specified in Section 105.

301.3.06 Quality Acceptance

A. Compaction Tests

Test compaction as follows:

1. Determine the maximum dry density for central plant mix construction from representative samples of the material to be compacted according to GDT 19.
2. Determine the maximum dry density for mixed-in-place construction according to GDT 19 or GDT 67 .
3. Determine the in-place density of the cement-stabilized base, subbase, or shoulders as soon as possible after compaction, but before the cement sets. Determine in-place density according to GDT 20, GDT 21, or GDT 59.

B. Finished Surface Tests

Test the finished surface as follows:

1. Check the finished surface of the cement stabilized base, subbase, or shoulder course transversely.
2. Place a 15 ft. (4.5 m) straightedge parallel to the centerline. Additionally, use one of the following tools:
   - A template, cut true to the required cross-section and set with a spirit level on non-super elevated sections
   - A system of ordinates, measured from a string line
   - A surveyor’s level
3. Ensure that ordinates measured from the bottom of the template, string line, or straightedge to the surface do not exceed 1/4 in. (6 mm) at any point. Rod readings shall not deviate more than 0.02 ft. (6 mm) from the required readings.
4. Correct any variations from requirements immediately, as specified in Subsection 300.3.05.D.

C. Tolerances

1. Thickness Measurements
   a. Thickness requirements apply to shoulder construction where the Plans specify a uniform thickness, or where the shoulders will be surfaced. Do the following:
   b. Determine the thickness of the base, subbase, or shoulder course, by making as many checks as necessary to determine the average thickness.
2. Deficient Thickness
   a. If any measurement is deficient in thickness more than 1/2 in. (13 mm), make additional measurements to determine the deficient area.
   b. Correct any area deficient by more than 1/2 in. (13 mm) to the design thickness by using one of the following methods according to these Specifications:

- Apply Asphaltic Concrete 9.5 mm Superpave.
- Remove material to the full depth of the course and reconstruct to the required thickness.

No payment will be made for any 9.5 mm Superpave asphaltic concrete applied to correct deficiencies nor will payment be made for removing and reconstructing the deficient work.

3. Average Thickness

Average thickness is measured as follows:

a. The average thickness per linear mile (kilometer) is determined from all measurements within the mile (kilometer) increments.

b. The average thickness shall not exceed the specified thickness by more than 1/2 in. (13 mm).

c. If the unit of payment is by the ton (megagram) or cubic yard (meter), and the average thickness for any mile (kilometer) increment exceeds the allowable 1/2 in. (13 mm) tolerance, payment for the excess quantity in that increment will be deducted.

d. The excess quantity is calculated by multiplying the average thickness that exceeds the allowable 1/2 in. (13 mm) tolerance by the surface area of the base, subbase, or shoulder, as applicable.

4. Strength

Do the following:

a. Ensure that the strength of the soil-cement base, subbase, or shoulder course is at least 300 psi (2070 kPa), as determined from testing the unconfined compressive strength of cores from the completed course in accordance with GDT 86.

b. If a strength test falls below 300 psi (2070 kPa), do the following:

1) Isolate the affected area by securing additional cores 75 ft. (22 meters) in each direction until passing strengths are achieved.

2) Average all compressive strengths in the affected area to determine the basis for corrective work according to the table below or the Engineer's directions.

5. Compaction

The compaction requirement for soil-cement base, subbase, or shoulder course shall be a minimum of 98 percent of the specified theoretical density.

If any compaction test falls below 98 percent, core and retest the represented area for compressive strength determination after 7 days. If the strength is 300 psi (2070 kPa) or greater, no correction will be required. If the strength is less than 300 psi (2070 kPa), isolate the affected area by obtaining additional cores.

Average all compressive strengths in the affected area to determine the basis for corrective work, according to the following table.

Compressive Strength	Corrective Work
300 psi (2070 kPa) or greater	None
200 psi (11380 kPa) to 299 psi (2062 kPa)	6 in., 8 in., & 10 in. (150 mm, 200 mm, & 250 mm) base - add 135 lbs./yd² (75 kg/m²) asphaltic concrete
Less than 200 psi (1379 kPa)	Reconstruct the affected area

Ensure that a corrected area requiring asphaltic concrete is at least 150 ft. (45 m) long.

Perform corrective work requiring asphaltic concrete or reconstruction at no additional cost to the Department.

301.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

301.4 Measurement

A. Soil-Cement Material

Soil-cement material is measured by the cubic yard (meter), loose volume, as specified in Section 109, during mixed-in-place construction if it is necessary to add materials to the roadbed or to build up the base, subbase, or shoulders with new material.

B. Soil-Cement Stabilized Base, Subbase, and Shoulder Course

Soil-cement stabilized base, subbase, and shoulder course are measured as follows:

1. The surface length is measured along the centerline when payment is specified by the square yard (meter). The width is specified on the plans.
    a. Irregular areas, such as turnouts and intersections, are measured by the square yard (meter).
    b. Material is measured in tons (megagrams), as mixed and accepted, when payment is specified by the ton (megagram).

The actual weight is determined by weighing each loaded vehicle on a required motor truck scale as the material is hauled to the roadway. The actual weight will be the pay weight; no deduction will be made for the weight of the cement.

C. Portland Cement

Portland cement is measured by the ton (megagram).

D. Prime

Bituminous prime is not measured for separate payment. Include the cost of furnishing and applying bituminous prime according to the provisions of Section 412 in the Unit Price Bid for each individual base item.

E. Unsuitable Material

Unsuitable materials that have been removed are measured and paid for according to the Earthwork Item in the Contract.

301.4.01 Limits

General Provisions 101 through 150.

301.5 Payment

A. Soil-Cement Material

Where in-place mixing is done, and when it is necessary to add other materials to those in the roadbed or to build up the base, subbase, and shoulders entirely with new materials, the added soil-cement material, in place and accepted, will be paid at the Contract Price per cubic yard (meter). Payment will be full compensation for soil-cement material; mixing in the pit; loading, hauling, and unloading; and spreading

B. Soil-Cement Stabilized Base, Subbase, and Shoulder Course

Where specified, soil-cement stabilized base, subbase, and shoulder course, in place and accepted, will be paid at the Contract Price per square yard (meter). Payment will be full compensation for roadbed preparation, mixing on the road, shaping, pulverizing, watering, compaction, defect repair, and maintenance.

C. Pre-mixed Soil-Cement Stabilized Base, Subbase, and Shoulder Course

Where specified, pre-mixed soil-cement stabilized base, subbase, and shoulder course, in place and accepted, will be paid at the Contract Price per ton (megagram) or square yard (meter).

Payment will be full compensation for roadbed preparation; all materials except Portland cement; loading, hauling, and unloading; mixing; spreading; watering; rolling and shaping; and maintenance.

D. Portland Cement

Portland cement will be paid at the Contract Price per ton (megagram). Payment is full compensation for furnishing, hauling, and applying the material. Only Portland cement incorporated in the finished course will be paid; no payment will be made for cement used to correct defects due to the Contractor's negligence, faulty equipment, or plant calibration error.

Payment will be made under:

Item No. 301	Soil-cement material—including material and haul	per cubic yard (meter)
Item No. 301	Soil-cement stabilized base, subbase, and shoulder course ___in. (mm)	per square yard (meter)
Item No. 301	Pre-mixed soil-cement stabilized base, subbase, and shoulder course—including material and haul	per ton (megagram) or per square yard (meter)
Item No. 301	Pre-mixed soil-cement stabilized base and shoulder course—including material and haul	per ton (megagram) or per square yard (meter)
Item No. 301	Portland cement	per ton (megagram)

301.5.01 Adjustments

General Provisions 101 through 150.

Section 315—Cement Stabilized Reclaimed Base Construction (CSRB)

Replace Section 315 with the following:

315.1 General Description

This work includes constructing a cement stabilized base course by pulverizing the existing flexible pavement, underlying base and subgrade, and mixing with Portland cement. Construct according to these specifications and to the lines, grades, thickness, and typical cross-sections shown on the plans or established by the Engineer.

315.1.01 Related References

General Provisions 101 through 150

A. Standard Specifications

Section 109—Measurement and Payment

Section 301—Soil-Cement Construction

Section 412—Bituminous Prime

Section 424—Bituminous Surface Treatment

Section 814—Soil Base Materials

Section 821—Cutback Asphalt

Section 822—Emulsified Asphalt

Section 824—Cationic Asphalt Emulsion

Section 830—Portland Cement

Section 880—Water

B. Referenced Documents

GDT 19 – Determining Maximum Density of Soil-Cement mixtures

GDT 20 – Determining Field Density of soils with <45% retained on the No. 10 sieve and < 10% retained on the 1 in. sieve

GDT 21 - Determining Field Density of soils containing >45% retained on the No.10 sieve or >10% retained on the 1 in. sieve

GDT 59 - Testing Density of roadway materials with Nuclear Gauge

GDT 65 – Laboratory Design of Soil-Cement and Cement Stabilized Graded Aggregate

GDT 67 – Family of Curves Method for determining Maximum Density of soils

GDT 86 – Determining the compressive strength of Cement Stabilized Base cores taken from the roadway

315.1.02 Submittals

Prior to construction, submit a Construction Work Plan to the Engineer consisting of the proposed equipment, materials, and operation procedures. If the Engineer determines that the work plan is not satisfactory, revise the procedures and augment or replace equipment, as necessary, to complete the work.

315.1.03 Mix Design

The Contractor shall submit a mix design to the Office of Materials and Testing for approval at least three weeks prior to construction. The Mix Design process shall be completed in accordance with GDOT Test Method/GDT 65 by an accredited materials laboratory. The sampling, testing, proportioning, and documentation shall be completed by an accredited materials laboratory. The Contractor will be responsible for ensuring that appropriate traffic control measures are in place during the sampling operations. In-place samples of the road structure shall be taken at a minimum frequency of 1000 ft. (300m) per two lanes; alternating the sample locations to achieve a sample every 500 lane-feet (152m). Additional samples may be needed to represent material changes and/or problem areas. Each sample shall contain at least 30 lbs. (14kg) of proportionally blended materials to be reclaimed. The Portland cement used in the design process must be from an approved source listed on GDOT's Qualified Products List/QPL3 and representative of the same material to be used in construction.

The mix design submittal to the Office of Materials and Testing shall include the following:

1. Approximately 100 lbs. (45kg) of proportionally blended material from all in-place samples taken from the roadway.
2. A one-gallon sample (plastic container) of the stabilizer used in the mix design.
3. All test data (charts, graphs, spreadsheets, etc.) along with design parameters. Test data should include the target gradation of the blended material, optimum moisture content of mixing, and application rate of the stabilizer to meet the design requirements.

Note: Since the Mix Design is based on source specific materials, any changes to materials or sources will render the design invalid.

315.2 Materials

Ensure that materials meet the requirements of the following GDOT Standard Specifications:

Material	Section
Blotter material (sand)	412.3.05.G.3
Soil Base Material	814.2.02
Cutback asphalt, RC-30, RC-70, RC-250 or MC-30, MC-70, MC-250, CSS-1h, AE-P, CRS-2	821.2.01
Portland Cement (Type I or Type II)	830.2.01
Water	880.2.01
Emulsified Asphalt *AEP, EAP-1	822.2.01
Cationic Emulsified Asphalt *C-AEP,	824.2.01

315.3 Construction Requirements

315.3.01 Personnel

Ensure that only experienced and capable personnel operate equipment.

315.3.02 Equipment

Equipment used in CSRB construction must meet the following requirements and be approved by the Engineer prior to the beginning of construction. All equipment shall be in satisfactory condition and capable of its intended purpose. The Engineer may at any time reject any equipment that is deemed unsafe, erratic, or produces an inadequate performance.

Note: Equipment type, size, operation and condition are subject to the Engineer's approval and must be adjusted and/or replaced upon their request.

A. Reclaimer

CSRB will require a reclaimer unit that meets the following requirements:

1. Designed expressly for reclamation capable of pulverizing and mixing through asphaltic pavement, granular/soil base, Subbases, and subgrade down to depths of at least 12 in. (300mm).
2. Have a cutting drum with a minimum width of 8 ft. (2m).
3. Capable of continuously mixing materials to a homogenous blend and at a consistent depth.
4. Powered by an engine of at least 500 horsepower with steerable front and rear wheels.
5. Controlled by an electronic metering system capable of injecting water directly into the mixing chamber and has automatic sensors to monitor water application and mixing depth.

B. Spreader

For CSRB construction, use a cyclone-type mechanical spreader, or its equivalent, that will spread Portland cement in a relatively dust-free process. The spreader must have an electronic or mechanical metering system which monitors the application rate.

Note: The use of pneumatic tubes to transfer cement or lime directly onto the roadway will not be allowed.

C. Additional Equipment (Water Truck, Compaction and Grading equipment, and Prime Distributer)

Additional equipment necessary to complete the work must be in satisfactory condition and proper for its intended purpose. Compactive equipment includes a sheep's foot roller, vibratory steel wheel roller and a pneumatic rubber tire roller. Use the correct size/type rollers or combination thereof that is capable of achieving the required density. A pressure distributor that complies with GDOT Standard Specifications/Subsection 424.3.02.B will be required to apply the bituminous prime coat.

Note: Equipment type, size, operation and condition are subject to the Engineer's approval and must be adjusted and/or replaced upon their request.

315.3.03 Preparation

Prior to commencing reclaiming operations, blade grass and excess soil a minimum of 12 in. (300mm) from the edge of pavement. Locate, mark and preserve existing centerline, manholes, and utilities (gas, water, and electric lines). Relocate mailboxes and other appurtenances within such proximity to the roadway as to risk damage or interfere with the work. Remove sections of driveway aprons in the Right-of-Way where necessary to permit the reclaimer to operate without damaging the machinery or driveway pavement. If necessary, saw-cut a neat parallel line to the proposed edge of pavement and remove the concrete along the road. After all work is complete, replace appurtenances to their original location as nearly as possible.

315.3.04 Construction

A. Weather Limitations

1. Mix only when the weather permits the course to be finished without interruption and within the time specified.
2. Mix materials only when the moisture of the materials to be used in the mixture meets the specified limits.
3. Begin mixing only when the air temperature is above 40°F in the shade and rising.

B. Moisture Adjustment

Adjust the moisture content of the roadway materials to within 100 to 120 percent of the optimum moisture immediately before spreading the cement. The optimum moisture content is determined by the Job Mix Design and can be adjusted by the Engineer.

C. Cement Application

1. Apply cement on days when wind will not interfere with spreading.
2. Apply cement at the rate specified on the Job Mix Design (as established by GDT-65) and mix to the depth shown on the Plans. The Engineer may alter the spread rate during the progress of construction if necessary. Maintain the application rate within ± 10 percent of that specified by the Engineer.
3. Provide both equipment and personnel to measure the application rate of cement placed. Each tanker of cement shall be checked by using a square yard cloth/certified scales and by determining the overall coverage area of each tanker. Multiple checks may be necessary to ensure that the spread rate is maintained within the ± 10 percent limit.
4. If the cement content falls below the 10 percent limit in the mixing area, add additional cement to bring the affected area within the tolerance specified, make necessary adjustments to the spreader, and perform additional checks to ensure the problem is corrected. If the cement content is more than the 10 percent limit in the mixing area, the excess quantity will be deducted from the Contractor’s pay for cement.
5. Regulate operations to limit the application of cement to sections small enough so that all of the mixing, compacting, and finishing operations can be completed within the required time limits.
6. Pass only spreading and mixing equipment over the spread cement and operate this equipment so that it does not displace cement.
7. Replace damaged cement at no cost to the Department when damage is caused by:
   a. Hydration due to rain, before or during mixing operations.
   b. Spreading procedures that are contrary to the requirements stated above.
   c. Displacement by the Contractor’s equipment or other traffic.

D. Mixing

1. Begin mixing as soon as possible after the cement is spread and continue until a homogeneous and uniform mixture is produced. The Engineer at any time may require adjustments or replacement of equipment if a homogeneous and uniform mixture conforming to these Specifications is not achieved.
2. Continue pulverizing until the base mixture is uniform in color and conforms to the following gradation requirements:
   a. 100 percent passing the 3 in. sieve (76.1mm) or the natural size of the in-situ aggregate.
   b. 55 percent of the roadway material, excluding gravel, passes the No. 4 sieve (4.75mm).
3. Add water as needed to maintain or bring the moisture content to within the moisture requirements immediately after the preliminary mixing of the cement and roadway material.
4. Mix the additional water homogeneously into the full depth of the mixture.

E. Compaction and Finishing

1. Test Section
    a. A test section shall be constructed with the first tanker of cement delivered to the project. The length of the test section will be determined by the area in which the entire tanker of cement will cover.
    b. The Engineer will evaluate compaction, moisture, homogeneity of mixture, thickness of stabilization, and finished base surface. If the Engineer deems necessary, revise the compaction procedure or replace equipment.
2. Time Limits
    a. Begin compaction within 45 minutes of the time of the mixing of cement.
    b. Complete compaction within 2 hours after the cement has been applied.
    c. Do not perform vibratory compaction on materials more than 90 minutes old, measured from the time cement was added to the mixture.
    d. Complete all operations within 4 hours from adding cement to finishing the surface.
3. Moisture Control
    a. During compaction, ensure that the moisture is uniformly distributed throughout the mixture at a level of between 100 and 120 percent of the optimum moisture content.
4. Compaction Requirements
    a. Use a sheep's foot roller, steel wheel roller or pneumatic-tired roller for initial compactive effort unless an alternate method is approved by the Engineer.
    b. Compact the cement-stabilized base course to at least 98 percent of the maximum dry density established on the Job Mix Design.
    c. Uniformly compact the mixture and then shape to the grade, line, and cross- section shown on the Plans.
    d. Remove all loosened material accumulated during the shaping process. Do not use additional layers of cement-treated materials in order to conform to cross-sectional or grade requirements.
    e. Use a pneumatic-tired roller to roll the finished surface until it is smooth, closely knit, and free from cracks or deformations, and conforming to the proper line, grade, and cross-section.
    f. In places inaccessible to the roller, obtain the required compaction with mechanical tampers approved by the Engineer. Apply the same compaction requirements as stated in this subsection.
    g. Perform grading operations immediately after the placement and compaction operations. Roll the stabilized base course again with a pneumatic-tired roller.

F. Construction Joints

1. Form a straight transverse joint at the end of each day's construction or whenever the work is interrupted.
2. Create the straight transverse joint by cutting back into the completed work to form a true vertical face free of loose or shattered material.
3. Form the joint at least 2 ft. (0.6m) from the point where the spreader strike-off plate comes to rest at the end of the day's work, or at the point of interruption.
4. Form a longitudinal joint, as described above, if cement-stabilized mixture is placed over a large area where it is impractical to complete the full width during one day's work. Use the procedure for forming a straight transverse joint. Remove all waste material from the compacted base.

G. Priming the Base

1. The surface of the completed base course must be moist cured until the bituminous prime is applied.
2. Apply prime only to an entirely moist surface. If weather delays prime application, apply prime as soon as the surface moisture is adequate.
3. Apply bituminous prime according to GDOT Standard Specifications/Section 412 as soon as possible and in no case later than 24 hours after completion of the finishing operations.
4. Protect finished portions of the cement-stabilized base course that are used by equipment in the construction of an adjoining section to prevent marring or damaging of the completed work. Protect the stabilized area from freezing during the curing period.
5. Apply cure coat depending on project ADT:
   - < 400 ADT: Prime and sand.
   - ≥ 400 ADT: Apply single 89 surface treatment layer.

H. Opening to Traffic

1. Correct any failures caused by traffic at no additional cost to the Department. Make repairs specified in GDOT Standard Specifications/Subsection 300.3.06.B whenever defects appear. This preservation action does not relieve the Contractor of his responsibility to maintain the work until final acceptance, as specified in GDOT Standard Specifications/Section 105.

315.3.05 Quality Acceptance

A. Compaction Tests

1. Determine the maximum dry density from representative samples of compacted material, according to GDOT Test Method/GDT 19 or GDT 67.
2. Determine the in-place density of finished courses according to GDOT Test Method/GDT 20, GDT 21 or GDT 59 as soon as possible after compaction but before the cement sets.

B. Gradation Tests

1. Ensure that the gradation of the completely mixed cement-stabilized base course meets the requirements as stated above in Subsection 315.3.04.D.2.

C. Finished Surface Tests

1. Check the finished surface of the cement-stabilized base course transversely using one of the following tools:
   a. A template cut true to the required cross-section and set with a spirit level on non-super elevated sections.
   b. A system of ordinates measured from a string line.
   c. A surveyor's level.
2. Ensure the ordinates measured from the bottom of the template, string line, or straightedge~~,~~ to the surface do not exceed ½ in. (12.5mm) at any point.

D. Thickness Tolerances

1. Determine the thickness of the cement-stabilized base course by making as many checks as necessary to determine the average thickness~~,~~ but not less than one check per 1000 ft. (300m) per 2 lanes. Checks shall be taken after the completion of the base course and prior to priming.
2. If any measurement is deficient in thickness by more than ½ in. (12.5mm), make additional measurements to isolate the affected area. Correct any area deficient by more than ½ in. (12.5mm) to the design thickness by using one of the following methods:

a. Apply GDOT approved asphaltic concrete 9.5mm Superpave.

b. Reconstruct to the required thickness.

No payment will be made for any Asphaltic Concrete 9.5mm Superpave used to correct deficiencies nor will payment be made for removing and reconstructing the deficient work.

3. If any measurement exceeds thickness by more than ½ in. (12.5mm), make additional measurements to isolate the affected area. If the basis of payment is per cubic yard and the average thickness for any mile increment exceeds the allowable ½ in. (12.5mm) tolerance, the excess quantity in that increment will be deducted from the Contractor's payments. The excess quantity is calculated by multiplying the average thickness that exceeds the allowable ½ in. (12.5mm) tolerance by the surface area of the base, as applicable.

315.4 Measurement

A. Cement-Stabilized Base Course

Measure the surface length along the centerline when payment is specified by the square yard. The width is specified on the plans. Measure irregular areas, such as turnouts and intersections, by the square yard.

B. Portland Cement

Measure Portland cement by the ton.

C. Bituminous Prime

Bituminous prime is not measured for separate payment. Include the cost of furnishing and applying bituminous prime according to the provisions of GDOT Standard Specifications/Section 412 in the Unit Price Bid for each individual base item.

315.5 Payment

A. Cement-Stabilized Base Course

Cement-stabilized base, in-place and accepted, will be paid for at the Contract Unit Price per square yard. Payment will be full compensation for roadbed preparation, mixing on the road, shaping, pulverizing, watering, compaction, defect repair, bituminous prime and maintenance.

B. Portland Cement

Portland cement will be paid for at the Contract Unit Price per ton. Payment is full compensation for furnishing, hauling, and applying the material. Only Type I or Type II Portland cement incorporated into the finished course will be paid for, and no payment will be made for cement used to correct defects due to the Contractor's negligence, faulty equipment, or error.

Payment will be made under:

Item No. 315	Cement Treated Base Course	Per square yard (meter)
Item No. 315	Portland Cement	Per ton (megagram)

Section 400—Hot Mix Asphaltic Concrete Construction

Replace Section 400 with the following:

400.1 General Description

This work includes constructing one or more courses of bituminous plant mixture on the prepared foundation or existing roadway surface. Ensure the mixture conforms with lines, grades, thicknesses, and typical cross sections shown on the plans or established by the Engineer.

This section includes the requirements for all bituminous plant mixtures regardless of the gradation of the aggregates, type and amount of bituminous material, or pavement use.

Acceptance of work is on a lot-to-lot basis according to the requirements of this Section and Section 106.

400.1.01 Definitions

Segregated Mixture: Mixture lacking homogeneity in HMA constituents of such magnitude there is a reasonable expectation of accelerated pavement distress or performance problems. May be quantified by measurable changes in temperature, gradation, asphalt content, air voids, or surface texture.

Wearing Course: The upper course of asphaltic concrete placed on a roadway, airport or other asphalt pavement.

Surface Course: The upper course of asphaltic concrete placed on a roadway, airport or other asphalt pavement and also includes the dense-graded asphaltic concrete mixture beneath Open Graded Friction Course (OGFC) or Porous European Mixture (PEM).

Intermediate (Binder) Course: The lift(s) of asphaltic concrete above the base course and below the wearing course.

Asphaltic Concrete Base Course: The lower lift(s) of asphaltic concrete generally placed on graded aggregate base (GAB), soil cement or other stabilized base material.

New Construction: A roadway section more than 0.5 mile (800 m) long that is not longitudinally adjacent to the existing roadway. If one or more lanes are added longitudinally adjacent to the existing lane, the lane(s) shall be tested under the criteria for a resurfacing project. If work is performed on the existing roadway including leveling, grade changes, widening and/or resurfacing then that lane shall be tested under the criteria for a resurfacing project.

Trench Widening: Widening no more than 4 ft. (1.2 m) in width.

Comparison Sample: Opposite quarters of material sampled by the Contractor.

Independent Sample (Quality Assurance Sample): A sample taken by the Department to verify an acceptance decision without regard to any other sample that may also have been taken to represent the material in question.

Referee sample: A sample of the material retained during the quartering process which is used for evaluation if a comparison of Contractor and Departmental split sample test results is outside allowable tolerances.

400.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials

Section 109—Measurement and Payment

Section 152—Field Laboratory Building

Section 413—Bituminous Tack Coat

Section 424—Bituminous Surface Treatment

Section 802—Aggregate for Asphaltic Concrete

Section 828—Hot Mix Asphaltic Concrete Mixtures

B. Referenced Documents

AASHTO T 324

AASHTO T 315

AASHTO T 209

AASHTO T 202

AASHTO T 49

Department of Transportation Standard Operating Procedure (SOP) 15

Department of Transportation Standard Operating Procedure (SOP) 27

Department of Transportation Standard Operating Procedure (SOP) 40

Department of Transportation Standard Operating Procedure (SOP) 46

GDT 38

GDT 39

GDT 42

GDT 59

GDT 73

GDT 78

GDT 83

GDT 119

GDT 125

GDT 126

GDT 134

GSP 15

GSP 21

QPL 1

QPL 2

QPL 7

QPL 26

QPL 30

QPL 39

QPL 41

QPL 45

QPL 65

QPL 67

QPL 70

QPL 77

QPL 88

QPL 91

QPL 92 (A, B, C)

QPL 97

400.1.03 Submittals

A. Invoices

Furnish formal written invoices from a supplier for all materials used in production of HMA when requested by the Department. Show the following on the Bill of Lading:

- Date shipped
- Quantity in tons (megagrams)
- Included with or without additives (for asphalt cement)

Purchase asphaltic cement directly from a supplier listed on Qualified Products List 7 and provide copies of Bill of Lading at the Department's request.

B. Paving Plan

Before starting asphaltic concrete construction, submit a written paving plan to the Engineer for approval. Include the following on the paving plan:

- Proposed starting date
- Location of plant(s)
- Rate of production
- Average haul distance(s)
- Number of haul trucks
- Paver speed feet (meter)/minute for each placement operation
- Mat width for each placement operation
- Number and type of rollers for each placement operation
- Sketch of the typical section showing the paving sequence for each placement operation
- Electronic controls used for each placement operation
- Temporary pavement marking plan

If staged construction is designated in the plans or contract, provide a paving plan for each construction stage.

If segregation is detected, submit a written plan of measures and actions to prevent segregation. Work will not continue until the plan is submitted to and approved by the Department.

C. Job Mix Formula

Submit to the Engineer a written job mix formula proposed for each mixture type to be used based on an approved mix design. Furnish the following information for each mix:

- Specific project for which the mixture will be used
- Source and description of the materials to be used
- Mixture I.D. Number
- Proportions of the raw materials to be combined in the paving mixture
- Single percentage of the combined mineral aggregates passing each specified sieve
- Single percentage of asphalt by weight of the total mix to be incorporated in the completed mixture
- Single temperature at which to discharge the mixture from the plant

- Theoretical specific gravity of the mixture at the designated asphalt content
- Name of the person or agency responsible for quality control of the mixture during production

Do the following to have the Job Mix Formulas approved in accordance with SOP 40 *Approval of Contractor Job Mix Formulas* and to ensure their quality:

1. Submit proposed job Mix Formulas for review at least two weeks before beginning the mixing operations.
2. Do not start hot mix asphaltic concrete work until the Engineer has approved a job mix formula for the mixture to be used. No mixture will be accepted until the Engineer has given approval.
3. Provide mix designs for all SMA, Superpave and 4.75 mm mixes to be used. The Department will provide mix design results for other mixes to be used.
4. After a job mix formula has been approved, assume responsibility for the quality control of the mixtures supplied to the Department according to Subsection 106.01, *Source of Supply and Quantity of Materials*.

D. Quality Control Program

Submit a Quality Control Plan to the Office of Materials and Testing for approval. The Quality Control Program will be included as part of the certification in the annual plant inspection report.

400.2 Materials

Ensure materials comply with the specifications listed in Table 1.

TABLE 1—MATERIALS SPECIFICATIONS

Material	Subsection
Asphalt Cement, Grade Specified	820.2
Coarse Aggregates for Asphaltic Concrete	802.2.02
Fine Aggregates for Asphaltic Concrete	802.2.01
Mineral Filler	883.1
Heat Stable Anti-Stripping Additive	831.2.04
Hydrated Lime	882.2.03
Silicone Fluid (When approved by the Office of Materials and Testing)	831.2.05
Bituminous Tack Coat: PG 58-22, PG 64-22, PG 67-22	820.2
Hot Mix Asphaltic Concrete Mixtures	828
Fiber Stabilizing Additives	819

When approved by the Office of Materials and Testing and required in the Contract, provide Uintaite material, hereafter referred to by the common trade name Gilsonite, as a reinforcing agent for bituminous mixtures. Supply a manufacturer's certification that the Gilsonite is a granular solid which meets the following requirements:

Softening Point (AASHTO: T-53)	300-350 °F (150-175 °C)
Specific Gravity, 77 °F (25 °C) (AASHTO: T-228)	1.04 ± 0.02
Flash Point, COC (AASHTO: T-48)	550 °F (290 °C) Min.
Ash Content (AASHTO: T-111)	1.0% Max.
Penetration, 77 °F (25 °C), 100 gm., 5 sec. (AASHTO: T-49)	0

400.2.01 Delivery, Storage, and Handling

Storage of material is allowed in a properly sealed and insulated system for up to 24 hours. Ensure Stone Matrix Asphalt (SMA), Open-Graded Friction Course (OGFC), or Porous European Mix (PEM) mixtures are not stored more than 12 hours. Mixtures other than SMA, OGFC, or PEM may be stored up to 72 hours in a sealed and insulated system, equipped with an auxiliary inert gas system, with the Engineer's approval. Segregation, lumpiness, drain-down, or stiffness of stored mixture is cause for rejection of the mixture. The Engineer will not approve using a storage or surge bin if the mixture segregates, loses excessive heat, or oxidizes during storage.

The Engineer may obtain mixture samples or recover asphalt cement according to GDT 119 or AASHTO T 324. AASHTO T 315, AASHTO T 202, or AASHTO T 49 will be used to perform viscosity and penetration tests to determine how much asphalt hardening has occurred. AASHTO T-324 will be used to perform Hamburg Wheel Tracking Device testing to determine rutting and moisture damage susceptibility.

A. Vehicles for Transporting and Delivering Mixtures

Ensure trucks used for hauling bituminous mixtures have tight, clean, smooth beds.

Follow these guidelines when preparing vehicles to transport bituminous mixtures:

1. Use an approved releasing agent from QPL 39 in the transporting vehicle beds, if necessary, to prevent the mixture from sticking to the bed. Ensure the releasing agent is not detrimental to the mixture. When applying the agent, drain the excess agent from the bed before loading. Remove from the project any transporting vehicles determined to contain unapproved releasing agents.
2. Protect the mixture with a waterproof cover large enough to extend over the sides and ends of the bed. Securely fasten the waterproof cover before the vehicle begins moving.
3. Insulate the front end and sides of each bed with an insulating material with the following specifications:
   - Consists of builders insulating board or equivalent;
   - Has a minimum "R" value of 4.0; and
   - Can withstand approximately 400 °F (200 °C) temperatures

   Install the insulating material so it is protected from loss and contamination. A "Heat Dump Body" may be used in lieu of insulation of the bed. "Heat Dump Body" refers to any approved transport vehicle capable of diverting engine exhaust and transmitting heat evenly throughout the dump body to keep asphalt at required temperature. Mark the "Heat Dump Body" clearly with "OPEN" and "CLOSE" position at the exhaust diverter. Install a padlock and lock it in the "OPEN" position when the "Heat Dump Body" is used to transport bituminous mixtures.
4. Mark each transporting vehicle with a clearly visible identification number.
5. Create a hole in each side of the bed so the temperature of the loaded mixture can be checked. Ensure the placement of these holes are located to assure the thermometer is being placed in the hot mix asphaltic concrete mixtures.

Ensure the mixture is delivered to the roadway at a temperature within ± 20 °F (± 11 °C) of the temperature on the job mix formula.

If the Engineer determines a truck may be hazardous to the project or adversely affect the quality of the work, remove the truck from the project.

B. Containers for Transporting, Conveying, and Storing Bituminous Material

To transport, convey, and store bituminous material, use containers free of foreign material and equipped with sample valves. Bituminous material will not be accepted from conveying vehicles if material has leaked or spilled from the containers.

400.3 Construction Requirements

400.3. 01 Personnel

General Provisions 101 through 150.

400.3.02 Equipment

Hot mix asphaltic concrete plants producing mix for Department use are governed by Quality Assurance for Hot Mix Asphaltic Concrete Plants in Georgia, Laboratory Standard Operating Procedure No. 27.

The Engineer will approve the equipment used to transport and construct hot mix asphaltic concrete. Ensure the equipment is in satisfactory mechanical condition and can function properly during production and placement operations. Place the following equipment at the plant or project site:

A. Field Laboratory

Provide a field laboratory according to Section 152.

B. Plant Equipment

1. Scales

   Provide scales as follows:

   a. Furnish (at the Contractor’s expense) scales to weigh bituminous plant mixtures, regardless of the measurement method for payment.

   b. Ensure the weight measuring devices provide documentation complying with Subsection 109.01, *Measurement and Quantities*.

   c. Provide weight devices recording the mixture net weights delivered to the truck when not using platform scales. A net weight system will include, but is not limited to:

      - Hopper or batcher-type weight systems delivering asphaltic mixture directly to the truck
      - Fully automatic batching equipment with a digital recording device

   d. Use a net weight printing system only with automatic batching and mixing systems approved by the Engineer.

   e. Ensure the net weight scale mechanism or device manufacturer, installation, performance, and operation meets the requirements in Subsection 109.01, *Measurement and Quantities*

   f. Provide information on the Project tickets according to Department of Transportation SOP-15.

2. Time-Locking Devices

   Furnish batch type asphalt plants with automatic time-locking devices controlling the mixing time automatically. Construct these devices to ensure the operator cannot shorten or eliminate any portion of the mixing cycle.

3. Surge- and Storage-Systems

Provide surge and storage bins as follows:

a. Ensure bins for mixture storage are insulated and have a working seal, top and bottom, to prevent outside air infiltration and to maintain an inert atmosphere during storage. Bins not intended as storage bins may be used as surge bins to hold hot mixtures for part of the working day. However, empty these surge bins completely at the end of the working day.

b. Ensure surge and storage bins can retain a predetermined minimum level of mixture in the bin when the trucks are loaded.

c. Ensure surge and storage systems do not contribute to mix segregation, lumpiness, drain-down, or stiffness.

d. Ensure the scale mechanism or device manufacture, installation, performance, and operation meets the requirements in Subsection 109.01 *Measurement and Quantities*.

4. Controls for Dust Collector Fines

Control dust collection as follows:

a. When collecting airborne aggregate particles and returning them to the mixture, have the return system meter all or part of the collected dust uniformly into the aggregate mixture and waste the excess. The collected dust percentage returned to the mixture is subject to the Engineer’s approval.

b. When the collected dust is returned directly to the hot aggregate flow, interlock the dust feeder with the hot aggregate flow, and meter the flow to maintain a constant, proportioned and uniform flow.

5. Mineral Filler Supply System

When mineral filler is required as a mixture ingredient:

a. Use a separate bin and feed system to store and proportion the required quantity into the mixture with uniform distribution.

b. Control the feeder system with a proportioning device meeting these specifications:

- Is accurate to within ± 10 percent of the filler required
- Has a convenient and accurate means of calibration
- Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes

c. Provide flow indicators or sensing devices for the mineral filler system and interlock them with the plant controls to interrupt the mixture production if mineral filler introduction fails to meet the required target value after no longer than 60 seconds.

d. Add mineral filler to the mixture as follows, according to the plant type:

- Batch Type Asphalt Plant: add mineral filler to the mixture in the weigh hopper.
- Continuous Plant Using Pugmill Mixers: feed the mineral filler into the hot aggregate before it is introduced into the mixer to ensure dry mixing is accomplished before the bituminous material is added.
- Continuous Plants Using the Drier-Drum Mixers: add the mineral filler to ensure dry mixing is accomplished before the bituminous material is added and ensure the filler does not become entrained into the air stream of the drier.

6. Hydrated Lime Treatment System

When hydrated lime is required as a mixture ingredient:

a. Use a separate bin and feed system to store and proportion the required quantity into the mixture.

b. Ensure the aggregate is uniformly coated with hydrated lime aggregate before adding the bituminous material to the mixture. Ensure the addition of hydrated lime will not become entrained in the exhaust system of the drier or plant.

c. Control the feeder system with a proportioning device meeting these specifications:
   - Is accurate to within ± 10 percent of the amount required
   - Has a convenient and accurate means of calibration
   - Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes and to ensure mixture produced is properly treated with lime

d. Provide flow indicators or sensing devices for the hydrated lime system and interlock them with the plant controls to interrupt mixture production if hydrated lime introduction fails to meet the required target value after no longer than 60 seconds.

7. Net Weight Weighing Mechanisms

Certify the accuracy of the net weight weighing mechanisms by an approved registered scale serviceperson at least once every 6 months. Check the accuracy of net weight weighing mechanisms at the beginning of Project production and thereafter as directed by the Engineer. Check mechanism accuracy as follows:

a. Weigh a load on a set of certified commercial truck scales. Ensure the difference between the printed total net weight and weight obtained from the commercial scales is no greater than 4 lbs./1,000 lbs. (4 kg/Mg) of load.

   Check the accuracy of the bitumen scales as follows:
   - Use standard test weights.
   - If the checks indicate printed weights are out of tolerance, have a registered scale serviceperson check the batch scales and certify the accuracy of the printer.
   - While the printer system is out of tolerance and before its adjustment, continue production only if using a set of certified truck scales to determine the truck weights.

b. Ensure plants using batch scales maintain ten 50 lb. (25 kg) standard test weights at the plant site to check batching scale accuracy.

c. Ensure plant scales are used only to proportion mixture ingredients, and not to determine that pay quantities, are within two percent throughout the range.

8. Fiber Supply System

When stabilizing fiber is required as a mixture ingredient:

a. Use a separate feed system to store and proportion by weight the required quantity into the mixture with uniform distribution.

b. Control the feeder system with a proportioning device meeting these specifications:
   - Is accurate to within ± 10 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
   - Has a convenient and accurate means of calibration.
   - Provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds (kg) per minute, to verify feed rate.
   - Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes.

c. Provide flow indicators or sensing devices for the fiber system and interlock them with the plant controls to interrupt the mixture production if fiber introduction fails or if the output rate is not within the tolerances given above.

d. Introduce the fiber as follows:

- When a batch type plant is used, add the fiber to the aggregate in the weigh hopper. Increase the batch dry mixing time by 8 to 12 seconds from the time the aggregate is completely emptied into the mixer to ensure the fibers are uniformly distributed prior to the injection of asphalt cement into the mixer.
- When a continuous or drier-drum type plant is used, add the fiber to the aggregate and uniformly disperse prior to the injection of asphalt cement. Ensure the fibers will not become entrained in the exhaust system of the drier or plant.

9. Crumb Rubber Modifier Supply System

When specified, crumb rubber modifier may be substituted at the Contractor's discretion to produce a PG 76-22 asphaltic cement at the production facility in accordance with Section 820:

a. Use a separate feed system to store and proportion by weight of the total asphaltic cement, the required percentage of crumb rubber into the mixture.

b. Control the feeder system with a proportioning device meeting these specifications:

- Is accurate to within ± 6 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
- Has a convenient and accurate means of calibration.
- Provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds per minute, to verify feed rate. Ensure the supply system reports the feed in 1 lb. (454 gr.) increments using load cells enabling the user to monitor the depletion of the modifier. Monitoring the system volumetrically will not be allowed.
- Interlocks with the aggregate weigh system and asphaltic cement pump to maintain the correct proportions for all rates of production and batch sizes.

c. Provide flow indicators or sensing devices for the system and interlock them with the plant controls to interrupt the mixture production if the crumb rubber introduction output rate is not within the ± 6 percent tolerance given above. This interlock will immediately notify the operator if the targeted rate exceeds introduction tolerances. All plant production will cease if the introduction rate is not brought back within tolerance after 30 seconds. When the interlock system interrupts production and the plant has to be restarted, upon restarting operations; ensure the modifier system runs until a uniform feed can be observed on the output display. Ensure all mix produced prior to obtaining a uniform feed is rejected.

d. Introduce the crumb rubber modifier as follows:

- When a batch type plant is used, add the rubber to the aggregate in the weigh hopper. Increase the batch dry mixing time by 15 to 20 seconds from the time the aggregate is completely emptied into the mixer to ensure the modifiers are uniformly distributed prior to the injection of asphalt cement into the mixer. Increase the batch wet mix time by 15 to 20 seconds to ensure the crumb rubber modifier is uniformly blended with the asphaltic cement.
- When a continuous or drier-drum type plant is used, add the rubber to the aggregate and uniformly disperse prior to the injection of asphalt cement. The point of introduction in the drum mixer will be approved by the Engineer prior to production. Ensure the crumb rubber modifier will not become entrained in the exhaust system of the drier or plant and will not be exposed to the drier flame at any point after induction.

e. No separate measurement and payment will be made if Contractor elects to utilize crumb rubber.

10. Fiber-Reinforcement Supply System

When reinforcement fiber is specified in the contract as a mixture ingredient:

Ensure, that the reinforcement fiber is an approved material and listed on QPL 97" Georgia's List of Approved Reinforcement Fiber". Use a separate Fiber Meetering Device feed system to proportion by weight of the total asphaltic cement, the required percentage of fiber-reinforcement into the mixture.

a. Control the meetering system with a proportioning device meeting these specifications:

- Is accurate to within ± 6 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
- Has a convenient and accurate means of calibration.
- Provides in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds, or (kg) per minute, to verify feed rate
- Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes.

b. Provide flow indicators or sensing devices for the fiber system and interlock them with the plant controls to interrupt the mixture production if fiber introduction fails or if the output rate is not within the tolerances given above.

c. Introduce the fiber as follows:

- When a batch type plant is used, add the fiber dossage to the aggregate in the weigh hopper. This may be done with loose fibers and a Fiber Meetering Device or may be done by using pre-measured packages that are specifically designed to disintegrate within the mixing cycle. Increase the batch dry mixing time by 8 to 12 seconds from the time the aggregate is completely emptied into the mixer to ensure the fibers are uniformly distributed prior to the injection of asphalt cement into the mixer.
- When a continuous or drier-drum type plant is used, add the fiber to the aggregate or RAP material at the beginning of the mixing cycle and uniformly disperse prior to the injection of asphalt cement. The final configuration of the fibers at the point when mixing begins, should closely resemble the fibers as they are packaged. Pre-distributing the fibers into their individual form should be avoided. Ensure the fibers will not become entrained in the exhaust system of the drier or plant. The producer should inspect their plant for any protrusions that may accumulate fibers and create the potential for fiber clumps.
- When a continuous or drier-drum type plant is used for limited production volumes, the addition of the fibers may be done by using pre-measured packages that are specifically designed to disintegrate within the mixing cycle and adding them directly into the RAP port of the plant. Because this is not an automated process, a written protocol must be supplied by the producer to demonstrate how they will attain the dossage requirement, and documentation must be supplied by the material manufacturer assuring this method will produce the desired random fiber distribution.

C. Equipment at Project Site

1. Cleaning Equipment

Provide sufficient hand tools and power equipment to clean the roadway surface before placing the bituminous tack coat. Use power equipment complying with Subsection 424.3.02.F, *Power Broom and Power Blower*.

2. Pressure Distributor

To apply the bituminous tack coat, use a pressure distributor complying with Subsection 424.3.02.B, *Pressure Distributor*.

3. Bituminous Pavers

To place hot mix asphaltic concrete, use bituminous pavers that can spread and finish courses that are:

- As wide and deep as indicated on the plans
- True to line, grade, and cross section
- Smooth
- Uniform in density and texture

a. Continuous Line and Grade Reference Control. Furnish, place, and maintain the supports, wires, devices, and materials required to provide continuous line and grade reference control to the automatic paver control system.

b. Automatic Screed Control System. Equip the bituminous pavers with an automatic screed control system actuated from sensor-directed mechanisms or devices that will maintain the paver screed at a pre-determined transverse slope and elevation to obtain the required surface.

c. Transverse Slope Controller. Use a transverse slope controller capable of maintaining the screed at the desired slope within ± 0.1 percent. Do not use continuous paving set-ups resulting in unbalanced screed widths or off-center breaks in the main screed cross section unless approved by the Engineer.

d. Screed Control. Equip the paver to permit the following four modes of screed control. Ensure the method used is approved by the Engineer.

- Automatic grade sensing and slope control
- Automatic dual grade sensing
- Combination automatic and manual control
- Total manual control

Ensure the controls are referenced with a taut string or wire set to grade, or with a ski-type device or mobile reference at least 30 ft. (9 m) long when using a conventional ski. Approved non-contacting laser or sonar-type skis listed on QPL 91 “Georgia’s List of Approved Non-contacting Laser and Sonar-type Electronic Grade and Slope Controls” may be used in lieu of conventional 30 ft. (9 m) skis. Under limited conditions, a short ski or shoe may be substituted for a long ski on the second paver operating in tandem, or when the reference plane is a newly placed adjacent lane.

Automatic screed control is required on all projects; however, when the Engineer determines that project conditions prohibit the use of such controls, the Engineer may waive the grade control, or slope control requirements, or both.

e. Paver Screed Extension. When the laydown width requires a paver screed extension, use bolt-on screed extensions to extend the screeds, or use an approved mechanical screed extension device. When the screed is extended, add auger extensions to assure a length of no more than 18 in. (0.5 m) from the auger to the end gate of the paver. Auger extensions may be omitted when paving variable widths. Ensure the paver is equipped with tunnel extensions when the screed and augers are extended.

NOTE: Do not use extendible strike-off devices instead of approved screed extensions. Only use a strike-off device in areas that would normally be luted in by hand labor.

4. Compaction Equipment

Ensure that the compaction equipment is in good mechanical condition and can compact the mixture to the required density. The compaction equipment number, type, size, operation, and condition is subject to the Engineer’s approval

5. Materials Transfer Vehicle (MTV)

a. Use a Materials Transfer Vehicle (MTV) when placing asphaltic concrete mixtures on projects on the state route system with the following conditions. If a project fails to meet any one of the following conditions, the MTV’s use is not required other than during the placement of SMA, PEM and OGFC mixtures. MTVs are required during the placement of SMA, PEM and OGFC mixtures regardless of ADT, project length and mixture tonnage unless waived at the discretion of the Office of Materials and Testing.

1) When to use:

- The two-way ADT is equal to or greater than 6000
- The project length is equal to or greater than 3000 linear feet (915 linear meters)
- The total tonnage (megagrams) of all asphaltic concrete mixtures is greater than 2000 tons (1815 Mg)

2) Where to use:

- Mainline of the traveled way
- Collector/distributor (C/D) lanes on Interstates and limited access roadways
- Leveling courses at the Engineer’s discretion

3) Do not use the MTV for the following conditions:

- A resurfacing project that only 9.5 mm mix is required.
- A project with lane width that is equal or less than 11 ft. (3.4 m).
- A passing lane only project.
- When noted on the plans.

b. Ensure the MTV and conventional paving equipment meet the following requirements:

1) MTV

- Has a truck unloading system which receives mixture from the hauling equipment and independently deliver mixtures from the hauling equipment to the paving equipment.
- Has mixture remixing capability approved by the Office of Materials and Testing and is listed on QPL 88 “Georgia’s List of Approved Materials Transfer Vehicles”.
- Provides to the paver a homogeneous, non-segregated mixture of uniform temperature with no more than 20 °F (11 °C) difference between the highest and lowest temperatures when measured transversely across the width of the mat in a straight line at a distance of one foot to twenty-five feet (0.3 m to 7.6 m) from the screed while the paver is operating. Ensure that the MTV is capable of providing the paver a consistent material flow that is sufficient to prevent the paver from stopping between truck exchanges.

2) Conventional Paving Equipment

- Has a paver hopper insert with a minimum capacity of 14 tons (13 Mg) installed in the hopper of conventional paving equipment when an MTV is used.

c. If the MTV malfunctions during spreading operations, discontinue placement of hot mix asphaltic concrete after there is sufficient mix placed to maintain traffic in a safe manner. However, placement of hot mix asphaltic concrete in a lift not exceeding 2 in. (50 mm) may continue until any additional hot mix in transit at the time of the malfunction has been placed. Cease spreading operations thereafter until the MTV is operational.

d. Ensure the MTV is empty when crossing a bridge and is moved across without any other Contractor vehicles or equipment on the bridge. Move the MTV across a bridge in a travel lane and not on the shoulder. Ensure the speed of the MTV is no greater than 5 mph (8 kph) without any acceleration or deceleration while crossing a bridge.

400.3.03 Preparation

A. Prepare Existing Surface

Prepare the existing surface as follows:

1. Clean the Existing Surface. Before applying hot mix asphaltic concrete pavement, clean the existing surface to the Engineer's satisfaction.
2. Patch and Repair Minor Defects

   Before placing leveling course:

   a. Correct potholes and broken areas requiring patching in the existing surface and base as directed by the Engineer.

   b. Cut out, trim to vertical sides, and remove loose material from the areas to be patched.

   c. Prime or tack coat the area after being cleaned. Compact patches to the Engineer's satisfaction. Material for patches does not require a job mix formula but must meet the gradation range shown in Section 828. The Engineer must approve the asphalt content to be used.
3. Apply Bituminous Tack Coat

   Apply the tack coat according to Section 413. The Engineer will determine the application rate, which must be within the limitations in Tables 2A and 2B.

TABLE 2A—APPLICATION RATES FOR BITUMINOUS TACK, GAL/YD² (L/M²)

Tack Uses	Minimum	Maximum
Under OGFC and PEM Mixes	0.06 (0.27)	0.08 (0.36)
All Other Mixes	0.04 (0.18)	0.06 (0.27)
Non-tracking Hot Applied Polymer Modified Tack (NTHAPT) (Note 2)	0.06 (0.27)	0.18 (0.81)
Note 1: On thin leveling courses and freshly placed asphaltic concrete mixes, reduce the application rate to 0.02 to 0.04 gal/yd² (0.09 to 0.18 L/m²). **Note 2: Use higher application rate (0.12 to 0.18) within the minimum and maximum range under OGFC and PEM Mixes**		

TABLE 2B – APPLICATION RATES FOR ANIONIC EMULSIFIED ASPHALT OR CATIONIC EMULSIFIED ASPHALT BITUMINUS TACK, GAL/YD² (L/M²)

Tack-Uses	Minimum	Maximum
New Asphaltic Concrete Pavement to New Asphaltic Concrete Pavement or Thin Lift Leveling	0.05 (0.23)	0.08 (0.36)
New Asphaltic Concrete Pavement (≤ 25% RAP) to Aged Existing Pavement or Milled Surface	0.06 (0.27)	0.10 (0.45)
New Asphaltic Concrete Pavement (> 25% RAP) to Aged Existing Pavement or Milled Surface	0.08 (0.36)	0.12 (0.54)
Non-tracking Emulsified Asphalt	0.07 (0.32)	0.12 (0.54)
CQS-Special Modified Asphalt Emulsion (Note 1)	0.12 (0.54)	0.28 (1.27)

- Allow standard anionic emulsified asphalt or cationic emulsified asphalt to break per emulsion manufacturer's recommendation. Proceed with paving only after the anionic emulsified asphalt or cationic emulsified asphalt has cured to the satisfaction of the Engineer.
- Do not use anionic emulsified asphalt or cationic emulsified asphalt, other than CQS-Special Modified Asphalt Emulsion in conjunction with a spray paver, under OGFC or PEM on interstates or limited access state routes.

Note 1: Use higher application rate (0.22 to 0.28) within the minimum and maximum under OGFC and PEM Mixes

B. Place Patching and Leveling Course

1. When the existing surface is irregular, bring the surface area to the proper cross section and grade with a leveling course of hot mix asphaltic concrete materials.
2. Place leveling at the locations and in the amounts directed by the Engineer.
3. Use leveling course mixtures meeting the requirements of the job mix formulas defined in:
   - Subsection 400.3.05.A, *Observe Composition of Mixtures*
   - Section 828
   - Leveling acceptance schedules in
     Subsection 400.3.06.A, *Acceptance Plans for Gradation and Asphalt Cement Content*
4. If the leveling and patching mix type is undesignated, determine the mix type by the thickness or spread rate according to Table 3, but do not use 4.75 mm mix on interstate projects.
5. If patching is required to correct mat deficiencies in the final surface layer, ensure patches extend full lane width and no less than the length of the affected area as determined by the Engineer.

TABLE 3—LEVELING AND PATCHING MIX TYPES

Thickness	Rate of Spread	Type of Mix
Up to 0.75 in. (19 mm)	Up to 85 lbs./yd² (46 kg/m²)	4.75 mm Mix or 9.5 mm Superpave Type 1
0.75 to 1.5 in. (19 to 38 mm)	85 to 165 lbs./yd²(46 to 90 kg/m²)	9.5 mm Superpave Type 2
1.5 to 2 in. (38 to 50 mm)	165 to 220 lbs./yd² (90 to 120 kg/m²)	12.5 mm Superpave *
2 to 3 in. (50 to 75 mm)	220 to 330 lbs./yd² (120 to 180 kg/m²)	19 mm Superpave **
Over 2.5 in. (64 mm)	Over 275 lbs./yd² (180 kg/m²)	25 mm Superpave

* This mixture may be used for isolated patches no more than 6 in. (150 mm) deep and no more than 4 ft. (1.2 m) in diameter or length.

** This mixture may be used for patching no more than 4 in. (100 mm) deep in limited confined deep mill and patching locations.

400.3.04 Fabrication

General Provisions 101 through 150.

400.3.05 Construction

Provide the Engineer at least one day's notice prior to beginning construction, or prior to resuming production if operations have been temporarily suspended.

A. Observe Composition of Mixtures

1. Calibration of plant equipment

   If the material changes, or if a component affecting the ingredient proportions has been repaired, replaced, or adjusted, check and recalibrate the proportions.

   Calibrate as follows:

   a. Before producing mixture for the Project, calibrate by scale weight the electronic sensors or settings for proportioning mixture ingredients.

   b. Calibrate ingredient proportioning for all rates of production.

2. Mixture control

   Compose hot mix asphaltic concrete from a uniform mixture of aggregates, bituminous material, and if required, hydrated lime, mineral filler, or other approved additive.

   Ensure the constituents proportional to produce mixtures meeting the requirements in Section 828. The general composition limits prescribed are extreme ranges within which the job mix formula must be established. Base mixtures on a design analysis that meets the requirements of Section 828.

   Ensure the field performance of the in-place mixtures meet the requirements of Subsection 828.2B for Permeability, Moisture Susceptibility, Rutting Susceptibility and Fatigue. In-place mix may be evaluated for compliance with Subsection 828.2.B at the discretion of the State Bituminous Construction Engineer under the following conditions:

   - Deviates greater than 10 percent on gradation for mixture control sieves from the approved Job Mix Formula based on Acceptance or Independent Samples.
   - Deviates greater than 0.7 percent in asphalt cement content from the approved Job Mix Formula based on Acceptance or Independent Samples.
   - The calculated mean pavement air voids result in an adjusted pay factor less than 0.80 or any single sub lot result in mean pavement air voids exceeding 10.5 percent.

- Mix produced not using an approved mix design and/or job mix formula.

Remove and replace any material determined to not meet the requirements established in Section 828.2.B at the Contractor's expense.

If control test results show the characteristic tested does not conform to the job mix formula control tolerances given in Section 828, take immediate action to ensure that the quality control methods are effective.

Control the materials to ensure extreme variations do not occur. Maintain the gradation within the composition limits in Section 828.

B. Prepare Bituminous Material

Uniformly heat the bituminous material to the temperature specified in the job mix formula with a tolerance of ± 20 °F (± 11 °C).

C. Prepare the Aggregate

Prepare the aggregate as follows:

1. Heat the aggregate for the mixture and ensure a mix temperature within the limits of the job mix formula.
2. Do not contaminate the aggregate with fuel during heating.
3. Reduce the absorbed moisture in the aggregate until the asphalt does not separate from the aggregate in the prepared mixture. If this problem occurs, the Engineer will establish a maximum limit for moisture content in the aggregates. When this limit is established, maintain the moisture content below this limit.

D. Prepare the Mixture

Proportion the mixture ingredients as necessary to meet the required job mix formula. Mix until a homogenous mixture is produced.

1. Add Mineral Filler

   When mineral filler is used, introduce it in the proper proportions and as specified in Subsection 400.3.02.B.5, *Mineral Filler Supply System*.

2. Add Hydrated Lime

   When hydrated lime is included in the mixture, add it at a rate specified in Section 828 and the job mix formula. Use methods and equipment for adding hydrated lime according to Subsection 400.3.02.B.6, *Hydrated Lime Treatment System*.

   Add hydrated lime to the aggregate by using Method A or B as follows:

   Method A—Dry Form—Add hydrated lime in its dry form to the mixture as follows, according to the type of plant:

   a. Batch Type Asphalt Plant: Add hydrated lime to the mixture in the weigh hopper or as approved and directed by the Engineer.
   b. Continuous Plant Using Pugmill Mixer: Feed hydrated lime into the hot aggregate before it is introduced into the mixer to ensure dry mixing is complete before the bituminous material is added.

   Method B—Lime/Water Slurry—Add the required quantity of hydrated lime (based on dry weight) in lime/water slurry form to the aggregate. This solution consists of lime and water in concentrations as directed by the Engineer.

   Equip the plant to blend and maintain the hydrated lime in suspension and to mix the hydrated lime with the aggregates uniformly in the proportions specified.

   c. Continuous Plant Using Drier-Drum Mixer: Add hydrated lime so to ensure the lime will not become entrained into the air stream of the drier and to ensure thorough dry mixing will be complete before the bituminous material is added.

3. Add Stabilizing Fiber

   When stabilizing fiber is included in the mixture, add stabilizing fiber at a rate specified in Section 819 and the Job Mix Formula. Introduce it as specified in Subsection 400.3.02.B.8, *Fiber Supply System*.

4. Add Gilsonite Modifier

   When approved by the Office of Materials and Testing and required by the Contract, add the Gilsonite modifier to the mixture at a rate to ensure eight percent by weight of the asphalt cement is replaced by Gilsonite. Use either PG 64-22 or PG 67-22 asphalt cement as specified in Subsection 820.2.01. Provide suitable means to calibrate and check the rate of Gilsonite being added. Introduce Gilsonite modifier by either of the following methods.

   a. For batch type plants, incorporate Gilsonite into the pugmill at the beginning of the dry mixing cycle. Increase the dry mix cycle by a minimum of 10 seconds after the Gilsonite is added and prior to introduction of the asphalt cement. For this method, supply Gilsonite in plastic bags to protect the material during shipment and handling and store the modifier in a waterproof environment. Ensure the bags are capable of being completely melted and uniformly blended into the combined mixture.

      Gilsonite may also be added through a mineral filler supply system as described in Subsection 400.3.02.B.5, *Mineral Filler Supply System*. Ensure the system is capable of injecting the modifier into the weigh hopper near the center of the aggregate batching cycle so the material can be accurately weighed.

   b. For drier-drum plants, add Gilsonite through the recycle ring or through an acceptable means which will introduce the Gilsonite prior to the asphalt cement injection point. The modifier must proportionately feed into the drum mixer at the required rate by a proportioning device which shall be accurate within ± 10 percent of the amount required. Ensure the entry point is away from flames and the Gilsonite will not be caught up in the air stream and exhaust system.

5. Materials from Different Sources

   Do not use mixtures prepared from aggregates from different sources intermittently. This will cause the color of the finished pavement to vary.

E. Observe Weather Limitations

Do not mix and place asphaltic concrete if the existing surface is wet or frozen. Do not lay asphaltic concrete OGFC mix or PEM at air temperatures below 60 °F (16 °C). When using a MTV, OGFC mix or PEM may be placed at 55 °F (13 °C) when approved by the Engineer. For other courses, follow the temperature guidelines in the following table:

TABLE 4—LIFT THICKNESS TABLE

Lift Thickness	Minimum Temperature
1 in. (25 mm) or less	55 °F (13 °C)
1.1 to 2 in. (26 mm to 50 mm)	45 °F (8 °C)
2.1 to 3 in. (51 mm to 75 mm)	40 °F (4 °C)
3.1 to 4 in. (76 mm to 100 mm)	35 °F (2 °C)
4.1 to 8 in. (101 mm to 200 mm)	32 °F (0 °C) and rising. Base material must not be frozen.

F. Perform Spreading and Finishing

Spread and finish the course as follows:
Determine the maximum compacted layer thickness by the type mix being used according to Table 5.

TABLE 5—MIX TYPE MINIMUM, MAXIMUM LAYER AND TOTAL THICKNESS

Mix Type	Minimum Layer Thickness	Maximum Layer Thickness	Maximum Total Thickness
25 mm Superpave	2 1/2 in. (64 mm)	5 in. (125 mm) *	—
19 mm Superpave	1 3/4 in. (44 mm)	3 in. (75 mm) *	—
12.5 mm Superpave	1 3/8 in. (35 mm)	2 1/2 in. (64 mm)**/***	8 in. (200 mm)
9.5 mm Superpave Type 2	1 1/8 in. (29 mm)	1 1/2 in. (38 mm)***	4 in. (100 mm)
9.5 mm Superpave Type 1	7/8 in. (22 mm)	1 1/4 in. (32 mm)	4 in. (100 mm)
4.75 mm Mix	3/4 in. (19 mm)	1 1/8 in. (29 mm)	2 in. (50 mm)
9.5 mm OGFC	75 lbs./yd² (41 kg/m²)	95 lbs./yd² (51 kg/m²)	—
12.5 mm OGFC	85 lbs./yd² (46 kg/m²)	110 lbs./yd² (60 kg/m²)	—
12.5 mm PEM	110 lbs./yd² (60 kg/m²)	165 lbs./yd² (90 kg/m²)	—
9.5 mm SMA	1 1/8 in. (29 mm)	1 1/2 in. (38 mm)	4 in. (100 mm)
12.5 mm SMA	1 3/8 in. (35 mm)	3 in. (75 mm)	6 in. (150 mm)
19 mm SMA	1 3/4 in. (44 mm)	3 in. (75 mm)	—

* Allow up to 6 in. (150 mm) per lift on trench widening. **Allow up to 4 in. (100 mm) per lift on trench widening of ≤ 2 ft. when no overlay is required. ***Place 9.5 mm Superpave and 12.5 mm Superpave up to 4 in. (100 mm) thick for driveway and side road transition.

1. Unload the mixture into the paver hopper or into a device designed to receive the mixture from delivery vehicles.
2. Except for leveling courses, spread the mixture to the loose depth for the compacted thickness or the spread rate. Use a mechanical spreader true to the line, grade, and cross section specified.
3. For leveling courses, use a motor grader equipped with a spreader box and smooth tires to spread the material or use a mechanical spreader meeting the requirements in Subsection 400.3.02.C, *Equipment at Project Site*.
4. Obtain the Engineer’s approval for the sequence of paving operations, including paving the adjoining lanes. Minimize tracking tack onto surrounding surfaces.
5. Ensure the outside edges of the pavement being laid are aligned and parallel to the roadway center line.
6. For New Construction or Resurfacing Contracts containing multiple lifts or courses, arrange the width of the individual lifts so the longitudinal joints of each successive lift are offset from the previous lift at least 1 ft. (300 mm). This requirement does not apply to the lift immediately over thin lift leveling courses.
7. Ensure the longitudinal joint(s) in the surface course and the mix immediately underneath asphaltic concrete OGFC or PEM are at the lane line(s).

NOTE: Perform night work with artificial light provided by the Contractor and approved by the Engineer.

8. Where mechanical equipment cannot be used, spread and rake the mixture by hand. Obtain the Engineer's approval of the operation sequence, including compactive methods, in these areas.
9. Keep small hand raking tools clean and free from asphalt build up. Do not use fuel oil or other harmful solvents to clean tools during the work.
10. Do not use mixture with any of these characteristics:
    - Segregated
    - Nonconforming temperature
    - Deficient or excessive asphalt cement content
    - Otherwise unsuitable to place on the roadway in the work
11. Remove and replace mixture placed on the roadway that the Engineer determines has unacceptable blemish levels from segregation, raveling, streaking, pulling and tearing, or other deficient characteristics. Replace with acceptable mixture at the Contractor's expense. Do not continually place mixtures with deficiencies.

    Do not place subsequent course lifts over another lift or course while the temperature of the previously placed mix is 140 °F (60 °C) or greater.
12. Obtain the Engineer's approval of the material compaction equipment. Perform the rolling as follows:
    a. Begin the rolling as close behind the spreader as possible without causing excessive distortion of the asphaltic concrete surface.
    b. Continue rolling until roller marks are no longer visible.
    c. Use pneumatic-tired rollers with breakdown rollers on all courses except asphaltic concrete OGFC, PEM and SMA or other mixes designated by the Engineer.
13. If applicable, taper or "feather" asphaltic concrete from full depth to a depth no greater than 0.5 in. (13 mm) along curbs, gutters, raised pavement edges, and areas where drainage characteristics of the road must be retained. The Engineer will determine the location and extent of tapering.

G. Maintain Continuity of Operations

Coordinate plant production, transportation, and paving operations to maintain a continuous operation. If the spreading operations are interrupted, construct a transverse joint if the mixture immediately behind the paver screed cools to less than 250 °F (120 °C).

H. Construct the Joints

1. Construct Transverse Joints
    a. Construct transverse joints to facilitate full depth exposure of the course before resuming placement of the affected course.
    b. Properly clean and tack the vertical face of the transverse joint before placing additional material.

NOTE: Never burn or heat the joint by applying fuel oil or other volatile materials.

    c. Straightedge transverse joints immediately after forming the joint.
    d. Immediately correct any irregularity that exceeds 3/16 in. in 10 ft. (5 mm in 3 m).
2. Construct Longitudinal Joints

    Clean and tack the vertical face of the longitudinal joint before placing adjoining material. Construct longitudinal joints so that the joint is smooth, well-sealed, and bonded.
3. Construction Joint Detail for OGFC and PEM Mixtures

    In addition to meeting joint requirements described above, construct joints and transition areas for 12.5 mm OGFC and 12.5 mm PEM mixtures as follows:

a. For projects which do not have milling included as a pay item:

1) Place OGFC mixture meeting gradation requirements of 9.5 mm OGFC as specified in Section 828 on entrance and exit ramp gore areas and end of project construction joints.

- Taper mixture from 3/8 in. (10 mm) at end of project to full plan depth within maximum distance of spread for one load of mixture.
- Taper mixture placed on gore areas from thickness of the edge of the mainline to 3/8 in. (10 mm) at the point of the ramp transverse joint.

2) Construct the ramp transverse joint at the point specified in the plans or as directed by the Engineer.

3) Mixture placed in the transition and gore areas will be paid for at the contract unit price for 12.5 mm OGFC or 12.5 mm PEM, as applicable.

b. For projects which have milling included as a pay item:

1) Taper milling for a distance of no less than 50 ft. (15 m) to a depth of 2 1/4 in. (59 mm) at the point of the transverse joint.

2) Taper thickness, if needed, of the dense-graded surface mix within the 50 ft. (15 m) distance to 1 1/2 in. (40 mm) at the point of the transverse joint.

3) Taper thickness of the 12.5 mm OGFC or 12.5 mm PEM to 3/4 in. (19 mm) to ensure the material ties in at grade level with the existing surface at the point of the transverse joint

I. Protect the Pavement

Protect sections of the newly finished pavement from traffic until the traffic will not mar the surface or alter the surface texture. If directed by the Engineer, use artificial methods to cool the newly finished pavement to open the pavement to traffic more quickly.

J. Modify the Job Mix Formula

If the Engineer determines that undesirable mixture or mat characteristics are being obtained, the job mix formula may require immediate adjustment.

400.3.06 Quality Acceptance

A. Acceptance Plans for Gradation and Asphalt Cement Content

The Contractor will randomly sample and test mixtures for acceptance on a lot basis. The Department will monitor the Contractor testing program and perform comparison and quality assurance testing. The Contractor’s Quality Control Technicians shall participate in the Department’s Independent Assurance Systems Basis Program.

1. Determine Lot Amount

A lot consists of the tons (megagrams) of asphaltic concrete produced and placed each production day. If this production is less than 500 tons (500 Mg), or its square yard (meter) equivalent, production may be incorporated into the next working day. The Engineer may terminate a lot when a pay adjustment is imminent if a plant or materials adjustment resulting in a probable correction has been made. Terminate all open lots at the end of the month, except for materials produced and placed during the adjustment period. The lot will be terminated as described in Subsection 400.5.01, *Adjustments*.

If the final day’s production does not constitute a lot, the production may be included in the lot for the previous day’s run; or, the Engineer may treat the production as a separate lot with a corresponding lower number of tests.

2. Determine Lot Acceptance

Determine lot acceptance as found in Subsection 400.5.01, *Adjustments*.

The Department will perform the following task:

Determine the pay factor by using the mean of the deviations from the job mix formula of the tests in each lot and apply it to Table 10 Mixture Acceptance Schedule for Surface Mixes or Table 11 Mixture Acceptance Schedule for Subsurface Mixes, whichever is appropriate. This mean will be determined by averaging the actual numeric value of the individual deviations from the job mix formula, disregarding whether the deviations are positive or negative amounts. Do not calculate lot acceptance using test results for materials not used in the Work. Determine the pay factor for each lot by multiplying the contract unit price by the appropriate pay factor from the Mixture Acceptance Schedule - Table 10 or Table 11. When two or more pay factors for a specific lot are less than 1.0, determine the adjusted payment by multiplying the contract unit price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the lot acceptance tests for a control sieve or for asphalt cement content exceeds the tolerances established in the appropriate Mixture Acceptance Schedule, and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the Engineer determines that the material is not acceptable to leave in place, the materials shall be removed and replaced at the Contractor's expense.

3. Provide Quality Control Program

Provide a Quality Control Program as established in SOP 27 which includes:

- Assignment of quality control responsibilities to specifically named individuals who have been certified by the Office of Materials and Testing
- Provisions for prompt implementation of control and corrective measures
- Provisions for communication with Project Manager, Bituminous Technical Services Engineer, and Testing Management Operations Supervisor at all times
- Provisions for reporting all test results daily through the Office of Materials and Testing computerized Field Data Collection System, AASHTO Trns*port SiteManager, or approved computerized application; other checks, calibrations and records will be reported on a form developed by the Contractor and will be included as part of the project records
- Notification in writing of any change in quality control personnel

a. Certification Requirements:

- Use laboratory and testing equipment certified by the Department. (Laboratories which participate in and maintain AASHTO accreditation for testing asphaltic concrete mixtures will be acceptable in lieu of Departmental certification.)
- Provide certified quality control personnel to perform the sampling and testing. A Quality Control Technician (QCT) may be certified at three levels:

1) Temporary Certification – must be a technician trainee who shall be given direct oversight by a certified Level 1 or Level 2 QCT while performing acceptance testing duties during the first 5 days of training. The trainee must complete qualification requirements within 30 Georgia Department of Transportation funded production days after being granted temporary certification. A trainee who does not become qualified within 30 Georgia Department of Transportation funded production days will not be re-eligible for temporary certification. A certified Level 1 or Level 2 QCT shall be at the plant at all times during production and shipment of mixture to monitor work of the temporarily certified technician.

2) Level 1 – must demonstrate they are competent in performing the process control and acceptance tests and procedures related to hot mix asphalt production and successfully pass a written exam.

3) Level 2 – must meet Level 1 requirements and must be capable of and responsible for making process control adjustments, and successfully pass a written exam.

- Technician certification is valid for 3 years from the date on the technician's certificate unless revoked or suspended. Eligible technicians may become certified through special training and testing approved by the Office of Materials and Testing. Technicians who lose their certification due to falsification of test data will not be eligible for recertification in the future unless approved by the State Materials and Testing Engineer.

b. Quality Control Management

1) Designate at least one Level 2 QCT as manager of the quality control operation. Ensure the Quality Control Manager meets the following requirements:

- Be accountable for actions of other QCT personnel.
- Ensure all applicable sampling requirements and frequencies, test procedures, and Standard Operating Procedures are followed.
- Ensure all reports, charts, and other documentation are completed as required

2) Provide QCT personnel at the plant as follows:

- If daily production for all mix types is to be greater than 250 tons (megagrams), have a QCT person at the plant at all times during production and shipment of mixture until all required acceptance tests have been completed.
- If daily production for all mix types will not be greater than 250 tons (megagrams), a QCT may be responsible for conducting tests at up to two plants, subject to random number sample selection.
- Have available at the plant, or within immediate contact by phone or radio, a Level 2 QCT responsible for making prompt process control adjustments as necessary to correct the mix.

3) Sampling, Testing, and Inspection Requirements.

a. Provide all sample containers, extractants, forms, diaries, and other supplies subject to approval of the Engineer.

b. Perform daily sampling, testing, and inspection of mixture production that meet the following requirements:

1) Randomly sample mixtures according to GSP 15 and GDT 73 (Method C) and test on a lot basis. In the event less than the specified number of samples are taken, obtain representative 6 in. (150 mm) cores from the roadway at a location where the load not sampled was placed. Take enough cores to ensure minimum sample size requirements are met for each sample needed.

2) Maintain a printed copy of the computer-generated random sampling data as a part of the project records.

3) Perform sampling, testing, and inspection duties of GSP 21.

4) Perform extraction or ignition test (GDT 83 or GDT 125) and extraction analysis (GDT 38). If the ignition oven is used, a printout of sample data including weights becomes a part of the project records. For asphalt cement content only, digital printouts of liquid asphalt cement weights may be substituted in lieu of an extraction test for plants with digital recorders. Calculate the asphalt content from the ticket representing the mixture tested for gradation.

5) Save extracted aggregate, opposite quarters, and remaining material (for possible referee testing) of each sample as follows:

- Store in properly labeled, suitable containers.
- Secure in a protected environment.
- Store for three working days. If not obtained by the Department within three days, they may be discarded in accordance with GSP 21.

6) Add the following information on load tickets from which a sample or temperature check is taken:

- Mixture temperature
- Signature of the QCT person performing the testing

7) Calibrate the lime system when hydrated lime is included in the mixture:
   - Perform a minimum of twice weekly during production
   - Post results at the plant for review.
   - Provide records of materials invoices upon request (including asphalt cement, aggregate, hydrated lime, etc.).

8) Take action if acceptance test results are outside Mixture Control Tolerances of Section 828.
   - One sample out of tolerance
     a. Contact Level 2 - QCT to determine if a plant adjustment is needed.
     b. Immediately run a process control sample. Make immediate plant adjustments if this sample is also out of tolerance.
     c. Test additional process control samples as needed to ensure corrective action taken appropriately controls the mixture.
   - Two consecutive acceptance samples of the same mix type out of tolerance regardless of Lot or mix design level, or three consecutive acceptance samples out of tolerance regardless of mix type.
     a. Stop plant production immediately.
     b. Reject any mixture in storage:
        - Deviating more than 10 percent in gradation from the job mix formula based on the acceptance sample.
        - Deviating more than 0.7 percent in asphalt content from the job mix formula based on the acceptance sample.
     c. Make a plant correction to any mix type out of tolerance prior to resuming production.
        - Do not send any mixture to the project before test results of a process control sample meets Mixture Control Tolerances.
        - Reject any mixture produced at initial restarting that does not meet Mixture Control Tolerances.

NOTE: Determine mixture temperature at least once per hour of production for OGFC and PEM mixes.

4) Comparison Testing and Quality Assurance Program

a. Periodic comparison testing by the Department will be required of each QCT to monitor consistency of equipment and test procedures. The Department will take independent samples to monitor the Contractor's quality control program.

1) Comparison Sampling and Testing

Retain samples for comparison testing and referee testing if needed as described in Subsection 400.3.06.A.3.b.3. Discard these samples only if the Contractor's acceptance test results meet a 1.00 pay factor and the Department does not procure the samples within three working days.

The Department will test comparison samples on a random basis. Results will be compared to the respective contractor acceptance tests, and the maximum difference is as follows:

TABLE 6—ALLOWABLE PERCENT DIFFERENCE BETWEEN DEPARTMENT AND CONTRACTOR ACCEPTANCE TESTS

Sieve Size	Surface	Sub-surface
1/2 in. (12.5 mm)		4.0%
3/8 in. (9.5 mm)	3.5%	4.0%
No. 4 (4.75 mm)	3.5%	3.5%
No. 8 (2.36 mm)	2.5%	3.0%
No. 200 (75 µm)	2.0%	2.0%
A.C.	0.4%	0.5%

1) If test comparisons are within these tolerances:
   - Continue production
   - Use the Contractor's tests for acceptance of the lot
2) If test comparisons are not within these tolerances:
   - Another Departmental technician will test the corresponding referee sample.
   - Results of the referee sample will be compared to the respective contractor and Departmental tests using the tolerance for comparison samples given above.
     a. If referee test results are within the above tolerances when compared to the Contractor acceptance test, use the Contractor's test for acceptance of the effected lot.
     b. If referee test results are not within the above tolerances when compared to the Contractor acceptance test, the Department will review the Contractor's quality control methods and determine if a thorough investigation is needed.

b. Independent Verification Sampling and Testing
   1) Randomly take a minimum of two independent samples from the lesser of five days or five lots of production regardless of mix type or number of projects.
   2) Compare test deviation from job mix formula to Mixture Control Tolerances in Section 828. If results are outside these tolerances, another sample from the respective mix may be taken.

      If test results of the additional sample are not within Mixture Control Tolerances, the Department will take the following action:

      - Take random samples from throughout the subject lot(s) as established in Subsection 400.3.06.A.3.b.3 and use these test results for acceptance and in calculations for the monthly plant rating. Applicable pay factors will apply and the contractor QCT test results will not be included in pay factor calculations nor in the monthly plant rating.
      - Determine if the Contractor's quality control program is satisfactory and require prompt corrective action by the Contractor if specification requirements are not being met.
      - Determine if the QCT has not followed Departmental procedures or has provided erroneous information.
      - Take samples of any in-place mixture represented by unacceptable QCT tests and use the additional sample results for acceptance and in calculations for the monthly plant

rating and apply applicable pay factors. The Contractor QCT tests will not be included in the pay factor calculations nor in the monthly plant rating.

NOTE: For leveling or dense graded surface courses less than 110 lb./yd² (60 kg/m²) having quality assurance test results outside the Mixture Control Tolerances of Section 828, use the Department's test results only and applicable pay factors will apply.

B. Compaction

Determine the mixture compaction using either GDT 39, GDT 59, or AASHTO T 331. The method of GDT 39 for "Uncoated Specimens, Dense Graded Mixtures Only" shall not apply when the water absorption of a sample exceeds 2.0 percent, as measured according to AASHTO T 166. In this case, either AASHTO T 331 or the paraffin method of GDT 39 shall apply. The compaction is accepted in lots defined in Subsection 400.3.06. A, *Acceptance Plans for Gradation and Asphalt Cement Content* and is within the same lot boundaries as the mixture acceptance.

1. Calculate Pavement Mean Air Voids

The Department is responsible for pavement mean air void acceptance testing. The Contractor is responsible for establishing all roller patterns and any quality control testing. Upon written request by the Contractor, the Office of Materials and Testing will provide nuclear gauge testing assistance for compaction related issues.

The Department will calculate the pavement air voids placed within each lot as follows:

a. One test per sub-lot.
   - Lots > 400 ton (400 Mg) of mix are divided into 5 sub-lots of equal distance.
   - Lots ≤ 400 tons (400 Mg) of mix are divided into a sub-lot or sub-lots of equal distance at a rate of one per 100 tons (100 Mg) mix each (Example: 299 tons of mix require 3 sublots and 301 tons of mix require 4 sublots). There will be less than 5 sub-lots.

b. Average the results of all tests run on randomly selected sites in that lot.

c. Select representative sites randomly using GDT 73.

   Density tests are not required for asphaltic concrete placed at 90 lbs./yd2 (50 kg/m2) or less, 4.75 mm mix, asphaltic concrete OGFC, PEM, and mixes placed as variable depth or width leveling. Compact these courses to the Engineer's satisfaction. Density tests will not be performed on turn-outs and driveways.

   The targeted maximum Pavement Mean Air Void content for all Superpave and Stone Matrix Asphalt mixtures is 5.0 percent. Ensure that the maximum Pavement Mean Air Voids for all Superpave and Stone Matrix Asphalt mixtures does not exceed 7.0 percent. The maximum Pavement Mean Air Voids for 2 ft. shoulder widening is 9.0 percent. The adjustment period for density is four lots or four production days, whichever is less, in order for the contractor to ensure maximum compactive effort has been achieved, which will yield no more than the specified maximum allowed Mean Air Voids. One additional lot or production day of adjustment may be given for a reduction in asphalt cement content on the JMF made by the Office of Materials and Testing for mix designs incorporating the Corrected Optimum Asphalt Content COAC.

   If the contractor needs to adjust the mixture to improve density results, a change in the job mix formula may be requested for approval during the adjustment period so long as the following values are not exceeded:

   - Coarse pay sieve ± 4%
   - No. 8 (2.36 mm) sieve ± 2%
   - No. 200 (75 µm) sieve ± 1%
   - Asphalt Content ± 0.2%
   - All value changes must still be within specification limits.

If the Office of Materials and Testing is satisfied that the contractor has exerted the maximum compactive effort and is not able to maintain Pavement Mean Air Voids at no more than 7.0%, the Engineer may establish a maximum target for Pavement Mean Air Voids.

Ensure mixture placed during the adjustment period for density meets the requirements for a 0.90 pay factor in Table 13 of Subsection 400.5.01.C, *Calculate Mean Pavement Air Voids*. Mixture not meeting these density requirements is paid for using the applicable pay factor.

If the mean air voids of the pavement placed within a lot exceeds 100% of the maximum target air voids, if established, and the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer.

2. Obtain Uniform Compaction

For a lot to receive a pay factor of 1.00 for compaction acceptance, the air void range cannot exceed 5 percent for new construction or resurfacing projects. The range is the difference between the highest and lowest acceptance test results within the affected lot. If the air void range exceeds these tolerances, apply a Pay Factor of 95%.

The 5% reduced pay factor for the compaction range does not apply in these instances:

- The mixture is placed during the adjustment period as defined in Subsection 400.5.01.A, *Materials Produced and Placed During the Adjustment Period*.
- All air void results within a given lot are less than 7.0%.
- A lot containing two sublot or less.
- On two foot trench widening.
- For sub-surfaces mixes including 19 mm and 25 mm Superpave mixes if all air void results within a given lot are >2.5 % <8 %.

When lots are reevaluated for range penalty, as shown in Subsection 106.03, *Samples, Tests, Cited Specifications*, sampling and testing is according to GDT 73. Request for reevaluation must be made within 5 working days of notification of the lot results. The following procedures apply:

The Department will reevaluate the lot through additional testing by obtaining and testing three additional cores acquired in representative sites selected randomly throughout each sub-lot representing the high and low in-place air voids as detailed in GDT 73. The additional six cores (three cores from each sub-lot will be averaged) will replace the original five core results for range specified requirements only. The original five cores' results will be reported for Pavement Mean Air Voids for the lot. This will be the final evaluation for compaction range for the lot. Lots will not be re-evaluated for range when the Pavement Mean Air Voids result in a lower than 95% pay factor. Ensure requests for reevaluation are made within 5 working days of notification of the lot results.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the Table 7 Average Air Voids Range Acceptance Schedule:

TABLE 7—AVERAGE AIR VOIDS RANGE FOR ACCEPTANCE SCHEDULE

Pay Factor	Range between High and Low Air Void Original 5 cores	Re-evaluated Range between High and Low Air Void Cores 6 New Cores obtained from High (3 cores) and Low location (3 cores)
100	≤ 5 %	≤ 4.50 %
0.95	> 5 %	> 4.50 %

C. Surface Tolerance

In this specification, pavement courses to be overlaid with an OGFC or PEM are considered surface courses. All OGFC or PEM are to be evaluated after the roadway has been opened to traffic for a minimum of 5 days and a maximum of 15 days. Asphaltic Concrete paving is subject to straightedge and visual inspection and irregularity correction as shown below:

1. Visual and Straightedge Inspection

   Paving is subject to visual and straightedge inspection during and after construction operations until Final Acceptance. Locate surface irregularities as follows:

   a. Keep a 10 ft. (3 m) straightedge near the paving operation to measure surface irregularities on courses. Provide the straightedge and the labor for its use.
   b. Inspect the base, intermediate, and surface course surfaces with the straightedge to detect irregularities.
   c. Correct irregularities that exceed 3/16 in. in 10 ft. (5 mm in 3 m) for base and intermediate courses and surface courses.

   Mixture or operating techniques will be stopped if irregularities such as rippling, tearing, or pulling occur and the Engineer suspects a continuing equipment problem. Stop the paving operation and correct the problem. Correct surface course evaluations on individual Laser Road Profiler test sections, normally 1mile (1 km) long.

2. Target Surface Profile Smoothness

   The Department will use the Laser Road Profiler method to conduct acceptance testing for surface course tolerance according to GDT 126. This testing will be performed only on:

   - Surface courses on Projects with mainline traveled way measuring a minimum distance of 1 mile (1600 m)
   - Ramps more than 0.5 mile (800 m) long

   Combine partial sections measuring less than 0.5 mile (800 m) with the previous full mile for acceptance.

   Achieve the smoothest possible ride during construction. Do not exceed the target Laser Road Profiler smoothness index as shown below:

TABLE 8—PAVEMENT SMOOTHNESS TARGET REQUIREMENTS

Construction Description	Smoothness Index
All Asphaltic Concrete OGFC and PEM on interstate including resurfacing and new construction. Asphaltic Concrete OGFC and PEM placed on state routes as new construction.	750
Asphaltic Concrete SMA or dense-graded surface mixtures placed directly beneath the Asphaltic Concrete OGFC or PEM on interstates. Asphaltic Concrete OGFC and PEM placed on state routes as resurfacing. All new construction on state routes with exception of OGFC and PEM as stated above.	825
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	900
All Urban new construction and resurfacing on state routes within curb and gutter sections located in posted 40 miles per hour (MPH) or less speed zones.	1175

If the target values are not achieved, immediately adjust the operations to meet the target values. Placement operations may be suspended until a remedial plan to comply with target smoothness requirements is submitted and approved by the Engineer if adjustments do not satisfy target smoothness values.

TABLE 9—PAVEMENT SMOOTHNESS CORRECTIVE WORK REQUIREMENT

Construction Description	Smoothness Index
All Asphaltic Concrete OGFC and PEM placed on interstate including resurfacing and new construction. Asphaltic Concrete OGFC and PEM placed on state routes as new construction.	825
Asphaltic Concrete SMA or dense-graded surface mixtures placed directly beneath the Asphaltic Concrete OGFC or PEM on interstates. Asphaltic Concrete OGFC and PEM placed on state routes as resurfacing. All new construction on state routes with exception of OGFC and PEM as stated above.	900
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	1025
All Urban new construction and resurfacing on state routes within curb and gutter sections located in posted 40 miles per hour (MPH) or less speed zones.	1250

If surface tolerance deficiencies need correction, obtain the Engineer’s approval of the methods and type mix used.

3. Bridge Approach Profile Smoothness Quality

The following are subject to a ride quality test of roadway approaching each end of a bridge using the Laser Road Profiler, Rainhart Profiler or Lightweight Profiler:

- A state route with 4 lanes or more
- A 2-lane state route with a current traffic count two-way ADT-2,000 vpd or more
- Locations designated on the plans

All other bridge approaches not meeting the above criteria shall meet the 3/16 in. in 10 ft. (5 mm in 3 m) straightedge requirement. When the distance between the ends of two bridges, the end of a bridge and an intersection, or the end of a bridge and a vertical or horizontal curve is less than 540 ft. (165 m) and locations where the testing vehicle cannot maintain minimum testing speed while taking profile measurements will not be tested and will be subject to straightedge requirements.

The bridge approaches will meet the straightedge requirements.

Test ride quality as follows:

For Resurfacing Projects:

a. The Department will determine a profile smoothness index value using the laser road profiler in accordance with test method GDT 126.

b. The Department will determine the Half Car Simulation (HCS) IRI for each HMA asphalt 1/10th of mile (0.16 km) segments adjacent to each approach slab joint for each lane. The HCS IRI will be reported in 1/20th of mile (0.08 km) segment readings that will be averaged to calculate the final 1/10-mile section, in accordance with GDT 126.

   - Correct individual bumps or depression exceeding 3/16 in. in 10 ft. (3 mm in 3 m) straightedge requirement as directed by the Engineer.
   - Ensure the profile smoothness index shows an improvement over pre-construction profile smoothness or meets a profile smoothness index of ≤ 1025 mm/km (66 inches/mile) for the average 1/10 mile (0.16 km).

c. Ensure Resurfacing projects meet the profile smoothness index improvement requirement for the specified 1/10th mile (0.16 km) segment of roadway up to the bridge approach/exit slab joint.

In accordance with Section 106.3.A.3, the Contractor may request reevaluation(s) for Laser Road Profiler Test results on Resurfacing Bridge Projects and straightedge measurement(s) on either that fail to meet specified requirements. Request for reevaluation shall be made to the Engineer within 5 working days of notification of failing results. At the Engineer's approval, reevaluation of failing results using the Lightweight Profiler Test, Laser Road Profiler Test and straightedge measurement(s) shall be conducted in conjunction with representatives from the Office of Materials and Testing in accordance with GDT 126 or GDT 134, whichever is applicable. The Department will perform ride quality testing up to two times on the bridge approaches/exits at no cost to the Contractor. For these reevaluations, evaluation of the bridge exit end may be taken testing towards the bridge against traffic if the contractor provides traffic control, at the contractors' expense, upon request.

For All New Construction Projects:

a. The Department will determine a profile index value according to test method GDT 78 or GDT 134.

b. The Department will average the profile index value from the right and left wheelpath for each 100 ft. (30 m) section for each lane.

- Keep the profile index value under 30 in/mile (475 mm/km), correct individual bumps or depressions exceeding 0.2 in. (5 mm) from blanking band on the profilograph trace.

c. Ensure New Construction projects meet the profile index value for the specified 100 ft. (30 m) section of roadway up to the bridge joint.

d. Schedule the ride quality testing on All New Construction projects 5 days before needed by contacting the Office of Materials and Testing. Clean and clear obstructions from the test area.

Correct the sections that do not meet the ride quality criteria of this specification. After correction, these sections are subject to retesting with the Lightweight Profiler. The Engineer direct the type of correction method, which may include:

- Milling
- Grinding
- Removing and replacing the roadway

No additional compensation will be made.

In accordance with Section 106.3.A.3, the Contractor may request reevaluation(s) for Lightweight Profiler Test results on newly construction bridge projects, Laser Road Profiler Test results on resurfacing bridge projects and straightedge measurement(s) on either that fail to meet specified requirements. Request for reevaluation shall be made to the Engineer within 5 working days of notification of failing results. At the Engineer's approval, reevaluation of failing results using the Lightweight Profiler Test, Laser Road Profiler Test and straightedge measurement(s) shall be conducted by representatives from the Office of Materials and Testing in accordance with GDT 134.

The Department will perform ride quality testing up to two times on the bridge approaches at no cost to the Contractor. Additional testing will be charged to the Contractor in accordance with Section 500.5.01.B.

4. Surface Smoothness Acceptance

When recommended by the Office of Materials and Testing, a pay reduction may be accepted in lieu of correction for roadways and bridge approaches that fail to achieve specified smoothness indexes in accordance with SOP 46 "Procedure for Calculating Pay Reduction for Failing Roadway and Bridge Approach Smoothness" Roadway and Bridge Approach Smoothness. The Office of Materials and Testing may recommend a waiver of profile smoothness requirements when improvement over pre-construction smoothness profile exceeds 25 percent for urban roadways, as defined in Table 9.

D. Reevaluation of Lots

When lots are reevaluated as shown in Subsection 106.03, *Samples, Tests, Cited Specifications*, sampling and testing is according to GDT 73. Ensure request for reevaluation are made within 5 working days of notification of the lot results. The following procedures apply:

1. For asphaltic concrete mixtures other than OGFC and PEM mix types, thin lift courses < 110 lbs./yd^2 and mixture paid for as patching, the Department will take the same number of new tests using cores taken at randomly selected locations in accordance GDT 73. The Department will use only these test results for gradation and AC content obtained using these cores for acceptance. For OGFC and PEM mix types, thin lift courses < 110 lbs./yd^2 and mixture paid for as patching, the retained opposite quarter shall be used for mixture acceptance reevaluation when requested by the Contractor. The Department will use the absolute average deviations from the job mix formula for these tests to determine acceptance based on the appropriate column in the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table 10 or 11.
2. Compaction Acceptance

   The Department will reevaluate the lot through additional testing by cutting the same number of cores originally obtained and averaging these results with the results from the original density tests. The Department will use the average to determine acceptance according to the Compaction Acceptance Schedule in Subsection 400.5.01.C, *Calculate Pavement Mean Air Voids*.

TABLE 10—MIXTURE ACCEPTANCE SCHEDULE—SURFACE MIXES

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
Asphalt Cement Content (Extraction, Ignition)	1.00	0.00 - 0.70	0.00 - 0.54	0.00 - 0.46	0.00 - 0.41	0.00 - 0.38	0.00 - 0.35	0.00 - 0.32	0.00 - 0.30
	0.95	0.71 - 0.80	0.55 - 0.61	0.47 - 0.52	0.42 - 0.46	0.39 - 0.43	0.36 - 0.39	0.33 - 0.36	0.31 - 0.34
	0.90	0.81 - 0.90	0.62 - 0.68	0.53 - 0.58	0.47 - 0.51	0.44 - 0.47	0.40 - 0.45	0.37 - 0.40	0.35 - 0.37
	0.80	0.91 - 1.00	0.69 - 0.75	0.59 - 0.64	0.52 - 0.56	0.48 - 0.52	0.44 - 0.47	0.41 - 0.44	0.38 - 0.41
	0.70	1.01 - 1.19	0.76 - 0.82	0.65 - 0.69	0.57 - 0.61	0.53 - 0.56	0.48 - 0.51	0.45 - 0.47	0.42 - 0.44
	0.50	1.20 - 1.40	0.83 - 0.85	0.70 - 0.72	0.62 - 0.64	0.57 - 0.59	0.52 - 0.55	0.48 - 0.51	0.45 - 0.48
3/8 in. (9.5 mm) Sieve (12.5 mm OGFC, 12.5 mm PEM, 12.5 mm Superpave)	1.00	0.00 – 9.0	0.00 - 6.6	0.00 - 5.6	0.00 - 5.0	0.00 - 4.6	0.00 - 4.2	0.00 - 3.9	0.00 - 3.6
	0.98	9.1 - 10.0	6.7 - 7.5	5.7 - 6.3	5.1 - 5.6	4.7 - 5.2	4.3 - 4.7	4.0 - 4.4	3.7 - 4.1
	0.95	10.1 - 11.9	7.6 - 8.4	6.4 - 7.0	5.7 - 6.3	5.3 - 5.8	4.8 - 5.3	4.5 - 5.0	4.2 - 4.6
	0.90	12.0 - 13.0	8.5 - 9.3	7.1 - 7.7	6.4 - 6.9	5.9 - 6.3	5.4 - 5.8	5.1 - 5.4	4.7 - 5.0
	0.85	13.1 - 14.0	9.4 - 10.2	7.8 - 8.6	7.0 - 7.6	6.4 - 6.9	5.9 - 6.3	5.5 - 5.9	5.1 - 5.5
	0.80	14.1 - 14.5	10.3 - 10.5	8.7 - 8.9	7.7 - 8.0	7.0 - 7.5	6.4 - 6.8	6.0 - 6.4	5.6 - 6.0
3/8 in. (9.5 mm) Sieve (12.5 mm SMA)	1.00	0.0 - 6.8	0.00 - 5.0	0.00 - 4.2	0.00 - 3.8	0.00 - 3.4	0.00 - 3.2	0.00 - 2.9	0.00 - 2.7
	0.98	6.9 - 7.5	5.1 - 5.6	4.3 - 4.7	3.9 - 4.2	3.5 - 3.9	3.3 - 3.5	3.0 - 3.3	2.8 - 3.1
	0.95	7.6 - 8.9	5.7 - 6.3	4.8 - 5.2	4.3 - 4.7	4.0 - 4.4	3.6 - 4.0	3.4 - 3.8	3.2 - 3.4
	0.90	9.0 - 9.8	6.4 - 7.0	5.3 - 5.8	4.8 - 5.2	4.5 - 4.8	4.1 - 4.4	3.9 - 4.1	3.5 - 3.8
	0.85	9.9 - 10.5	7.1 - 7.6	5.9 - 6.4	5.3 - 5.7	4.9 - 5.2	4.5 - 4.7	4.2 - 4.4	3.9 - 4.1
	0.80	10.6 - 10.9	7.7 - 7.9	6.5 - 6.7	5.8 - 6.0	5.3 - 5.6	4.8 - 5.1	4.5 - 4.8	4.2 - 4.5
No. 4 (4.75 mm) Sieve	1.00	0.00 - 9.0	0.00 - 6.7	0.00 - 5.7	0.00 - 5.2	0.00 - 4.8	0.00 - 4.4	0.00 - 4.1	0.00 - 3.8
	0.98	9.1 - 10.0	6.8 - 7.6	5.8 - 6.3	5.3 - 5.8	4.9 - 5.4	4.5 - 4.9	4.2 - 4.6	3.9 - 4.3

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
(9.5 mm OGFC, 9.5 mm Superpave)	0.95	10.1 - 11.9	7.7 - 8.5	6.4 - 6.9	5.9 - 6.4	5.5 - 5.9	5.0 - 5.4	4.7 - 5.0	4.4 - 4.7
	0.90	12.0 - 13.0	8.6 - 9.4	7.0 - 7.5	6.5 - 7.0	6.0 - 6.5	5.5 - 5.9	5.1 - 5.5	4.8 - 5.1
	0.85	13.1 - 14.0	9.5 - 10.2	7.6 - 8.0	7.1 - 7.6	6.6 - 7.0	6.0 - 6.4	5.6 - 5.9	5.2 - 5.5
	0.80	14.1 - 14.5	10.3 - 10.5	8.1 - 8.3	7.7 - 8.0	7.1 - 7.5	6.5 - 6.9	6.0 - 6.4	5.6 - 5.9
No. 4 (4.75 mm) Sieve (9.5 mm SMA)	1.00	0.00 - 6.8	0.00 - 5.0	0.00 - 4.3	0.00 - 3.9	0.00 - 3.6	0.00 - 3.3	0.00 - 3.1	0.00 - 2.8
	0.98	6.9 - 7.5	5.1 - 5.7	4.4 - 4.7	4.0 - 4.4	3.7 - 4.0	3.4 - 3.7	3.2 - 3.4	2.9 - 3.2
	0.95	7.6 - 8.9	5.8 - 6.4	4.8 - 5.2	4.5 - 4.8	4.1 - 4.4	3.8 - 4.0	3.5 - 3.8	3.3 - 3.5
	0.90	9.0 - 9.8	6.5 - 7.0	5.3 - 5.6	4.9 - 5.2	4.5 - 4.9	4.1 - 4.4	3.9 - 4.1	3.6 - 3.8
	0.85	9.9 - 10.5	7.1 - 7.7	5.7 - 6.0	5.3 - 5.7	5.0 - 5.2	4.3 - 4.8	4.2 - 4.4	3.9 - 4.1
	0.80	10.6 - 10.9	7.8 - 7.9	6.1 - 6.2	5.8 - 6.0	5.3 - 5.6	4.9 - 5.2	4.5 - 4.8	4.2 - 4.4
No. 8 (2.36 mm) Sieve (OGFC, PEM, Superpave and 4.75 mm mixes)	1.00	0.00 - 7.0	0.00 - 5.6	0.00 - 4.8	0.00 - 4.3	0.00 - 4.0	0.00 - 3.6	0.00 - 3.4	0.00 - 3.2
	0.98	7.1 - 8.0	5.7 - 6.3	4.9 - 5.4	4.4 - 4.8	4.1 - 4.5	3.7 - 4.1	3.5 - 3.8	3.3 - 3.6
	0.95	8.1 - 9.0	6.4 - 7.0	5.5 - 6.0	4.9 - 5.3	4.6 - 4.9	4.2 - 4.5	3.9 - 4.2	3.7 - 3.9
	0.90	9.1 - 10.9	7.1 - 7.7	6.1 - 6.6	5.4 - 5.8	5.0 - 5.4	4.6 - 4.9	4.3 - 4.6	4.0 - 4.3
	0.85	11.0 - 12.0	7.8 - 8.5	6.7 - 7.2	5.9 - 6.4	5.5 - 5.8	5.0 - 5.3	4.7 - 5.0	4.4 - 4.6
	0.75	12.1 - 12.5	8.6 - 8.8	7.3 - 7.5	6.5 - 6.8	5.9 - 6.3	5.4 - 5.7	5.1 - 5.3	4.7 - 4.9
No. 8 (2.36 mm) Sieve (12.5 mm SMA, 9.5 mm SMA)	1.00	0.00 - 5.3	0.00 - 4.2	0.00 - 3.6	0.00 - 3.2	0.00 - 3.0	0.00 - 2.7	0.00 - 2.6	0.00 - 2.4
	0.98	5.4 - 6.0	4.3 - 4.7	3.7 - 4.0	3.3 - 3.6	3.1 - 3.4	2.8 - 3.1	2.7 - 2.9	2.5 - 2.7
	0.95	6.1 - 6.8	4.8 - 5.3	4.1 - 4.5	3.7 - 4.0	3.5 - 3.7	3.2 - 3.4	3.0 - 3.2	2.8 - 2.9
	0.90	6.9 - 8.2	5.4 - 5.8	4.6 - 5.0	4.1 - 4.5	3.8 - 4.0	3.5 - 3.7	3.3 - 3.5	3.0 - 3.2
	0.85	8.3 - 9.0	5.9 - 6.4	5.1 - 5.4	4.6 - 4.8	4.1 - 4.4	3.8 - 4.0	3.6 - 3.8	3.3 - 3.4

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
	0.75	9.1 - 9.4	6.5 - 6.6	5.5 - 5.0	4.9 - 5.1	4.5 - 4.7	4.1 - 4.3	3.9 - 4.0	3.5 - 3.7
No. 8 (2.36 mm) Sieve for OGFC and PEM mixes: When the mean of the deviations from the Job Mix Formula for a particular lot exceeds the tolerance for a 1.00 pay factor in the appropriate column, the lot will be paid for at 0.50 of the Contract Price.									

TABLE 11—MIXTURE ACCEPTANCE SCHEDULE—SUBSURFACE MIXES

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
Asphalt Cement Content (Extraction, Ignition)	1.00	0.00 - 0.80	0.00 - 0.61	0.00 - 0.52	0.00 - 0.46	0.00 - 0.43	0.00 - 0.39	0.00 - 0.36	0.00 - 0.34
	0.95	0.81 - 0.90	0.62 - 0.68	0.53 - 0.58	0.47 - 0.51	0.44 - 0.47	0.40 - 0.43	0.37 - 0.40	0.35 - 0.37
	0.90	0.91 - 1.00	0.69 - 0.75	0.59 - 0.64	0.52 - 0.56	0.48 - 0.52	0.44 - 0.47	0.41 - 0.44	0.38 - 0.41
	0.80	1.01 - 1.19	0.76 - 0.82	0.65 - 0.69	0.57 - 0.61	0.53 - 0.56	0.48 - 0.51	0.45 - 0.47	0.42 - 0.44
	0.70	1.20 - 1.40	0.83 - 0.85	0.70 - 0.72	0.62 - 0.64	0.57 - 0.59	0.52 - 0.55	0.48 - 0.51	0.45 - 0.48
	0.50	1.41 - 1.60	0.86 - 0.88	0.73 - 0.75	0.65 - 0.67	0.60 - 0.63	0.56 - 0.60	0.52 - 0.56	0.49 - 0.52
1/2 in. (12.5 mm) Sieve (25 mm Superpave)	1.00	0.00 - 12.9	0.00 - 8.1	0.00 - 6.9	0.00 - 6.1	0.00 - 5.5	0.00 - 5.0	0.00 - 4.7	0.00 - 4.4
	0.98	13.0 - 14.0	8.2 - 9.1	7.0 - 7.7	6.2 - 6.8	5.6 - 6.1	5.1 - 5.6	4.8 - 5.2	4.5 - 4.9
	0.95	14.1 - 15.0	9.2 - 10.1	7.8 - 8.5	6.9 - 7.5	6.2 - 6.7	5.7 - 6.1	5.3 - 5.7	5.0 - 5.4
	0.90	15.1 - 16.0	10.2 - 11.1	8.6 - 9.3	7.6 - 8.2	6.8 - 7.4	6.2 - 6.7	5.8 - 6.3	5.5 - 5.9
	0.85	16.1 - 17.0	11.2 - 11.5	9.4 - 9.6	8.3 - 8.6	7.5 - 7.8	6.8 - 7.0	6.4 - 6.5	6.0 - 6.1
	0.80	17.1 - 18.0	11.6 - 11.9	9.7 - 9.9	8.7 - 9.0	7.9 - 8.1	7.1 - 7.3	6.6 - 6.8	6.2 - 6.4
1/2 in. (12.5 mm) Sieve (19 mm SMA)	1.00	0.00 - 9.7	0.00 - 6.0	0.00 - 5.2	0.00 - 4.6	0.00 - 4.1	0.00 - 3.8	0.00 - 3.5	0.00 - 3.3
	0.98	9.8 - 10.5	6.2 - 6.8	5.3 - 5.8	4.7 - 5.1	4.2 - 4.6	3.9 - 4.2	3.6 - 3.9	3.4 - 3.7
	0.95	10.6 - 11.2	6.9 - 7.8	5.9 - 6.4	5.2 - 5.6	4.7 - 5.0	4.3 - 4.6	4.0 - 4.3	3.8 - 4.0
	0.90	11.3 - 12.0	7.9 - 8.3	6.5 - 7.0	5.7 - 6.1	5.1 - 5.6	4.7 - 5.0	4.4 - 4.7	4.1 - 4.4
	0.85	12.1 - 12.8	8.4 - 8.6	7.1 - 7.2	6.2 - 6.5	5.7 - 5.9	5.1 - 5.3	4.8 - 4.9	4.5 - 5.6
	0.80	12.9 - 13.5	8.7 - 8.9	7.3 - 7.4	6.6 - 6.8	6.0 - 6.1	5.4 - 5.5	5.0 - 5.1	4.7 - 4.8
3/8 in. (9.5 mm) Sieve	1.00	0.00 - 10.0	0.00 - 7.5	0.00 - 6.3	0.00 - 5.6	0.00 - 5.2	0.00 - 4.7	0.00 - 4.4	0.00 - 4.1
	0.98	10.1 - 11.9	7.6 - 8.4	6.4 - 7.0	5.7 - 6.3	5.3 - 5.8	4.8 - 5.3	4.5 - 5.0	4.2 - 4.6

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
(19 mm Superpave, 12.5 mm Superpave)	0.95	12.0 - 13.0	8.5 - 9.3	7.1 - 7.7	6.4 - 6.9	5.9 - 6.3	5.4 - 5.8	5.1 - 5.4	4.7 - 5.0
	0.90	13.1 - 14.0	9.4 - 10.2	7.8 - 8.6	7.0 - 7.6	6.4 - 6.9	5.9 - 6.3	5.5 - 5.9	5.1 - 5.5
	0.85	14.1 - 14.5	10.3 - 10.5	8.7 - 8.9	7.7 - 8.0	7.0 - 7.5	6.4 - 6.8	6.0 - 6.4	5.6 - 6.0
	0.80	14.6 - 15.0	10.6 - 10.8	9.0 - 9.2	8.1 - 8.4	7.6 - 7.8	6.9 - 7.3	6.5 - 6.8	6.1 - 6.5
No. 4 (4.75 mm) Sieve (9.5 mm Superpave)	1.00	0.00 - 10.0	0.00 - 7.6	0.00 - 6.3	0.00 - 5.8	0.00 - 5.4	0.00 - 4.9	0.00 - 4.6	0.00 - 4.3
	0.98	10.1 - 11.9	7.7 - 8.5	6.4 - 6.9	5.9 - 6.4	5.5 - 5.9	5.0 - 5.4	4.7 - 5.0	4.4 - 4.7
	0.95	12.0 - 13.0	8.6 - 9.4	7.0 - 7.5	6.5 - 7.0	6.0 - 6.5	5.5 - 5.9	5.1 - 5.5	4.8 - 5.1
	0.90	13.1 - 14.0	9.5 - 10.2	7.6 - 8.0	7.1 - 7.6	6.6 - 7.0	6.0 - 6.4	5.6 - 5.9	5.2 - 5.5
	0.85	14.1 - 14.5	10.3 - 10.5	8.1 - 8.3	7.7 - 8.0	7.1 - 7.5	6.5 - 6.9	6.0 - 6.4	5.6 - 5.9
	0.80	14.6 - 15.0	10.6 - 10.8	8.4 - 8.6	8.1 - 8.4	7.6 - 8.0	7.0 - 7.4	6.5 - 6.8	6.0 - 6.3
No. 8 (2.36 mm) Sieve (All mixes except SMA)	1.00	0.00 - 8.0	0.00 - 6.3	0.00 - 5.4	0.00 - 4.8	0.00 - 4.5	0.00 - 4.1	0.00 - 3.8	0.00 - 3.6
	0.98	8.1 - 9.0	6.4 - 7.0	5.5 - 6.0	4.9 - 5.3	4.6 - 4.9	4.2 - 4.5	3.9 - 4.2	3.7 - 3.9
	0.95	9.1 - 10.0	7.1 - 7.7	6.1 - 6.6	5.4 - 5.8	5.0 - 5.4	4.6 - 4.9	4.3 - 4.6	4.0 - 4.3
	0.90	10.1 - 11.9	7.8 - 8.5	6.7 - 7.2	5.9 - 6.4	5.5 - 5.8	5.0 - 5.3	4.7 - 5.0	4.4 - 4.6
	0.85	12.0 - 13.0	8.6 - 8.8	7.3 - 7.5	6.5 - 6.8	5.9 - 6.3	5.4 - 5.7	5.1 - 5.3	4.7 - 4.9
	0.75	13.1 - 14.0	8.9 - 9.1	7.6 - 7.8	6.9 - 7.2	6.4 - 6.6	5.8 - 6.1	5.4 - 5.7	5.0 - 5.3
No. 8 (2.36 mm) Sieve (19 mm SMA)	1.00	0.00 - 6.0	0.00 - 4.7	0.00 - 4.1	0.00 - 3.6	0.00 - 3.4	0.00 - 3.1	0.00 - 2.9	0.00 - 2.4
	0.98	6.1 - 6.8	4.8 - 5.2	4.2 - 4.5	3.7 - 4.0	3.5 - 3.7	3.2 - 3.4	3.0 - 3.2	2.8 - 2.9
	0.95	6.9 - 7.5	5.3 - 5.8	4.6 - 5.0	4.1 - 4.4	3.8 - 4.0	3.5 - 3.7	3.3 - 3.5	3.0 - 3.2

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
	0.90	7.6 - 8.9	5.9 - 6.4	5.1 - 5.4	4.5 - 4.8	4.1 - 4.4	3.8 - 4.0	3.6 - 3.8	3.3 - 3.5
	0.85	9.0 - 9.8	6.5 - 6.6	5.5 - 5.6	4.9 - 5.1	4.5 - 4.7	4.1 - 4.3	3.9 - 4.0	3.6 - 3.7
	0.75	9.9 - 10.5	6.7 - 6.8	5.7 - 5.9	5.2 - 5.4	4.8 - 5.0	4.4 - 4.6	4.1 - 4.3	3.8 - 4..0

E. Segregated Mixture

Prevent mixture placement yielding a segregated mat by following production, storage, loading, placing, and handling procedures. Ensure needed plant modifications and provide necessary auxiliary equipment. (See Subsection 400.1.01, *Definitions*.)

If the mixture is segregated in the finished mat, the Department will take actions based on the degree of segregation. The actions are described below.

1. Unquestionably Unacceptable Segregation

   When the Engineer determines the segregation in the finished mat is unquestionably unacceptable, follow these measures:

   a. Suspend Work and require the Contractor to take positive corrective action. The Department will evaluate the segregated areas to determine the extent of the corrective work to the in-place mat as follows:

      - Perform extraction and gradation analysis by taking 6 in. (150 mm) cores from typical, visually unacceptable segregated areas.
      - Determine the corrective work according to Subsection 400.3.06.E.3.

   b. Require the Contractor to submit a written plan of measures and actions to prevent further segregation. Work will not continue until the plan is submitted to and approved by the Department.

   c. When work resumes, place a test section not to exceed 500 tons (500 Mg) of the affected mixture for the Department to evaluate. If a few loads show that corrective actions were not adequate, follow the measures above beginning with step 1.a. above. If the problem is solved, work may continue.

2. Unacceptable Segregation Suspected

   When the Engineer observes segregation in the finished mat and the work may be unacceptable, follow these measures:

   a. Allow work to continue at Contractor's risk.

   b. Require Contractor to immediately and continually adjust operation until the visually apparent segregated areas are eliminated from the finished mat. The Department will immediately investigate to determine the severity of the apparent segregation as follows:

      - Take 6 in. (150 mm) cores from typical areas of suspect segregation.
      - Test the cores for compliance with the mixture control tolerances in Section 828.

      When these tolerances are exceeded, suspend work for corrective action as outlined in Subsection 400.3.06.E.3.

3. Corrective Work

   a. Remove and replace (at the Contractor's expense) any segregated area where the gradation on the control sieves is found to vary 10 percent or more from the approved job mix formula, the asphalt cement varies 1.0% or more from the approved job mix formula, or if in-place air voids exceed 13.5% based on GDT 39. The control sieves for each mix type are shown in Subsection 400.5.01.B *Determine Lot Acceptance*.

   b. Subsurface mixes. For subsurface mixes, limit removal and replacement to the full lane width and no less than 10 ft. (3 m) long and as approved by the Engineer.

   c. Surface Mixes. For surface mixes, ensure that removal and replacement is not less than the full width of the affected lane and no less than the length of the affected areas as determined by the Engineer.

   d. Surface tolerance requirements apply to the corrected areas for both subsurface and surface mixes.

400.3.07 Contractor Warranty and Maintenance

A. Contractor’s Record

Maintain a dated, written record of the most recent plant calibration. Keep this record available for the Engineer’s inspection at all times. Maintain records in the form of:

- Graphs
- Tables
- Charts
- Mechanically prepared data

400.4 Measurement

Thickness and spread rate tolerances for the various mixtures are specified in Subsection 400.4.A.2.b, Table 12, Thickness and Spread Rate Tolerance at Any Given Location. These tolerances are applied as outlined below:

A. Hot Mix Asphaltic Concrete Paid for by Weight

1. Plans Designate a Spread Rate

a. Thickness Determinations. Thickness determinations are not required when the plans designate a spread rate per square yard (meter).

If the spread rate exceeds the upper limits outlined in the Subsection 400.4.A.2.b, Table 12, *Thickness and Spread Rate Tolerance at Any Given Location*, the mix in excess will not be paid for.

If the rate of spread is less than the lower limit, correct the deficient course by overlaying the entire lot.

The mixture used for correcting deficient areas is paid for at the Contract Unit Price of the course being corrected and is subject to the Mixture Acceptance Schedule—Table 10 or 11.

b. Recalculate the Total Spread Rate. After the deficient hot mix course has been corrected, the total spread rate for that lot is recalculated, and mix in excess of the upper tolerance limit as outlined in the Subsection 400.4.A.2.b, Table 12, *Thickness and Spread Rate Tolerance at Any Given Location* is not paid for.

The quantity of material placed on irregular areas such as driveways, turnouts, intersections, feather edge section, etc., is deducted from the final spread determination for each lot.

2. Plans Designate Thickness

If the average thickness exceeds the tolerances specified in the Subsection 400.4.A.2.b, Table 12, *Thickness and Spread Rate Tolerance at Any Given Location*, the Engineer shall take cores to determine the area of excess thickness. Excess quantity will not be paid for.

If the average thickness is deficient by more than the tolerances specified in the Thickness and Spread Rate Tolerance at Any Given Location table below, the Engineer shall take additional cores to determine the area of deficient thickness. Correct areas with thickness deficiencies as follows:

a. Overlay the deficient area with the same mixture type being corrected or with an approved surface mixture. The overlay shall extend for a minimum of 300 ft. (90 m) for the full width of the course.

b. Ensure that the corrected surface course complies with Subsection 400.3.06.C.1, *Visual and Straightedge Inspection*. The mixture required to correct a deficient area is paid for at the Contract Unit Price of the course being corrected.

The mixture is subject to the Mixture Acceptance Schedule—Table 10 or 11. The quantity of the additional mixture shall not exceed the required calculated quantity used to increase the average thickness of the overlaid section to the maximum tolerance allowed under the following table.

TABLE 12—THICKNESS AND SPREAD RATE TOLERANCE AT ANY GIVEN LOCATION

Course	Thickness Specified	Spread Rate Specified
Asphaltic concrete base course	± 0.5 in. (± 13 mm)	± 55 lbs./yd^2 (30 kg/m^2)
Intermediate and/or wearing course	± 0.25 in. (± 6 mm)	± 27.5 lbs./yd^2 (15 kg/m^2)
Overall of any combination of 1 and 2	± 0.5 in. (± 13 mm)	± 55 lbs./yd^2 (30 kg/m^2)

Note: For asphaltic concrete 9.5 mm OGFC and 12.5 mm OGFC, control the spread rate per lot within 7 lbs./yd^2 (4 kg/m^2) of the designated spread rate. For asphaltic concrete 12.5 mm PEM, control the spread rate per lot within 10 lbs./yd^2 (6 kg/m^2) of the designated spread rate.

Note: Thickness and spread rate tolerances are provided to allow normal variations within a given lot. Do not continuously operate at a thickness of spread rate not specified.

When the plans specify a thickness, the Engineer may take as many cores as necessary to determine the average thickness of the intermediate or surface course. The Engineer shall take a minimum of one core per 1,000 ft. (300 m) per two lanes of roadway. Thickness will be determined by average measurements of each core according to GDT 42.

If the average exceeds the tolerances specified in the *Subsection 400.4.A.2.b, Table 12, Thickness and Spread Rate Tolerance at Any Given Location*, additional cores will be taken to determine the area of excess thickness and excess tonnage will not be paid for.

B. Hot Mix Asphaltic Concrete Paid for by Square Yard (Meter)

1. The thickness of the base course or the intermediate or surface course will be determined by the Department by cutting cores and the thickness will be determined by averaging the measurements of each core.
2. If any measurement is deficient in thickness more than the tolerances given in the table above, additional cores will be taken by the Department to determine the area of thickness deficiency. Correct thickness deficiency areas as follows:
   a. Overlay the deficient area with the same type mixtures being corrected or with surface mixture. Extend the overlay at least 300 ft. (90 m) for the full width of the course.
   b. Ensure the corrected surface course complies with Subsection 400.3.06.C.1, *Visual and Straightedge Inspection*.
   c. The mixture is subject to the Mixture Acceptance Schedule—Table 10 or 11.
3. No extra payment is made for mixtures used for correction.
4. No extra payment is made for thickness in excess of that specified.

C. Asphaltic Concrete

Hot mix asphaltic concrete, complete in place and accepted, is measured in tons (megagrams) or square yards (meters) as indicated in the Proposal. If payment is by the ton (megagram), the actual weight is determined by weighing each loaded vehicle on the required motor truck scale as the material is hauled to the roadway, or by using recorded weights if a digital recording device is used.

The weight measured includes all materials. No deductions are made for the weight of the individual ingredients. The actual weight is the pay weight except when the aggregates used have a combined bulk specific gravity greater than 2.75. In this case the pay weight is determined according to the following formula:

$$T1 = T \times \left\{ \frac{\%\,AC + \left(\dfrac{\%\ \text{Aggregate} \times 2.75}{\text{combined bulk Specific Gravity}} \right) + \%\,Y}{100} \right\}$$

Where:

T1	Pay weight, tonnage (Mg)
T=	Actual weight
% AC=	Percent asphalt cement by weight of total mixture
% Aggregate =	Percent aggregate by weight of total mixture minus the hydrated lime
Combined Bulk Sp. Gr.=	Calculated combined bulk specific gravity of various mineral aggregates used in the mixture
% Y=	Percent hydrated lime by weight of mineral aggregate

D. Bituminous Material

Bituminous material is not measured for separate payment.

E. Hydrated Lime

When hydrated lime is used as an anti-stripping additive, it is not measured for separate payment.

F. Field Laboratory

The field laboratory required in this specification is not measured for separate payment.

G. Asphaltic Concrete Leveling

Payment of hot mix asphaltic concrete leveling, regardless of the type mix, is full compensation for furnishing materials, bituminous materials, and hydrated lime (when required) for patching and repair of minor defects, surface preparation, cleaning, hauling, mixing, spreading, and rolling.

Mixture for leveling courses is subject to the acceptance schedule as stated in Subsection 400.3.06.A and Subsection 400.3.06.B.

H. Asphaltic Concrete Patching

Hot mix asphaltic concrete patching, regardless of the type mix, is paid for at the Contract Unit Price per ton (Megagram), complete in place and accepted. Payment is full compensation for:

- Furnishing materials such as bituminous material and hydrated lime (when required)
- Preparing surface to be patched
- Cutting areas to be patched, trimmed, and cleaned
- Hauling, mixing, placing, and compacting the materials

When mixture for patching is paid for by the Department, ensure the mixture is subject to the acceptance schedule as stated in Subsection 400.3.06.A.

400.4.01 Limits

When the asphaltic concrete is paid for by the square yard (meter) and multiple lifts are used, the number and thickness of the lifts are subject to the Engineer's approval and are used to prorate the pay factor for the affected roadway section.

400.5 Payment

When materials or construction are not within the tolerances in this specification, the Contract Price will be adjusted according to Subsection 106.03, *Samples, Tests, Cited Specifications* and Subsection 400.3.06, *Quality Acceptance*.

Hot mix asphaltic concrete of the various types are paid for at the Contract Unit Price per ton (megagram) or per square yard (meter). Payment is full compensation for furnishing and placing materials including asphalt cement, hydrated lime when required, approved additives, and for cleaning and repairing, preparing surfaces, hauling, mixing, spreading, rolling, and performing other operations to complete the Contract Item.

Payment will be made under:

Item No. 400	Asphaltic concrete type Superpave, group-blend, Including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type, Superpave, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type Superpave, group-blend, Including bituminous materials, Gilsonite modifier, and hydrated lime	Per ton (megagram)
Item No. 400	_______ inches asphaltic concrete, type Superpave, group-blend including bituminous materials, Gilsonite modifier and hydrated lime	Per square yard (meter)
Item No. 400	Asphaltic concrete type Stone Matrix Asphalt, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type OGFC, group 2 only, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type OGFC, group 2 only, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete type Porous European Mix, group 2 only, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)

400.5.01 Adjustments

A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract. Asphaltic Concrete OGFC or PEM shall be granted an adjustment period for the first 500 tons (500 Mg) produced for the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the Mixture Acceptance Schedule—Table 10 or 11.

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs./yd² (50 kg/m²) or less is also used for the surface mix at a spread rate greater than 90 lbs./yd² (50 kg/m²), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 10 or 11 for both asphalt content and gradation.
    - Meets the minimum requirements for a 0.90 pay factor in Table 13 of Subsection 400.5.01C, *Calculate Mean Pavement Air Voids*.

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm SMA	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm SMA	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm PEM	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm OGFC	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm SMA	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
concrete 9.5 mm OGFC	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

For projects which do not have milling quantities established as a Pay Item, the Department will pay for 12.5 mm OGFC and PEM placed on ramps and end of project transitions under the appropriate mixture pay item, but the mix shall be subject to the same gradation and control sieve requirements as asphaltic concrete 9.5 mm OGFC. Add polymer-modified bituminous material, hydrated lime, and stabilizing fiber to this mix.

The Department will perform the following tasks:

1. Using the Mixture Acceptance Schedule—Table 10 or 11, determine the mean of the deviations from the job mix formula per test results per lot.

2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table10 to determine acceptance of surface mixes and the Mixture Acceptance Schedule—Table 11 to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

1. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable Mixture Acceptance Schedule—Table 10 or 11.
2. Minimum requirements for a 0.90 pay factor in Table 13 of Subsection 400.5.01C, *Calculate Pavement Mean Air Voids*.

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

TABLE 13 - AIR VOIDS ACCEPTANCE SCHEDULE

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1— 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 —172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When recommended by the Office of Materials and Testing, Lots receiving less than 0.5 pay factor shall be removed and replaced at the Contractor’s expense.

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in Subsection 400.3.06.B.2.

D. Asphaltic Concrete for Temporary Detours

Hot mix asphaltic concrete placed on temporary detours not to remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price. Ensure the payment for this item covers all cost of construction, maintenance and removal of all temporary mix. Ensure hot mix asphaltic concrete placed as temporary mix meets requirements established in Subsection 400.3.05.F.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting $1.75/ton ($2.00/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting \$0.09/yd^2 (\$0.11/m^2) per 1 in. (25 mm) plan depth.

Further price adjustments required in Subsection 400.3.06, *Quality Acceptance*, which are based on the appropriate adjusted Contract Price for mix used in the temporary detour work shall apply should temporary mix be left in place. Ensure hot mix asphalt produced as temporary mix containing no hydrated lime is removed and replaced with permanent mix containing hydrated lime.

E. Determine Lot Payment

Determine the lot payment as follows:

1. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.
2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the Mixture Acceptance Schedule—Table 10 or 11 and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the Air Voids Acceptance Schedule – Table 13, remove and replace the materials at the Contractor’s expense.

If the Engineer determines the material is not acceptable to leave in place, remove and replace the materials at the Contractor’s expense.

Section 402—Hot Mix Recycled Asphaltic Concrete

Replace Section 402 with the following:

402.1 General Description

This work includes producing and placing hot mix recycled asphaltic concrete that incorporates reclaimed asphalt pavement (RAP), reclaimed asphalt shingles (RAS), virgin aggregate, hydrated lime, and neat asphalt cement.

402.1.01 Definitions

General Provisions 101 through 150.

402.1.02 Related References

A. Standard Specifications

Section 400—Hot Mix Asphaltic Concrete Construction

Section 800—Coarse Aggregate

Section 828—Hot Mix Asphaltic Concrete Mixtures

B. Referenced Documents

SOP 41 *Guidelines for RAP Stockpile Approval*

402.1.03 Submittals

A. Certified Weight Tickets

Notify the Engineer before removing RAP from a stockpile that belongs to the Department. Submit to the Engineer the certified weight tickets of materials removed from the stockpile.

B. Affidavit

Submit to the laboratory an affidavit stating the sources of stockpiled materials to be used on a State project. Include the following information in the letter:

- State project number
- Location from which the material was removed
- Approximate removal dates
- Mix types removed and the estimated quantity of each type in the stockpiles
- Other available information about the stockpiled material such as percentage of local sand in the RAP

Obtain specific approval from the laboratory to use RAP or RAS stockpiles.

Adhere to Guidelines for RAP Stockpile Approval.

402.2 Materials

A. RAP Material Composition

Use RAP materials from any of the following:

- Existing roadway
- Contractor's RAP stockpile that has been approved by the Department

- Department stockpile

NOTE: The location of Department RAP material stockpiles will be given on the plans.

Do not use RAP materials that contain alluvial gravel or local sand in any mixture placed on interstate projects except for mixtures used in shoulder construction. When used in shoulder construction, limit RAP containing local sand or alluvial gravel so that the sand or gravel contributes no more than 20 percent of the total aggregate portion of the mix.

1. RAP Percentage

   For non-interstate projects, limit the percentage of RAP allowed in recycled mixes so that the overall amount of alluvial gravel does not exceed 5 percent of the total mix. The percentage of alluvial gravel, local sand, and Group I material in the RAP will be determined through petrographic analysis or available records.

2. RAP furnished to the Contractor but not used in the work remains the Contractor's property.

   RAP used in the recycled mixtures for mainline or ramps (if applicable) may make up from 0 to 40 percent of the mixture depending on the amount of RAP available, the production facilities, and whether the mixture meets the requirements in Section 828.

   The maximum ratio of RAP material to the recycled mixtures other than SMA is 40 percent for continuous mix type plants and 25 percent for batch type plants. The maximum ratio of RAP material to the recycled mixture is 15 percent for Stone Matrix Asphalt (SMA) mixes.

3. Process RAP Material

   Process RAP material to be used in the recycled mixture so that 100 percent will pass the 2 in. (50 mm) sieve. Additional crushing and sizing may be required if the RAP aggregate exceeds the maximum sieve size for the mix type as shown in Section 828. Obtain representative materials from the RAP stockpile for the mix design.

B. RAS Material

RAS materials are produced as a by-product of manufacturing roofing shingles and/or discarded shingle scrap from the reroofing of buildings.

1. Limit the amount of RAS material used in the recycled mixture to no greater than 5 percent of the total mixture weight.
2. Shred the RAS material before incorporating it into the mix to ensure that 100 percent of the shredded pieces are less than 1/2 in. (12.5 mm) in any dimension.
3. Remove all foreign materials such as paper, roofing nails, wood, or metal flashing.
4. Provide test results for Bulk Sample Analysis, known as Polarized Light Microscopy, if post-consumer shingles are used to certify the RAS material is free of asbestos. Test stockpiles at the rate of one test per 1000 tons (megagrams) prior to processing.

Other than as specifically stated in this Subsection, ensure that RAS material is used according to the same requirements as described for RAP material.

C. Asphaltic Concrete Removed from an Existing Roadway

Asphaltic concrete removed from an existing roadway becomes the Contractor's property unless specified otherwise on the plans. RAP material retained by the Department is designated on the plans, and the RAP shall be stockpiled at the location specified on the plans.

D. Local Sand and Group I Material in RAP

Use of local sand in recycled mixes is restricted as stipulated in Section 828 for the Project. However, RAP which contains local sand may be used in surface and intermediate layers of non-interstate projects so long as the RAP percentage used does not contribute more than 5% local sand to the total aggregate portion of the mix. The amount of local sand in the RAP material shall be considered when determining the percentage of local sand in the total mix.

Where Pay Items specify that Group II only aggregate is to be used, RAP which consists primarily of Group II aggregate, but contains some Group I aggregate, shall be limited such that the Group I aggregate makes up no more than 5 percent of the total aggregate portion of the mix. When a Blend I mix is specified, any Group I materials in the RAP will be considered when determining the Group I portion allowed in the total mix as specified in Subsection 828.2.A.2.

E. Asphalt Cement

Using laboratory evaluations, the Department will determine the asphalt cement grade to be used in the recycled mixture. The asphalt cement shall meet the requirements of Section 820.

When the asphalt cement is blended with asphalt cement recovered from the RAP material and after tests on residue from thin film oven tests, the asphalt cement shall have a viscosity of 6,000 to 16,000 poises (600 to 1600 Pa) or as approved by the Engineer. Recover asphalt cement from the recycled mixture to verify that the specified viscosity is being met.

If the Engineer determines during construction that the selected asphalt cement grade is not performing satisfactorily, the Department may change the asphalt cement grade in the mixture, with no change in the Contract Unit Price.

F. Recycled Mixture

The recycled mixture shall be a homogenous mixture of RAP or RAS material, virgin aggregate, hydrated lime, and neat asphalt cement. Ensure that the mixture conforms to an approved mixture design outlined in Section 828.

402.2.01 Delivery, Storage, and Handling

Separate the stockpiles by Project sources and by Group I and Group II aggregate types. Erect a sign on each stockpile to identify the source(s).

If RAP material from different project sources becomes intermixed in a stockpile, only use those materials when approved by the laboratory.

The Department may reject by visual inspection stockpiles that are not clean and free of foreign materials.

402.3 Construction Requirements

402.3.01 Personnel

General Provisions 101 through 150.

402.3.02 Equipment

A. Hot Mix Plant

Use a hot mix plant for the recycling process with necessary modifications approved by the Engineer to process recycled material. Design, equip, and operate the plant so that the proportioning, heating, and mixing yields a uniform final mixture within the job mix formula tolerances.

B. Cold Feed Bin

Proportion the RAP or RAS material using a separate cold feed bin. Ensure that the material meets the size requirements in Subsection 402.2, *Materials*. The ratio of the RAP or RAS to virgin aggregate shall be controlled gravimetrically.

C. Electronic Belt Weighing Devices

Use electronic belt weighing devices to monitor the flow of RAP or RAS and the flow of virgin aggregate. For batch-type plants, the RAP or RAS portion of the mix may be weighed in a weigh hopper before incorporating it into the pugmill. The RAP shall be screened through a 2-inch maximum sized screen prior to crossing the cold feed weigh. Ensure the amount of RAP material incorporated into the asphalt plant does not change after this final measurement is processed by the asphalt plant computer.

D. Feeders and Conveyors

Equip plants with an interlocking system of feeders and conveyors that synchronize the RAP or RAS material flow with the virgin aggregate flow. Ensure that the electronic controls track the flow rates indicated by the belt weighing devices and develop the signal to automatically maintain the desired ratio at varying production rates. Design the RAP or RAS feeder bins, conveyor system, and auxiliary bins (if used) to prevent RAP material from segregating and sticking.

402.3.03 Preparation

General Provisions 101 through 150.

402.3.04 Fabrication

General Provisions 101 through 150.

402.3.05 Construction

Follow the requirements in Section 400 for hot mix recycled asphaltic concrete production and placement, materials, equipment, and acceptance plans except as noted or modified in this specification.

402.3.06 Quality Acceptance

The Department may require additional quality control tests to determine the RAP stockpile consistency and the RAP aggregate quality. In this case, conduct at least three extraction/gradation tests from each individual source. Ensure that aggregate meets the quality standards in Section 800.

402.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

402.4 Measurement

Recycled asphaltic concrete mixture, complete in place and accepted, is measured in tons (megagrams). The weight is determined by recorded weights if an approved recording device is used. Or, the weight is determined by weighing each loaded vehicle on an approved motor truck scale as the material is hauled to the roadway.

402.4.01 Limits

General Provisions 101 through 150.

402.5 Payment

The work performed and the materials furnished as described in this specification will be paid for at the Contract Unit Price per ton (megagram). Payment is full compensation for providing materials, hauling and necessary crushing, processing, placing, rolling and finishing the recycled mixture, and providing labor, tools, equipment, and incidentals necessary to complete the work, including hauling and stockpiling RAP or RAS material.

Payment will be made under:

Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, Type__, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete _______mm mix, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	__________in. (mm) recycled asphaltic concrete type Superpave, group-blend, including bituminous materials	Per square yard (meter)
Item No. 402	__________in. (mm) recycled asphaltic concrete type Superpave, group-blend, including bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	__________in. (mm) recycled asphaltic concrete type Superpave, group-blend, including polymer-modified bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	__________in. (mm) recycled asphaltic concrete ______ mm mix, group-blend, including bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	Recycled asphaltic concrete patching including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete patching including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete leveling including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete leveling including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete type Stone Matrix Asphalt, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)

A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the Mixture Acceptance Schedule—Table 9 or 10.

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs./yd² (50 kg/m²) or less is also used for the surface mix at a spread rate greater than 90 lbs./yd² (50 kg/m²), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 9 or 10 for both asphalt content and gradation.
- Meets the minimum requirements for a 0.90 pay factor in Table 12 of Subsection 400.5.01C, *Calculate Mean Pavement Air Voids*.

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm SMA	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm SMA	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm SMA	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

The Department will perform the following tasks:

1. Using the Mixture Acceptance Schedule—Table 9 or 10, of Subsection 400.3.06 to determine the mean of the deviations from the job mix formula per test results per lot.
2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete Mixture Acceptance Schedule—Table 9 or 10 of Subsection 400.3.06 to determine acceptance of surface mixes and the Mixture Acceptance Schedule—Table 10 of Subsection 400.3.06 to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

4. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable Mixture Acceptance Schedule—Table 9 or 10 of Subsection 400.3.06.

5. Minimum requirements for a 0.90 pay factor in Table 12 of Subsection 402.5.01.C, *Calculate Pavement Mean Air Voids*.

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

TABLE 12 - AIR VOIDS ACCEPTANCE SCHEDULE

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1— 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 —172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in Subsection 400.3.06.B.2.

D. Asphaltic Concrete for Temporary Detours

Hot mix asphaltic concrete placed on temporary detours that will not remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price. The payment for this item shall cover all cost of construction, maintenance and removal of all temporary mix. Hot mix asphaltic concrete placed as temporary mix shall meet requirements established in Subsection 400.3.05.F.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting $1.75/ton ($2.00/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting $0.09/yd^2 ($0.11/ m^2) per 1- in. (25-mm) plan depth.

Further price adjustments required in Subsection 400.3.06, *Quality Acceptance*, which are based on the appropriate adjusted Contract Price for mix used in the temporary detour work shall apply should temporary mix be left in place. Hot mix asphalt produced as temporary mix containing no hydrated lime shall be removed and replaced with permanent mix containing hydrated lime.

E. Determine Lot Payment

Determine the lot payment as follows:

1. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.
2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the Mixture Acceptance Schedule—Table 9 or 10 and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the Air Voids Acceptance Schedule – Table 12, remove and replace the materials at the Contractor’s expense.

If the Engineer determines that the material is not acceptable to leave in place, remove and replace the materials at the Contractor’s expense.

Section 412—Bituminous Prime

Replace Section 412 with the following:

412.1 General Description

This work includes preparing and treating an existing surface with bituminous material and blotter material, if required. Treat the surface according to these specifications and conform to the lines shown on the plans or established by the Engineer.

412.1.01 Definitions

General Provisions 101 through 150.

412.1.02 Related References

A. Standard Specifications

Section 424—Bituminous Surface Treatment

Section 821—Cutback Asphalt

B. Referenced Documents

General Provisions 101 through 150.

412.1.03 Submittals

General Provisions 101 through 150.

412.2 Materials

Unless otherwise specified, select the types of bituminous materials. The Engineer will determine the grade of materials to be used. The specifications for the bituminous materials include:

Material	Section
Cutback Asphalt, RC-30, RC-70, RC-250 or MC-250, MC-30, or MC-70	821.2.01
Emulsified Asphalt *AEP, EAP-1	822.2.01
Cationic Emulsified Asphalt *C-AEP,	824.2.01
Blotter Material (Sand)	412.3.05.G.3

Note: *Approved for use as Prime when used in conjunction with Section 315 – Cement Stabilized Reclaimed Base Construction (CSRB).

412.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

412.3 Construction Requirements

412.3.01 Personnel

General Provisions 101 through 150.

412.3.02 Equipment

Provide equipment that is in good repair, including at least the following units that meet the requirements of Subsection 424.3.02, *Equipment*.

- Pressure distributor
- Power broom and blower
- Aggregate spreader (if required)
- Pneumatic-tired roller

412.3.03 Preparation

See Subsection 412.3.05.B, *Condition of Surface*.

412.3.04 Fabrication

General Provisions 101 through 150.

412.3.05 Construction

Prime the following bases and other areas:

- Cement or lime stabilized bases or sub-bases, regardless of pavement thickness
- Soil or aggregate bases or sub-bases on which bituminous surface treatment will be placed
- Soil or aggregate bases or sub-bases on which less than 5 in. (125 mm) total thickness of hot mix asphaltic concrete will be placed

Prime is not required on driveway construction and paved shoulders.

A. Weather Limitations

Do not apply bituminous prime under any of these conditions:

- Surface is wet.
- Air temperature is below 40 °F (4 °C) in the shade.
- Rain is imminent.
- Weather conditions may prevent proper prime coat construction.

B. Condition of Surface

Ensure that the surface to which the prime is to be applied has been finished to the line, grade, and cross-section specified.

Ensure that the surface is uniformly compacted and bonded. Correct surface irregularities according to the specifications for the construction being primed.

C. Cleaning

Remove from the road loose material, dust, caked clay, and other material that may prevent bonding of the prime with the surface. Use power sweepers or blowers the full width of the prime and 2 ft. (600 mm) more on each side. Where necessary, sweep by hand.

D. Moisture

Ensure that the surface is only slightly damp. If the surface is too wet, allow it to dry. If it is too dry, the Engineer may require that it be sprinkled lightly just before priming.

E. Temperature and Surface Texture

The surface texture and condition of the surface determine the bituminous material grades to be used.

The following table shows the bituminous material grades and application temperatures as they are applied to various surface textures.

Base Texture	Tight	Average	Open
Materials and Grade			
Cutback Asphalt	MC-30 RC-30	RC-70 or MC-70	RC-250 or MC-250
Emulsified Asphalt	*AEP, EAP-1	*AEP, EAP-1	*AEP, EAP-1
Cationic Emulsified Asphalt	*C-AEP, *AEP	*C-AEP, *AEP	*C-AEP, *AEP
Application Temperature °F (°C)			
Cutback Asphalt	80–120 (27–49)	105-180 (41 - 82)	145–220 (63 – 104)
Emulsified Asphalt	140 – 180 (60 – 82)	140 – 180 (60 – 82)	140 – 180 (60 – 82)
Cationic Emulsified Asphalt	140 – 180 (60 – 82)	140 – 180 (60 – 82)	140 – 180 (60 – 82)

Note: *Approved for use as Prime when used in conjunction with Section 315 – Cement Stabilized Reclaimed Base Construction (CSRB).

The Engineer will determine the temperature for applying bituminous prime within the limits shown above.

Heat and apply bituminous materials as specified in Subsection 424.3.05.D, *Heating Bituminous Material* and Subsection 424.3.05.E, *Applying Bituminous Material*.

F. Amount and Extent of Prime

The Engineer will determine the exact amount of bituminous material to be used within minimum and maximum rates of 0.15 to 0.30 gal/yd² (0.7 to 1.4 liters/m²). Apply the specified amount as follows:

1. Apply the determined amount uniformly and accurately. Ensure that the amount applied to any 0.5-mile (800 m) section is within 5 percent of the amount specified.
2. Apply the prime the full width of the proposed wearing surface that will be superimposed plus 6 in. (150 mm) more on each side.

G. Protection, Curing, and Maintenance

Do the following after priming the surface:

1. Close to Traffic

   Do not allow traffic on the primed surface. Leave the surface undisturbed until the prime thoroughly cures and does not pick up under traffic.

2. Roll

   If the surface becomes soft after it is primed, roll the surface longitudinally with a pneumatic-tired roller at no more than 6 mph (10 kph) until the surface is firmly set.

3. Blot

   If necessary to prevent the prime from being picked up, spread clean, dry, sharp sand over the surface by hand or mechanically. Apply sand only to places that are tacky and use the least amount needed to prevent pick up. No extra payment for this work or material will be made.

4. Open to Traffic

   After rolling and sanding (if required), open the primed surface to ordinary traffic subject to the conditions in Subsection 412.3.05.G.1, *Close to Traffic*.

5. Curing and Maintenance

6. The primed surface is properly cured when it has penetrated the base sufficiently to not be picked up or displaced by traffic. Temperature and weather conditions may increase curing time. Insure the primed surface has cured to the satisfaction of the Engineer prior to its being covered by other construction.

7. Maintain the prime coat and the primed surface course until it is covered by other construction. Repair potholes, scabs, and soft spots prior to covering with other construction. Remove excess bituminous material.

412.3.06 Quality Acceptance

General Provisions 101 through 150.

412.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

412.4 Measurement

Bituminous material for prime is not measured for separate payment.

412.4.01 Limits

General Provisions 101 through 150.

412.5 Payment

Bituminous material for prime is not paid for separately. The cost to clean the surface, furnish, haul and apply materials including water and sand, roll, and perform repairs and maintenance is included in the Unit Price bid for each individual Base Item.

412.5.01 Adjustments

General Provisions 101 through 150.

Section 415—Asphaltic Concrete Open-Graded Crack Relief Interlayer

Replace Section 415 with the following:

415.1 General Description

The work includes constructing a bituminous plant produced Asphaltic Concrete Open-Graded Crack Relief Interlayer (OGI) over the existing roadway surface. The mixture shall serve as asphaltic concrete leveling over irregular surfaces and provide mitigation for reflective cracking prior to the placement of the final surface pavement. The mixture shall conform to the lines, grades, thicknesses, typical sections and cross sections shown on the plans or established by the Engineer.

This section includes the requirements for Asphaltic Concrete Open-Graded Crack Relief Interlayer mixtures regardless of the gradation of the aggregates, type and amount of bituminous material, or pavement use. Follow the requirements in Section 400, Section 402 and Section 828 for production and placement, materials, equipment, and acceptance plans except as noted or modified in this specification.

Acceptance of the work is on a lot-to-lot basis according to the requirements of this Section, Section 400, Section 402 and Section 106.

415.1.01 Definitions

Asphaltic Concrete Open-Graded Crack Relief Interlayer: an open graded mixture placed at a lift thickness that yields stone on stone contact that provides in-place air void content of 18 to 22 percent to mitigate existing cracking within asphaltic concrete pavements.

415.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials

Section 109—Measurement and Payment

Section 152—Field Laboratory Building

Section 400 – Hot Mix Asphaltic Concrete Construction

Section 402 – Hot Mix Recycled Asphaltic Concrete

Section 413—Bituminous Tack Coat

Section 800 – Coarse Aggregate

Section 802 - Aggregates for Asphaltic Concrete

Section 820 – Asphalt Cement

Section 828—Hot Mix Asphaltic Concrete Mixtures

Section 831 – Admixtures

Section 882 – Lime

Section 883 – Mineral Filler

B. Referenced Documents

AASHTO T 209

AASHTO T 202

AASHTO T 49

AASHTO T 315

Department of Transportation Standard Operating Procedure (SOP) 27

Department of Transportation Standard Operating Procedure (SOP) 15

Department of Transportation Standard Operation Procedure (SOP) 40

GDT 38

GDT 73

GDT 83

GDT 114

GDT 119

GDT 125

GDT 126

GSP 15

GSP 21

QPL 1

QPL 2

QPL 7

QPL 26

QPL 39

QPL 41

QPL 45

415.1.03 Submittals

A. Invoices

Furnish formal written invoices from a supplier for all materials used in production of HMA when requested by Department. Show the following on the Bill of Lading:

- Date shipped
- Quantity in tons (megagrams)
- Included with or without additives (for asphalt cement)

Purchase asphaltic cement directly from a supplier listed on Qualified Products List 7 and provide copies of Bill of Lading at the Department's request.

B. Paving Plan

Before starting asphaltic concrete construction, submit a written paving plan to the Engineer for approval. Include the following on the paving plan:

- Proposed starting date
- Location of plant(s)
- Rate of production
- Average haul distance(s)

- Number of haul trucks
- Paver speed feet (meter)/minute for each placement operation
- Mat width for each placement operation
- Number and type of rollers for each placement operation
- Sketch of the typical section showing the paving sequence for each placement operation
- Electronic controls used for each placement operation
- Temporary pavement marking plan

If staged construction is designated in the plans or contract, provide a paving plan for each construction stage.

If segregation is detected, submit a written plan of measures and actions to prevent segregation. Work will not continue until the plan is submitted to and approved by the Department.

C. Job Mix Formula

Submit to the Engineer a written job mix formula proposed for each mixture type to be used based on an approved mix design. Furnish the following information for each mix:

- Specific project for which the mixture will be used
- Source and description of the materials to be used
- Mixture I.D. Number
- Proportions of the raw materials to be combined in the paving mixture
- Single percentage of the combined mineral aggregates passing each specified sieve
- Single percentage of asphalt by weight of the total mix to be incorporated in the completed mixture
- Single temperature at which to discharge the mixture from the plant
- Theoretical specific gravity of the mixture at the designated asphalt content
- Name of the person or agency responsible for quality control of the mixture during production

Do the following to have the formulas approved in accordance with SOP 40 *Approval of Contractor Job Mix Formulas* and to ensure their quality:

1. Submit proposed job mix formulas for review at least two weeks before beginning the mixing operations.
2. Do not start hot mix asphaltic concrete work until the Engineer has reviewed and approved a job mix formula for the mixture to be used. No mixture will be accepted until the job mix formula is approved.
3. Provide mix designs for all Asphaltic Concrete Open Graded Crack Relief Interlayer mixtures to be used. PG binder grades PG 64-22 and PG 67-22 may be used interchangeably but separate Job Mix Formulas must be submitted and approved for any PG Grade change.
4. After a job mix formula has been approved, assume responsibility for the quality control of the mixtures supplied to the Department according to Subsection 106.01, *Source of Supply and Quantity of Materials*.

D. Quality Control Program

Submit a Quality Control Plan to the Office of Materials and Testing for approval. The Quality Control Program will be included as part of the certification in the annual plant inspection report.

415.2 Materials

The requirements established in Section 400 are to be followed for Asphaltic Concrete Open-Graded Crack Relief Interlayer production and placement, materials, equipment, and acceptance plans except as noted or modified in this specification.

Ensure that materials comply with the specifications listed in Table 1.

TABLE 1—MATERIALS SPECIFICATIONS

Material	Subsection
Asphalt Cement, Grade Specified	820.2
Coarse Aggregates for Asphaltic Concrete	802.2.02
Fine Aggregates for Asphaltic Concrete	802.2.01
Mineral Filler	883.1
Heat Stable Anti-Stripping Additive	831.2.04
Hydrated Lime	882.2.03
Silicone Fluid (When approved by the Office of Materials and Testing)	831.2.05
Bituminous Tack Coat: PG 58-22, PG 64-22, PG 67-22	820.2
Cationic emulsified asphalt CSS-1h, CRS-1h, CRS-2h,	824.2.01
Hot Mix Asphaltic Concrete Mixtures	828

415.2.01 Mix Design Requirements

The Open Graded Crack Relief Interlayer Mixture shall be formulated to contain approximately 18 to 22 percent in-place air voids after compaction. Use approved mixtures that meet the following mixture control tolerances and design criteria:

TABLE 2 – ASPHALTIC CONCRETE OPEN GRADED CRACK RELIEF INTERLAYER MIXTURE DESIGN AND CONTROL

Sieve Size	Mixture Control Tolerance, %	Design Gradation Limits, % Passing
		Open Graded Crack Relief Interlayer
3/4 in. (19 mm) sieve	±0.0	100
1/2 in. (12.5 mm) sieve	±6.1	80 - 100
3/8 in. (9.5 mm) sieve	±5.6	40 - 67
No. 4 (4.75 mm) sieve	±5.7	10 - 27
No. 8 (2.36 mm) sieve	±4.6	2 - 12
No. 200 (75 µm) sieve	±2.0	3 - 5
Range for % AC	±0.4	4.50 – 5.25
Class of stone		Section 802
Drain-down (AASHTO T305), %		<0.3
Design optimum air voids (%)		20% ± 2%
Control Sieves used in Acceptance Schedule		3/8 in., No. 8 (9.5 mm, 2.36 mm) and Asphalt Cement

Notes:

1. Use only PG 64-22 or PG 67-22 asphalt cement (specified in Section 820).
2. Use no less than 1.0% hydrated lime regardless of aggregates group or source(s) used.
3. Ensure no more than 10 percent Recycled Asphalt Pavement (RAP) is used in Asphaltic Concrete Open Graded Interlayer mixtures with the exception that RAP content can be increased to ≤ 15 percent when using fractionated + 4.75 mm sieve RAP.
4. Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.
5. Range for % AC is Original Optimum AC (OOAC) at 25 blow Marshall prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D).

415.3 Construction Requirements

The requirements established in Section 400 are to be followed for asphaltic concrete mixture production and placement, materials, equipment, and acceptance plans except as noted or modified in this specification.

415.3.01 Personnel

General Provisions 101 through 150.

415.3.02 Construction

Asphaltic concrete plants that produce mix for Department use are governed by Quality Assurance for Hot Mix Asphaltic Concrete Plants in Georgia, Laboratory Standard Operating Procedure No. 27.

Follow requirements established in Section 400 for production and placement, materials, equipment, acceptance plans and adjustments except as noted or modified in this specification.

A. Apply a bituminous tack coat according to Section 413. The Engineer will determine the application rate, which must be within the limits of 0.08 gal/yd^2 to 0.10 gal/yd^2 (0.36 L/m^2 to 0.45 L/m^2) (residual asphalt cement).

B. The mix shall be produced and placed at a temperature of 270°F with a tolerance of ± 20°F.

C. Place the mix at a spread rate of 100 lb./yd^2. The spread rate shall be controlled within +15 lbs./yd^2 (8 kg/m^2) to -10 lbs./yd^2 (6 kg/m^2).

D. Do not place mix at air temperatures below 50 °F (10 °C).

E. The mix shall be compacted in a manner to achieve 18 to 22 percent in-place air voids. Steel wheel rollers operating in static mode ***only*** will be used to seat the lift of Asphaltic Concrete Open Graded Crack Relief Interlayer mixture. Pneumatic tire rollers shall not be allowed on the Asphaltic Concrete Open Graded Crack Relief Interlayer mat.

415.4. Measurement

Asphaltic Concrete Open Graded Crack Relief Interlayer mixture, complete, in place and accepted, is measured in tons (megagrams). If the spread rate exceeds the upper limits outlined in Subsection 415.3.02.C by > 15 lbs./yd^2, the mix in excess will not be paid for. If the rate of the spread is ≤ 10 lbs./yd^2 than the lower limit, the deficient course is subject to correction by overlaying the entire lot. The mixture used for correcting deficient areas is paid for at the Contract Unit Price of the course being corrected and is subject to mixture control requirements established in Table 2 – Asphaltic Concrete Open Graded Crack Relief Interlayer Mixture Design and Control. After the deficient course has been corrected, the total spread rate for that lot is recalculated, and the mix in excess of the upper limits outlined in Subsection 415.3.02.C will not be paid for.

415.5 Payment

Asphaltic Concrete Open Graded Crack Relief-Interlayer mix is paid for at the Contract Unit Price per ton (megagram). Payment is full compensation for furnishing and placing materials including asphalt cement, hydrated lime, approved additives, and for cleaning and repairing, preparing surfaces, hauling, mixing, spreading, rolling, and performing other operations to complete the Contract Item.

Payment will be made under:

Item No. 415	Asphaltic Concrete Open Graded Crack Relief Interlayer, group-blend, Including bituminous materials and hydrated lime	Per ton (megagram)

415.5.01 Adjustments

A. Materials Produced and Placed During the Adjustment Period

Follow requirements established in Section 400 for production and placement, materials, equipment, acceptance plans and adjustments except as noted or modified in this specification.

Asphaltic Concrete Open Graded Crack Relief Interlayer shall be granted an adjustment period for the first Lot or day, whichever is less, produced for the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations. Test the mixture in accordance with Section 400.3.06. Maintain the asphalt cement content and gradation within the limits provided in Table 2 – Asphaltic Concrete Open Graded Interlayer Mixture Design and Control. The Engineer will not use these test results in the acceptance for payment decision, but production and placement operations shall cease for failure to meet mixture control tolerances established in Table 2 – Asphaltic Concrete Open Graded Interlayer Mixture Design and Control.

415.5.02 Determine Lot Acceptance

The Engineer will accept the mixture based on visual inspection. The mixture shall be inspected for texture, segregation, bleeding, fat spots, raveling, delamination, tearing, targeted in-place air void content and slippage areas. Remove and replace any areas determined to be unacceptable to the Engineer.

Section 423 - Surfacing For Shoulder Treatment

Add Section 423:

423.1 General Description

This work includes the materials, equipment, construction and application procedures for placing Surfacing For Shoulder Treatment (SFST) as a pavement preservation technique for extending the life of existing asphaltic concrete paved shoulder surfaces. SFST is also intended for use on micro-milled asphalt pavement shoulders in conjunction with a mainline micro-milling process when other asphalt pavement shoulder rehabilation is not specified. Ensure the SFST is a mixture of fine aggregates blended with included specified grades of emulsified asphalt or polymeric cement meeting the requiremens for Type 1 or Type 2 SFST. All ingredients shall be properly proportioned, mixed and spread on the asphaltic concrete paved shoulder surfaces in accordance with the Specifications and as directed by the Engineer.

423.1.01 Definitions

General Provisions 101 through 150.

423.1.02 Related References

A. Standard Specifications

Section 106 Control of Materials

Section 109 Measurement and Payment

Section 802 Aggregates for Asphaltic Concrete

Section 822 Emulsified Asphalt

Section 824 Cationic Asphalt Emulsion

Section 830 Portland Cement

B. Referenced Documents

AASHTO T 49

AASHTO T 59

AASHTO T 111

ANSI B 74.8

ASTM C 109

ASTM C 128

ASTM C 170

ASTM C 496

ASTM C 882

ASTM C 1260

ASTM C 1326

ASTM C 1353

ASTM C 1583

ASTM C 2939

ASTM D 1644

ASTM D 2172

ASTM D 2196

ASTM D 2486 (Modified)

ASTM D 2939

ASTM D 3960

ASTM D 3910

ASTM E 70

GDT 63

GDT 75

QPL 1

QPL 2

QPL 3

QPL 7

423.1.03 Submittals

A. Invoices

Furnish formal written invoices from suppliers for all materials used in production of SFST when requested by the Department. Show the following on the Bill of Lading:

- Date shipped
- Quantity in tons (megagrams)
- Included with or without additives

Purchase emulsified asphalt and/or Portland cement materials directly from a supplier listed on the applicable Qualified Products List and provide copies of Bill of Lading at the Department's request.

B. Placement Plan

Before starting the SFST application, submit a written placement plan to the Engineer for approval. Include the following on the placement plan:

- Proposed starting date
- Rate of production
- Mat width for each placement operation
- Placement Equipment used for the application
- Temporary pavement marking plan, if applicable

If visual surface defects are detected during placement operations, submit a written plan of measures and actions to prevent surface defects. Work shall not continue until the plan is submitted to and approved by the Department.

C. Mix Design

At least three weeks prior to beginning work, submit a mix design with certified test results from the most recent mix design verification testing to the State Materials Engineer. Furnish the following information for each mix:

- Specific project for which the mixture will be used

- Type(s) of SFST to be used on the Project
- Source and description of the materials to be used
- Proportions of the raw materials to be combined in the SFST mixture
- Single temperature at which to discharge the SFST onto the asphaltic concrete paved shoulder surfaces
- Name of the person responsible for quality control of the mixture during production and placement
- Proposed spread rate for SFST placement
- Test results for SFST Mix Design Properties

Do not start SFST work until the Engineer has approved the mix design for the SFST to be used. No material will be accepted until the Engineer has given approval.

After a SFST mix design has been approved, assume responsibility for the quality control of the mixtures supplied to the Department according to Subsection 106.01, “Source of Supply and Quantity of Materials.”

Table 1 – All Types - Surfacing For Shoulder Treatment - General Mix Design Properties and Requirements

Test Method	Description	Criteria	Specification
ASTM D 3910	Wet Track Abrasion Loss	6 Day Soak	Maximum 1.5 lb/yd^2 (807 g/m^2)
		1 Hour Soak	Maximum 1.0 lb/yd^2 (538 g/m^2)

Table 1A – Type 1 - High Density Surfacing for Shoulder Treatment Mix Design Properties and Requirements

Test Method	Description	Specification
ASTM D 2172[1]	Asphalt Content	17.0 – 20.0 %
ASTM D 1644[1]	Solids Content	55.0 – 63.0 %
ASTM D 2196	Initial Brookfield Viscosity at 77°F (RV-4, 20 rpm)	5,500 – 9,000 cPs
ASTM C 2939[2]	Ash Content of wet mix	> 38.0 %
ASSHTO T111[2]	Ash Content of Solids	> 63.0 %
AASHTO T 59	Density	> 11.0 lbs/gal (1318 g/l)
ASTM E 70	pH	6.0 – 8.0
AASHTO T111[3]	Total Inorganic Aggregate Content	> 34.0 %
ASTM D 3960	Maximum VOC	< 0.04 lbs/gal (5.0 g/l)
ASTM D 2939	Resistance to Re-emulsification	No Re-emulsification
ASTM D 2486 Modified[4]	Wear Resistance	< 4.0 %
	Total Sand Content[5]	< 6.0 %

1. Report Asphalt Content of Mixture prior to being loaded for install as % Solids minus % Ash.
2. Ash Content as a percentage of Solids Content.
3. Ash Content of completed HDMB minus Ash Content of HDMB Base Non-Ionic Emulsion. Total Inorganic Aggregate Content defined as slate, refined corundum, and sand.
4. ASTM D 2486 (Modified): Prepare samples at 48 Wet Mils on glass panel. Dry at 77 °F for 3 days. Immerse in water for 24 hours at 77 °F. Test scrub resistance with 1,000 gram brass brush for 12,000 cycles. Report % of dry film lost.
5. Total allowed sand content in Mix Design.

Table 1B – Type 2 - Cementitious Surfacing For Shoulder Treatment Mix Design Properties and Requirements

Test Method	Description	Criteria	Specification
ASTM C 109,	Compressive Strength	3 Hours	2000 PSI (13.7 MPa)
		28 Days	6000 PSI (41.3 MPa)
ASTM C 496, Wet Cured	Tensile Strength	1 Day	300 PSI (2.1 MPa)
		7 Days	450 PSI (3.9 MPa)
		28 Days	600 PSI (4.2 MPa)
ASTM C 882	Slant Shear Bond Strenght	28 Days	2000 PSI (17.2 MPa)
ASTM C 1353*	Abrasion Resistance	1000 revolutions	≤ 1% Loss

*Note: ASTM C1353 specifies the use of the H-22 Calibrade wheels to be used for testing

423.2 Materials

Ensure materials comply with the specifications listed in Table 2.

Table 2 - Materials Specifications

Materials	Specification
Emulsified Asphalt, Grade Specified	822.2
Cationic Emulsified Asphalt Emulsion, Grade Specified	824.2
Portland Cement	830.2
Fine Aggregates for Asphaltic Concrete	802.2.01
Mineral Filler	883.1
Hydrated Lime	882.2.03

Submit a Quality Control Plan to the Office of Materials and Testing for approval. The Quality Control Program will be included as part of the mix design approval process.

A. Aggregate

Use aggregates in SFST that meet the requirements of Subsections 423.2.A.1, and 423.2.A.2. Ensure that all aggregate sources are approved on QPL 1 and /or QPL 2.

1. Aggregates used in a high density SFST shall meet the requirements for Table 3A.

Table 3A – Type 1 - High Density Surfacing For Shoulder Treatment Aggregate Properties

Test Method	Test Name	Specification
ASTM C 128	Specific Gravity (Slate)	> 2.600
ASTM C 170	Compression (Slate)	11,000 Minimum psi
ASTM C 128	Specific Gravity (Refined Corundum)	> 3.9
ASTM C 1326	Knoop 100 Hardness (Refined Corundum)	> 2,000
ANSI B 74.8	Ball Mill Fiability (Refined Corundum)	50 (14 grit)

2. Use aggregate in cementitious material SFST mixtures that meets the requirements of Subsection 802.2.02 “Coarse Aggregates for Asphaltic Concrete”. Aggregates used in cementitious material SFST mixtures shall meet the requirements for Table 3B.

Table 3B – Type 2-- Cementitious Material Surfacing For Shoulder Treatment Aggregate Properties

Test Method	Test Name	Requirement
ASTM C 128	Specific Gravity (Slate)	≥ 2.670
ASTM C 1260	Alkali Reactivitity	Expansion < 0.10 %
GDT 75	Durability Index	≤ 70

3. Ensure the fine aggregate used in the cementitious material SFST is quartz silica sand.

B. Bituminous Materials

Ensure the emulsified asphalt meets the requirements specified in 423.2.B.. Ensure bituminous materials are approved on QPL 7.

1. Ensure the Non-ionic Emulsified Asphalt meets the requirements specified in Table 4A.

Table 4A – Type 1 - High Density Surfacing For Shoulder Treatment Non-ionic Emusion: Inorganic*

Test Method	Test Name	Requirement
ASTM D 2196	Brookfield Viscosity at 77 °F	11,000 – 25,000 cPs
ASTM E 70	pH	5.0 – 7.5 pH
AASHTO T 59	Density	8.5 – 9.0 lbs./gal
AASHTO T 59	Solids Content	50.0 – 54.0 %
AASHTO T 111	Ash Content	7.0 – 11.0 %

* Inorganic is defined as a non-carbon-based emulsifier

C. Cementitious Material for Type 2– Cementitious Material Surfacing For Shoulder Treatment

Ensure the cementitious material meets the requirments for Type I and/or Type II in accordance with AASHTO M 85/ASTM C 150. Ensure the base Portland cement used in the cementitious material is approved on QPL 3.

423.2.01 Delivery, Storage, and Handling

Storage of material is allowed in a properly sealed and insulated system as recommended by the manufacturer. The Engineer may obtain SFST mixture samples for testing for compliance with specified requirements detailed in Table 1.

A. Containers for Transporting, Conveying, and Storing Bituminous Material or Portland Cement

To transport, convey, and store bituminous or cementitious material, use containers free of foreign material and equipped with sample valves. Bituminous or cementitious material will not be accepted from conveying vehicles if material has leaked or spilled from the containers. If the Engineer determines a truck may be hazardous to the Project or adversely affect the quality of the work, remove the transport vehicle from the Project.

423.3 Construction Requirements

423.3.01 Personnel

General Provisions 101 through 150.

423.3.02 Equipment

The Engineer will approve the equipment, tools and machinery used to transport and construct SFST. Ensure the equipment is in satisfactory mechanical condition and can function properly during production and placement operations. No work will be performed with equipment that is not functioning properly.

A. Quality Control Testing Laboratory

Use a GDOT approved Quality Control Testing Laboratory for SFST mix design and quality control/acceptance testing.

B. Mixing/Placing Equipment

Prior to SFST placement, perform and provide to the Engineer a record of the placement equipment calibration using a test strip of 300 feet in length to determine the correct pump/flow settings at the bar or nozzle height, and ground speed intended for the SFST application. Provide a SFST self-propelled blending and/or placing machine that is:

- A continuous flow mixing/placing unit
- Able to accurately deliver and discharge a predetermined proportion of aggregate, mineral fillers, additives, water and bituminous and/or cementitious materials
- Able to provide an accurate means of determining the application rate
- Able to assure proper suspension of the fine aggregates in the SFST mixture

Uniformily place the SFST mixture using a self-propelled mechancial vehicle. Produce a free flow of material to the asphaltic concrete paved shoulder surfaces without the presence of skips, lumps or tears in the finshied surface. Application by handheld devices are limited to isolated areas such as beginning or ending joints, around guardrail, sign structures and similar locations at the discretion of the Engineer. Ensure there is sufficient agitation/turbulence to the mixture to prevent the material from buildup, clumping or setting-up in the placement equipment. Provide a sealed application head to prevent loss of mixture at the road contact surface. If necessary, provide an adjustable rear seal to act as a strike-off.

Thoroughly blend the SFST mixture so that no uncoated aggregate is visible upon discharge from the mixing/placing unit or in samples taken from the roadway.

When mixing onsite, provide equipment the meets the following criteria:

- Provides individual volume or mass controls or other gauging devices for measuring and proportioning each material added to the mixture. Properly calibrate, mark and positively interlock each material control device.
- Ensure that the aggregate feed to the mixer unit is equipped with a revolution counter or similar device to determine the amount of bituminous or cemetitious material used at any time.

Before beginnning work, calibrate each mixing unit and provide a record of the calibration worksheet to the Engineer. Once calibrated, do not change the aggregate and bituminous or cementitious material flows without the Engineer's approval. Water and additives may be adjusted in the field to control the mix properties to produce an acceptable mixture.

C. Equipment at Project Site

Provide sufficient hand tools and power equipment to clean the roadway surface prior to placing the SFST mixture on the asphaltic concrete paved shoulder surface. Use power equipment complying with Subsection 424.3.02.F, "Power Broom and Power Blower."

423.3.03 Preparation

A. Prepare Existing Surface

Prepare the existing surface as follows:

Clean the Existing Surface. Before applying SFST to the asphaltic concrete paved shoulder surface, clean the existing surface to the Engineer's satisfaction. Ensure the asphaltic concrete paved shoulder surface to be covered is cleaned of all loose material, mud, dust, oil, vegetation and other detritus material. When specified in the contract, thoroughly clean all cracks, using air pressure only, and seal cracks according to Section 407. Provide a means for clean straight lines at the transition points of the installation area. Ensure an effective means to protect structures, walls, curbs, etc. from discoloration or splattering material.

1. Patch and Repair Minor Defects

   When included as a part of the contract and before placing SFST:

   a. Correct potholes and broken areas requiring patching in the existing surface and base as directed by the Engineer.
   b. Cut out, trim to vertical sides, and remove loose material from the areas to be patched.
   c. Tack the existing border area being patched. Compact patches to the Engineer's satisfaction. Material for patches does not require a job mix formula, but must meet the gradation range shown in Section 828. The Engineer must approve the asphalt content to be used. Use patching mix types as required in Table 3, Section 400.3.03.B.
   d. Ensure the patches extend the full width and length of the affected area as determined by the Engineer.

423.3.04 Fabrication

General Provisions 101 through 150.

423.3.05 Construction

Provide the Engineer at least one day's notice prior to beginning construction, or prior to resuming production if operations have been temporarily suspended.

A. General

Produce, transport, and place the SFST mixture according to these specifications and as approved by the Engineer. Produce a finished SFST that has a uniform texture free of excessive scratch marks, tears or other surface irregularities or defects. Ensure that the cured mixture fully adheres to the underlying asphaltic concrete paved shoulder surface. The Engineer may reject any work due to poor workmanship, loss of texture, raveling or apparent instability based on visual evaluation or tests' results. Remove and replace all rejected work to the satisfaction of the Engineer.

Ensure the approved spreadrate of in-place SFST necessary to meet the performance testing requirements established in 423.1.03.C. Table 1 is applied for each Lot of material placed by taking a measurement at a random location selected by the Engineer using a pre-weighed 1 square yard piece of felt material placed in the application area. Ensure the SFST spreadrate is maintained within ± 10% of the spreadrate approved in the original mix design submittal. Ensure the material temperature during application varies ≤ 5 ° F (3 °C) from the approved mix design temperature. Once the SFST has been applied to the felt material and it can safely be removed, weigh the coated felt material and calculate the square yard spread rate. Use the hand applicator to coat the area where the felt material had been placed.

B. Weather Limitations

- Ensure the surface and ambient temperature in the shade are 45 °F and rising. Ensure the temperature is taken in the shade.
- The placement shall be stopped a minimum 2 hours prior to forecasted rain.
- There is no forecast of temperatures below 32 °F within 48 hours from the time of placement

C. Maintain Continuity of Operations

Coordinate SFST mixture production, transportation, and placement operations to maintain a continuous operation. If the placing operations are interrupted, construct a straight transverse joint to tie to when placement operations resume.

D. Protect the Pavement

Protect sections of the newly placed SFST from traffic until the traffic will not mar the surface or alter the surface texture. Any damage occurring due to traffic, shall be repaired by the Contractor at no additional cost to the Department.

E. Modify the SFST Mix Design

If the Engineer determines that undesirable mixture or mat characteristics are being obtained, the SFST mix design and related proportions may require immediate adjustment.

423.3.06 Quality Acceptance

A. Quality Control

The contractor must have successfully demonstrated their expertise in this construction method by submitting documentation proving past experience with at least three (3) projects of similar size and nature. The contractor shall provide a list of three (3) projects using SFST mixtures that have demonstrated a five-year minimum proven performance (≥ 70 percent residual SFST coverage) on an asphaltic concrete paved shoulder surface or similar use.

The Contractor will randomly sample and test mixtures for acceptance on a lot basis. The Department will monitor the Contractor testing program and perform comparison and quality assurance testing. The Contractor's Quality Control Technicians shall participate in the Department's Independent Assurance Systems Basis Program.

B. Lot Determination and Testing

1. A Lot is defined as the quantity of SFST placed in a single production day. For each Lot, the contractor shall provide a lot sheet containing the following information:
    - Lot number
    - Project number
    - Date and weather
    - Beginning and ending station numbers or other identifiable locations

- Length, width, and total area in square yards placed
- Recorded application rate and gallons/yards placed
- Contractors' authorized signature

2. Provide a Certificate of Analysis from the bituminous or cementitious materials manufacturer/supplier certifying that the base bituminous or cementitious material meets the requirements of the SFST base specified in Sub-sections 423.2.B.1, 423.2.B.2 and 423.2.C in this specification. A Certification from the SFST manufacturer, stating that the combined SFST mixture, if manufactured off site, met the requirements of Table 1, of this specification prior to being transported for placement shall also be provided.
3. Provide tests results from the tests required in Table 1, current for this project, shall be provided prior to SFST installation and anytime, the Engineer deems the material properties or proportions have varied from the original approved SFST mix design.
4. Mat appearance or surface defects may subject the SFST mixture to removal and replacement requirements. Acceptance of non-complying in-place SFST mixture may be subject to a price adjustment in lieu of removal and replacement at the Engineer's discretion. A minimum price adjustment of 5 percent to a maximum of 20 percent may be applied for non-compliant material. Deficiencies warranting price adjustments will still be compliant to all warranty requirements. Opening the SFST to traffic and observation of the Contractor's field quality control testing does not constitute acceptance.

423.3.07 Contractor Warranty and Maintenance

A. Contractor Warranty and Maintenance

Maintain and protect the surface course as specified in Section 105 unitl the Project has been accepted. Make repairs as directed by the Engineer. The cost of maintenance, protection, and repair is included in the Unit Prices Bid for the Item.

423.4 Measurement

SFST mixture is measured and accepted as completed by the in-place square yard (meter). In computing square yards (meters), the lengths and widths used shall be as specified in Section 109, "Measurement and Payment".

423.4.01 Limits

When the SFST mixture is paid for by the square yard (meter) and multiple lifts are used, the number and thickness of the lifts are subject to the Engineer's approval and are used to prorate the pay factor for the affected roadway section.

423.5 Payment

When materials or construction are not within the tolerances in this Specification, the Contract Price will be adjusted according to Subsection 106.03, "Samples, Tests, Cited Specifications" and Subsection 423.3.06, "Quality Acceptance."

SFST mixtures of the various types are paid for at the Contract Unit Price per square yard (meter). Payment is full compensation for furnishing and placing materials including bituminous or cementitious materials, approved additives, and for cleaning, repairing when specified, preparing surfaces, hauling, mixing, placing, and performing other operations to complete the Contract Item.

Payment will be made under:

Item No. 423	Surfacing For Shoulder Treatment, Including bituminous and/or cementitious materials	Sq. yard (square meter)

If the Engineer determines the material is not acceptable to leave in place, remove and replace the materials at the Contractor's expense.

Section 430—Portland Cement Concrete Pavement

Replace Section 430 with the following:

430.1 General Description

This work includes constructing pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or subbase course.

Follow the requirements of these Specifications and conform to the lines, grades, thicknesses, and cross-sections shown on the plans or by the Engineer.

430.1.01 Definitions

General Provisions 101 through 150.

430.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials

Section 152—Field Laboratory Building

Section 431—Grind Concrete Pavement

Section 461—Sealing Roadway and Bridge Joints and Cracks

Section 500—Concrete Structures

Section 800—Coarse Aggregate

Section 801—Fine Aggregate

Section 830—Portland Cement

Section 831—Admixtures

Section 832—Curing Agents

Section 833—Joint Fillers and Sealers

Section 853—Reinforcement and Tensioning Steel

Section 880—Water

Section 886—Epoxy Resin Adhesives

B. Referenced Documents

AASHTO T 126

AASHTO T 97

AASHTO T 22

AASHTO T 23

ACI 214

ASTM C 94, Requirements for Uniformity

ASTM C 684, Method A

GDT 26

GDT 27

GDT 28

GDT 31

GDT 32

GDT 72

GDT 78

SOP 34

Report form, furnished by the Engineer

Requests for certification

430.1.03 Submittals

A. Profilograph Equipment and Operator Certification

Include in the Contract Unit Bid Price the cost to furnish and operate a Rainhart (Model 860) Profilograph to measure pavement profile deviations.

Before paving, ensure that the operator and the profilograph are certified by the Office of Materials and Research in accordance with Standard Operating Procedure No. 34, Certification of Contractor Personnel and Equipment for Smoothness Testing of Portland Cement Concrete Pavement with the Rainhart Profilograph. Certification includes a mechanical check of the profilograph functions and a written examination by the operator.

Request certification in writing to the Office of Materials and Research at least two weeks before it is needed.

B. Concrete Design

Submit for approval a concrete design that is prepared by a testing laboratory approved by the Office of Materials and Research. The Contractor will transmit the design to the Engineer for approval at least 35 days before use.

C. Approval of Mix Design Proportions

Obtain approval from the Office of Materials and Research for proposed concrete mix designs. Class 1 and 2 concrete mix designs will be verified for early compressive strength according to ASTM C-684, Method A. Class HES concrete mix designs will be verified for compressive strength development at 72 hours according to AASHTO T 126 and AASHTO T 22.

430.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Portland cement	830.2.01
Portland Pozzolan cement	830.2.03
Water	880.2.01
Fine Aggregate, Size No. 10	801.2.02
Coarse Aggregate, Class A or B Crushed Stone or Gravel, Sizes as Specified	800.2.01
Steel Bars for Reinforcement	853.2.01
Steel Wire for Concrete Reinforcement	853.2.06
Welded Steel Wire Fabric for Concrete Reinforcement	853.2.07
Dowel Bars and Bar Coatings	853.2.08
Curing Agents	832
Air Entraining Admixtures	831.2.01
Fly Ash and Slag	831.2.03
Joint Fillers and Sealers	833
Low Modulus Silicone Sealant for Roadway Construction Joints	833.2.06
Epoxy Adhesive for Repairing Cracks	886.2.01
Chemical Admixtures	831.2.02

A. Fly Ash

Use fly ash, if appropriate, as a concrete additive to promote workability and plasticity. It may be used as a partial replacement for Portland cement in concrete, but follow these limits:

1. Do not replace the cement quantity more than 15 percent by weight.
2. Replace cement with fly ash at the rate of 1.25 to 2.0 lbs. (1.25 to 2.0 kg) of fly ash to 1 lb. (1.0 kg) of cement.
3. Ensure that the fly ash mix conforms to Subsection 430.3.06, *Quality Acceptance*.
4. Do not use Type IP cement in fly ash mixes.

B. Granulated Iron Blast-Furnace Slag

If high early strengths are not desired, use granulated slag as a partial replacement for Portland cement in concrete. Follow these limits:

1. Replace the quantity of cement 50 percent or less by weight if the 5-day forecast of the National Weather Service expects temperatures higher than 60 °F (15 °C).
    a. If the 5-day expected low temperature is less than 60 °F (15 °C) but not less than 40 °F (4 °C), replace the quantity of cement 30 percent or less by weight.
    b. If the 5-day expected low temperature is less than 40 °F (4 °C), do not use granulated slag.
2. Replace cement with slag at the rate of 1 lb. (1 kg) of slag to 1 lb. (1 kg) of cement.

3. Ensure that the granulated slag mix conforms to Subsection 430.3.06, “Quality Acceptance.”
4. Do not use Type IP cement or fly ash in slag mixes.

C. Composition of Concrete

Design the concrete mix to conform to the following requirements:

1. Coarse Aggregate

   Use coarse aggregate size No. 467, 67, or 57 for plain Portland cement concrete pavement.

   Use size No. 67 or 57 coarse aggregate for continuous reinforced concrete pavement.

   Separate size No. 467 or 456 in individual stockpiles of size No. 4 and size No. 67. Blend according to approved mix proportions.

2. Fine Aggregate

   Use fine aggregate that meets the requirements for size No. 10.

   When using two sizes or sources of fine aggregate to produce the proper gradation, blend according to the approved design proportions.

D. Protective Materials

Provide materials to protect the concrete edges and surface from rain, including:

- Standard metal forms or wood planks to protect the pavement edges
- Covering material such as burlap or cotton mats, curing paper, or plastic sheeting material to protect the pavement surface

430.2.01 Delivery, Storage, and Handling

Store aggregate from different sources in separate stockpiles.

430.3 Construction Requirements

430.3.01 Personnel

A. Certified Operator

Before paving, have the Office of Materials and Research, certify a profilograph equipment operator. Certification includes a written examination by the operator.

430.3.02 Equipment

A. Equipment Requirements

Provide equipment and tools to perform the work. Provide equipment that allows the paver to operate at a constant production rate and rarely start and stop. The Engineer may limit the production rate or batch size if equipment does not keep pace with the other operations or causes poor workmanship.

B. Scales

Before use, the Engineer will inspect and approve the scales to weigh concrete materials and the devices to measure water. Tolerances are ± 1.0 percent throughout the operating range. Measure admixtures to ± 3.0 percent.

C. Paving Equipment

Ensure that equipment operating on the pavement has rubber-tired wheels or flat steel wheels. Wait to operate concrete or shoulder paving equipment on the pavement until the concrete slab is 14 days old or has 2,500 psi (15 MPa) compressive strength.

Paving equipment may be either slip-form or fixed form.

D. Surface Finish Equipment

Use mechanical equipment to produce the surface finish of the mainline and transverse plastic concrete grooving. Ensure that the equipment uses rectangular-shaped steel tines of the same size and uniform length. Use tines with a width between 0.08 in. (2 mm) and 0.130 in. (3.5 mm). Space the tines approximately 1/2 in. (13 mm) apart.

E. Field Laboratory

Provide a field laboratory according to Section 152.

F. Mechanical Sprayers

Provide fully atomizing spraying equipment with a tank agitator to place curing compounds.

430.3.03 Preparation

A. Prepare the Road Bed

Prepare the roadbed as required by the Plans and Specifications before placing concrete pavement.

B. Observe Condition of Subgrade and Subbase

Check the subgrade and subbase as follows:

1. Prepare the full width of the subgrade and subbase according to the plans and specifications.
2. Ensure that the surface immediately under the concrete pavement allows proper pavement thickness and yield.
3. Trim high areas to the proper elevation.
4. Ensure that the subbase can support paving equipment without rutting or bogging.

430.3.04 Fabrication

General Provisions 101 through 150.

430.3.05 Construction

A. Mix the Concrete

Produce Portland cement concrete by combining authorized proportions of materials in batches according to the construction methods in this Specification.

Mix the concrete produced in a stationary central mix plant for at least 60 seconds after all materials have entered the drum. Reduce the mix time if representative tests show that the concrete meets requirements of ASTM C 94, Requirements for Uniformity. Never reduce the mix time to less than 50 seconds.

B. Set Forms

Set the forms as follows:

1. Compact the foundation under the forms true to grade. Set the form so that it firmly contacts the foundation for the entire length at the specified grade.
2. Prevent the forms from settling or springing under the finishing machine.
3. Clean and oil the forms before placing the concrete.

C. Dowel Bars

Provide dowel bars at transverse joints unless otherwise noted in the Contract Plans.

D. Place Concrete

After depositing the concrete on the grade, avoid re-handling. Unload and place it as follows:

1. Unload the concrete into an approved spreading device and mechanically spread it on the grade.

2. Place the concrete continuously between transverse joints without using intermediate bulkheads.
3. Hand spread the concrete with shovels, not rakes.

NOTE: Do not allow personnel to walk in freshly mixed concrete with shoes coated with dirt or other materials.

4. Thoroughly consolidate the concrete against the faces of forms and along the full length and sides of joint assemblies.
5. Ensure that vibration does not cause puddling or grout accumulation on the surface.

   For construction or expansion joints, do not use grout that accumulates ahead of the paver.
6. Deposit concrete near the formed joints. Dump or discharge concrete only in the center of a joint assembly.
7. Take slab depth measurements as follows:
   a. Probe the plastic concrete behind the paver.
   b. Record the station number and depth measurements at least every 500 ft. (150 m) at 3 random increments across the slab.
   c. Provide these measurements to the Engineer when requested.
8. Take air and slump determination tests at a rate of at least three of each test evenly distributed during the workday. Provide the results to the Engineer when requested.
9. Keep reinforcing steel free of dirt, oil, paint, grease, mill scale, and loose or thick rust that could impair the bond of the steel to the concrete.
10. Arrange operations to prevent “leave-outs” in continuous reinforced concrete pavement. The Engineer may approve “leave-outs” in emergencies if a plan is approved to increase the reinforcement. The Department will not pay for extra leave-outs.

E. Place Reinforcement

Place reinforcement according to the plans and as follows:

1. Do not insert lane tie bars in unsupported sides of fresh concrete.
2. Ensure that the steel placement method does not damage or disrupt concrete.
3. Use bent lane tie bars if needed in longitudinal formed joints construction. However, replace broken or damaged bars at no additional cost to the Department.

F. Construct the Ramps

Prevent pavement slab stress by constructing a ramp of compacted earth or other material for movement on and off the pavement. Do not allow equipment that exceeds legal load limits on the pavement.

G. Consolidate and Finish

Ensure that the sequence of operations is continuous from placement to final finish.

1. Consolidation

   Perform vibration for the full width and depth of the pavement as follows:
   a. Do not allow the vibrators to misalign load transfer devices, or to contact forms or base.
   b. Ensure that the vibrator amplitude is within the range recommended by the manufacturer.

      Use spud vibrators with an adjustable operating frequency between 8,000 and 12,000 vibrations per minute.

      Use surface pan vibrators with an adjustable operating frequency between 3,000 and 6,000 vibrations per minute.

c. If appropriate, use surface vibrators and internal vibrators on concrete greater than 8 in. (200 mm) thick.

d. If appropriate, use surface vibrators exclusively on pavements less than 8 in. (200 mm) thick.

e. Stop vibration when the machine cannot go forward.

f. Obtain uniform consolidation and density throughout the pavement.

If it is not uniform, stop the operation and provide methods or equipment that will produce pavement that conforms to the Specifications.

2. Finishing

After striking off and consolidating the concrete, follow these steps:

a. Smooth and true the concrete using a float or finishing machine to minimize or eliminate hand finishing.

Perform hand finishing only under the following conditions:

Irregular dimension areas where operating mechanical equipment is impractical

Mechanical equipment breakdown (only finish the concrete already deposited when the breakdown occurred)

Abnormal circumstances approved by the Engineer

b. Ensure that the pavement surface final finish is true to grade, uniform in appearance, and free of irregular, rough, or porous areas.

c. Prevent the surface within 6 in. (150 mm) of the pavement edge to deviate more than 0.25 in. (6 mm) in 10 ft. (3 m) when tested with a 10 ft. (3 m) straightedge in both transverse and longitudinal directions.

d. Use mechanical equipment to produce a surface finish of transverse plastic concrete grooving for the mainline and ramps.

e. Have the Engineer determine the texture depth by conducting pavement surface tests such as GDT 72 at selected locations.

f. Transversely saw-groove mainline and ramp areas with a surface texture depth less than 0.018 in. (0.5 mm). Meet the depth requirement of 0.035 in. (0.9 mm) or greater.

Perform saw-grooving to meet the following dimensions:

Width	1/8 in. (3 mm)
Depth	3/16 in. (5 mm)
Spacing	3/4 in. (19 mm) center-to-center

g. If required, use hand tools to texture ramps, acceleration lanes, and deceleration lanes to surface texture mainline requirements. Finish irregular sections to a surface texture of at least 0.025 in. (0.64 mm) as shown in GDT 72.

3. Numbering Stations

Cast station numbers with a die in the pavement every 500 ft. (200 m) and 1 ft. (300 mm) from the right edge of the travel lane.

4. Protection from Rain

Protect the unhardened concrete from rain. See Subsection 430.2.D, *Protective Materials*.

When rain is imminent, stop paving operations and place forms against the sides of the pavement. Cover the surface of the unhardened concrete with the protective covering.

H. Remove Forms

Do not remove forms from freshly placed concrete until it has set for at least 12 hours, unless otherwise provided.

1. Remove forms carefully to avoid damaging the pavement.
2. After removing the forms, immediately cure the sides of the slab using the same method used to cure the pavement surface.
3. Remove and replace major honeycombed areas.

I. Work at Night

Provide adequate lighting for work performed at night. If lighting will not be provided at night, stop the concreting operation in time to finish and saw during daylight hours.

J. Provide Joints

Ensure that joints are designed, configured, and located as shown on the Plans or required by the specifications.

1. Provide dowel bars at transverse joints unless otherwise noted.
2. Remove and replace plain concrete pavement that cracks during construction with no additional cost to the Department, at the Engineer's discretion.
3. When chipping out random cracks for sealing, use nonrigid epoxy on cracks that are not under expansion-contraction influence and that meet Subsection 886.2.01.
4. Seal continuous cracks that are under movement with sealant that meets Subsection 833.2.06.
5. When removing and replacing a pavement section, remove an area at least 6 ft. (1.8 m) long and the full width of the lane.
   a. Saw to vertical face the sections to be removed and replace the concrete as a construction joint with dowels.
   b. Use deformed bars as dowels in the saw-cut construction joint. Use the size specified for contraction joints in the plans.
6. Thoroughly clean the drilled holes of contaminants and set the dowels into the hardened concrete face of the existing pavement with a Type VIII epoxy bonding compound. See Section 886 for epoxy bonding requirements.
7. For contraction joints, use undamaged and properly positioned dowels in existing construction or slab replacement areas. Coat the protruding dowel portions with a thin film of heavy grease.
8. When both sides of an existing construction or contraction joint require slab replacements, replace slabs continuously from saw-cut construction joint to saw-cut construction joint. Use dowels specified for contraction joints.
9. Before placing concrete, uniformly apply a thin coat of heavy grease to epoxy-coated dowels.
10. When placing slabs continuously across transverse contraction joint locations, use saw-cuts to provide planes of weakness according to the requirements of this Specification and the standard drawing for contraction joints.

K. Types of Joints

1. Longitudinal Joints

   For longitudinal joints, use unpainted and uncoated deformed steel bars that are the size and length specified on the plans.

   Place the bars perpendicular to the joint using a mechanical device, or rigidly secure the bars in place with supports.
2. Longitudinal Formed Joints

   Construct longitudinal formed joints while the concrete is in a plastic state.

Use methods and equipment that locate the joint reinforcement properly without disrupting it during construction.

3. Longitudinal Sawed Joints

Cut longitudinal sawed joints with a mechanical saw within three days after the concrete is placed and before traffic or equipment enters the pavement.

4. Transverse Joints

Transverse joints consist of construction joints, contraction joints, or expansion joints constructed at required locations.

a. Construct transverse joints in partial width or adjoining lanes to abut the same joint of adjacent lanes unless otherwise specified on the plans.
b. Ensure that transverse joints in plain Portland cement concrete requiring load transfer devices contain either plastic-coated or epoxy-coated dowels.
c. Before placing concrete, secure dowel bars in place with supporting assemblies.
d. Secure the assemblies in position on the subbase to keep the dowels from moving during concrete placement.
e. Place dowel bars to a vertical and horizontal tolerance of plus or minus 1 in. (25 mm) of the plan position. Do not misalign the dowel bar more than 3/8 in per 1 ft. (10 mm per 300 mm) in the horizontal or the vertical plane.
f. Remove and replace dowel assemblies displaced from the Plan position more than the tolerances in Subsection 430.3.05.J.
g. When using epoxy-coated dowels, coat the entire surface with a thin film of heavy waterproof grease.
h. Ensure accurate positioning of transverse sawed joints by marking the position of dowel bar assembly locations.

5. Construction Joints

Construct transverse construction joints when interrupting concreting operations for more than one hour.

NOTE: Do not construct transverse construction joints within 10 ft (3 m) of an expansion joint, contraction joint, or transverse plane of weakness.

a. Move an unanticipated construction joint back to the last plan joint, if necessary. Remove and dispose of excess concrete.
b. Form construction joints by securing in place a removable bulkhead or header board.
    1) Place the board so that it conforms to the full cross section of the pavement. Secure it flush with the subbase and parallel to the normal transverse joints.
    2) Slot or drill the board to allow placement of reinforcement as required by the plans.

NOTE: Do not use the roll of laitance and grout that forms in front of the paver adjacent to transverse construction joints.

c. Consolidate to full width and depth concrete adjacent to transverse construction joints with mechanical hand-type spud vibrators. Keep one auxiliary vibrator available in case of mechanical malfunctions.
d. Before applying the final finish to the concrete, string line and correct variations of the concrete surface within 30 ft. (9 m) on either side of the transverse construction joints. Provide equipment and tools such as:
    - Work bridges
    - Personnel

- String lines
- Straightedges
- Lighting

e. While the concrete is in a plastic condition, stringline the surface longitudinally and correct surface deviations greater than 1/8 in. per 15 ft. (3 mm per 4.6 m) in any direction.

f. When using plain Portland cement concrete pavement, place dowel bars in construction joints. Cast half the length of each dowel bar in the concrete during each phase of joint construction.

g. When using epoxy coated dowels, coat the protruding half of each dowel bar with a thin film of heavy waterproof grease before resuming joint construction. Grease coating is not required on plastic coated dowels.

h. After the concrete has hardened, dismantle the bulkhead supporting the dowels. Do not disturb the dowels.

6. Contraction Joints

Create planes of weakness in plain Portland cement concrete pavement by cutting joints in the pavement surface. Create the planes according to the Plans as follows:

a. Saw transverse contraction joints before the pavement cracks. Begin sawing when the concrete has hardened enough to prevent surface raveling, usually 4 hours after placement, but no more than 24 hours.

b. Continue sawing day and night regardless of weather conditions.

7. Expansion Joints

Transverse expansion joints are required at locations shown on the plans.

a. Form expansion joints by securing a removable bulkhead that conforms to the full cross section of the pavement. Use bulkheads that can construct a vertical expansion wall without offsets, indentations, or burrs.

b. Use expansion joint filler required by the plans.

c. Furnish and install preformed joint filler in lengths equal to the pavement width or the width of one lane. Do not use damaged or repaired joint fillers.

d. Position the expansion joint filler vertically in the joint and at the proper grade. Use an installing bar or other device to secure the expansion joint filler at the proper grade and alignment.

L. Cure the Concrete

Immediately after finishing the concrete, cure the entire surface when the concrete will not mar. Use one or more of these methods:

1. Impervious Membrane Method

To use this method:

a. Spray the entire surface of the pavement with white pigmented curing compound immediately after finishing the surface and before the concrete has set.

If the pavement is cured initially with cotton mats, burlap, or cotton fabric, apply the compound after removing the mats.

NOTE: Do not apply curing compound during rain.

b. Use mechanical sprayers to apply curing compound under pressure at a minimum rate of 1 gal per 150 ft^2 (1 L per 3.5 m^2).

c. Thoroughly mix the compound with uniformly dispersed white pigments.

d. During application, use a mechanical device to stir the compound continuously.

e. Use a hand sprayer (if required) to spray odd widths, odd shapes, and concrete surfaces exposed by removing forms.
f. Do not apply curing compound to the inside faces of joints to be sealed.
g. If the membrane film becomes damaged within the curing period, repair the damaged portions immediately with additional compound.

2. White Polyethylene Sheeting

   To use this method:

   a. Cover the top surface and sides of the pavement with polyethylene sheeting. Lap the units at least 18 in. (450 mm).
   b. Place the sheeting and weigh it down so that it contacts the surface.
   c. Extend the sheeting beyond the edges of the slab at least twice the thickness of the pavement.
   d. Unless otherwise specified, maintain the covering in place for 72 hours after placing the concrete.

3. Burlap, Cotton Fabric, or Other Methods

   Contractors may cure the pavement with burlap, cotton fabrics, or other materials if the section remains wet for the duration specified by the Engineer.

4. Cold Weather Curing

   To use this method:

   a. Remove and replace concrete that freezes before the initial set time at no cost to the Department.
   b. Use polyethylene or canvas to protect concrete that has set but is exposed to freezing temperatures within 24 hours of placement. Ensure that the internal concrete temperature is above freezing for at least 24 hours after placing the concrete.
   c. Obtain approval from the Engineer to use other protection methods such as hay, straw, or grass, or to change the duration of the protection.

M. Seal the Joints

Clean and seal the joints according to Section 461 and the plans.

Immediately after completing the curing period, fill in the joints with joint sealing material before opening the pavement to traffic.

During sealing, do not spill the material on the concrete surface. Immediately remove excess material on the concrete surface and clean the surface.

Do not use sand or similar material as a cover for the seal. Seal joints according to the plans.

N. Open Pavement to Traffic

Wait to open the pavement slab to traffic, except for joint sawing vehicles, until the concrete is 14 days old unless representative compressive tests show that the slab has a compressive strength of 2,500 psi (15 MPa). Cure compressive test specimens used for traffic opening as near as possible to the roadway.

Protect the pavement against traffic from the public, employees, and agents.

1. Erect and maintain barricades. Employ watchmen to block traffic from the newly constructed pavement for the period required in this specification.
2. Arrange the barriers away from public traffic on lanes remaining open.
3. Maintain signs that clearly indicate the lanes open to public traffic.
4. If traffic must go across the pavement, construct crossings satisfactory to the Engineer to bridge over the concrete. Construct the crossing without additional compensation.

5. Repair or replace pavement damaged by traffic or other causes before Final Acceptance without additional compensation. Make repairs to the Engineer's satisfaction.

430.3.06 Quality Acceptance

The typical section sheet in the Plans gives specific uses for each concrete classification. Refer to this specification for the minimum requirements of the concrete classifications for concrete design approval, concrete mix design proportions, batching control responsibilities, and acceptance of hardened concrete based upon compressive strength development.

A. Transit Mixed Concrete

Ensure that transit mixed concrete meets the requirements of Subsection 500.2, *Materials*.

B. Mix Design Criteria

Proportion concrete mix designs using the following requirements:

	Minimum Cement Content per Cubic Yard Concrete (CWT)	Max. Water-Cement Ratio (lbs./lb.)	Design Air Content Range (%)
Class 1	5.41	0.53	4.0 to 5.5
Class 2	5.64	0.50	4.0 to 5.5
Class HES	6.58	0.47	4.0 to 5.5

	Minimum Cement Content per Cubic Meter Concrete (kg)	Maximum Water-Cement Ratio (kg/kg)	Design Air Content Range (%)
Class 1	320	0.53	4.0 to 5.5
Class 2	335	0.50	4.0 to 5.5
Class HES	390	0.47	4.0 to 5.5

Produce evidence that the mix design proportions for Class 1 and 2 concrete have strength development potential for 24 hours plus or minus 15 minutes and at 28 days as specified in Subsection 430.3.06.C, *Approval of Mix Design Proportions*.

C. Approval of Mix Design Proportions

The Department will approve each proposed combination of materials and mix designs based on the use of approved materials, compliance with Subsection 430.3.06.B, *Mix Design Criteria*, and the following:

1. Flexural Strength

   Prepare at least 9 normally cured flexural specimens and test according to AASHTO T 126 and T 97 to ensure that the demonstrated laboratory flexural design strength at 28 days meets the following minimum Design Acceptance Requirement (DAR).

NOTE: Take the 9 flexural specimens from 3 separate trial batches. Make 3 specimens from each

Class No. 1	Concrete DAR = 600 psi + .67 s Concrete DAR = 4.1 MPa + .67 s
Class No. 2	Concrete DAR = 700 psi + .50 s Concrete DAR = 4.8 MPa + .50 s
Class HES	Concrete DAR = 700 psi + .50 s Concrete DAR = 4.8 MPa + .50 s
s = a standard deviation of all 28-day flexural specimens for a given combination of materials and mix proportions prepared together. Do not use a value of "s" greater than 37 psi (255 kPa) to calculate DAR.	

2. Compressive Strength

Prepare and test at least 6 cylinders according to AASHTO T 126 and T 22 to ensure that the demonstrated laboratory compressive strength at 28 days for Class 1 and 2 concrete exceeds the minimum Job Performance Value (JPV).

Produce similar evidence that demonstrates strength development at 72 hours for Class HES concrete.

Class 1	Concrete JPV Minimum = 3,000 psi + .18 R Concrete JPV Minimum = 20 MPa + .18 R
Class 2	Concrete JPV Minimum = 3,500 psi + .21 R Concrete JPV Minimum = 25 MPa + .21 R
Class HES	Concrete JPV Minimum = 3,000 psi + .05 R Concrete JPV Minimum = 20 MPa + .05 R
R = the difference between the largest observed value and the smallest observed value for all compressive strength specimens at 28 days for a combination of materials and mix proportions prepared together.	

d. Class 1 and 2 Concrete

1) Submit early compressive strength test results made at 24 hours plus or minus 30 minutes for at least 12 cylinders. Prepare and test according to ASTM C 684, Method A.

2) Prepare cylinders from three separate trial batches and make four specimens from each batch.

3) Determine the average strength, standard deviation, and coefficient of variation for the design according to ACI 214. Do not use designs that produce a coefficient variation greater than 10 percent.

e. Class HES Concrete

Submit evidence that designs proposed for use as Class HES concrete have compressive strength development potential at 72 hours of 3,000 psi (20 MPa) plus .05 R.

D. Field Adjustments on Concrete Mixes

Determine the aggregate surface moisture and apply free moisture corrections to the approved mix design. The Engineer will verify that the corrections are made properly.

Adjust the approved proportions of the fine and coarse aggregate and water as desired, provided:

1. The cement factor is not decreased.

2. The water-cement ratio is not increased.

3. Adjustments produce concrete proportions according to this Specification.

4. The Engineer is notified before use.

E. Concrete Mix Tolerances

Keep concrete consistency and air content to vary within the following limits:

1. Consistency

   Immediately before placement, use GDT 27 to determine concrete slump. Do not use concrete for Portland cement concrete pavement with a slump value greater than 2.5 in. (65 mm).

2. Air Content

   Immediately before placement, use GDT 26, GDT 28, or GDT 32 to determine the air content of the concrete. Concrete will not be accepted that has an air content outside of these limits:

Lower acceptance limit	3.0%
Upper acceptance limit	6.5%

F. Concrete Strength Acceptance

The concrete strength of Portland cement concrete pavement is accepted based upon development of compressive strength at a specific time.

Strength development is determined by a lot acceptance plan. The pavement is subdivided into separate concrete lots of approximately 5,334 yd^2 (4400 m^2) placed continuously, except for required work stoppages.

1. Ramps

   Ramps may be set apart as individual lots. Include acceleration or deceleration lanes, wedges, or other varied width sections in other lots if the total paving quantity is not greater than 7,500 yd^2 (6300 m^2). The Engineer will randomly select three production units from each lot for strength determination tests.

2. Class 1 and 2 Concrete

   a. Cast at least two cylinder sets for each production unit selected for acceptance testing. Cure one set according to ASTM C-684, Method A. Cure the other set according to AASHTO T 23.

   NOTE: A set is defined as two 6 by 12 inch (150 by 300 mm) or three 4 by 8 inch (100 by 200 mm) cylinders.

   b. After curing, test each concrete cylinder according to AASHTO T 22. The test result is the average strength of the two cylinders.

3. Acceptance Based on 24-Hour Strength

   Concrete may be accepted by early strength determinations. However, concrete will not be accepted based on early strength development when the difference between the largest observed strength value and the smallest observed strength value exceeds 35 percent of the average.

   a. Compute the average (X) and the range (R) from the three acceptance tests results.

   b. Have the Engineer establish the minimum early strength (S) to be used for concrete acceptance.

      The minimum early acceptance strength is the average strength at 24 hours plus or minus 30 minutes of the laboratory design less 1.5 times the standard deviation of the laboratory design.

   c. If the average (X) of the three lot acceptance tests equal or exceed the value (S), the lot will be accepted at the full contract price, and 28-day cylinders for this lot can be discarded.

   d. If the average of the three lot acceptance tests fails to meet the acceptance limit, the Engineer will contact the Contractor immediately. The Contractor may immediately remove the concrete in the lot or leave it in place pending acceptance or rejection from the 28-day strength test results.

4. Acceptance Based on 28-Day Strength Tests

When a lot is potentially defective based on the early strength determinations and the Contractor leaves the lot in place to be judged by the 28-day strength tests results, retain and cure all 3 sets of 28-day cylinders.

a. If the average 28-day strength of the lot does not meet the lower acceptance limit for a 0.70 pay factor, the Engineer may either:

   Order removal of the concrete in the lot

   Apply a pay factor of 0.50 for the lot

b. The Unit Price of concrete pavement will be reduced for areas represented by each lot that does not meet the specified compressive strength at 28 days according to the following schedule:

Pay Factor Schedule for Strength Determinations at 28 Days			
Acceptance Limits for Pay Factor Levels			
	1.00 LAL*	0.95 LAL	0.70 LAL
Concrete Class 1	3,000 psi (20 MPa) + 0.18 R	3,000 psi (20 MPa) - 0.07 R	3,000 psi (20 MPa)- 0.30 R
Concrete Class 2	3,500 psi (25 MPa)+ 0.21 R	3,500 psi (25 MPa)- 0.07 R	3,500 psi (25 MPa)-0.30 R
* Lower acceptance limit (LAL)			

5. Classification HES Concrete

Cast at least two sets of cylinders for each production unit selected for acceptance testing.

a. Cure one set for 72 hours under conditions similar to those under which the pavement is cured. Cure the other set of cylinders for 28 days according to AASHTO T 23.

b. Test each cylinder according to AASHTO T 22 when the specified curing is complete. The test results are the average strength of the two cylinders.

c. The Engineer may accept the concrete at full contract price if the average of the three 72-hour test results exceeds the JPV established in Subsection 430.3.06.C.

d. When the 72-hour strength tests determine that a lot is potentially defective, the Engineer will immediately notify the Contractor. At this time, the Engineer may require the immediate removal of the pavement in question.

   If the Engineer does not require immediate removal of the pavement, select removal or acceptance on the basis of the 28-day strength development.

e. When the 72-hour strength tests determine that a lot is potentially defective and the concrete is retained for subsequent judgment, conduct acceptance tests at 28 days on selected cylinders cured according to AASHTO T 23.

   Questionable lots will be accepted based on the 28-day strength and provisions for testing, computations, and payment for Classification No. 2 concrete in Subsection 430.3.06.F.2, *Class 1 and 2 Concrete*.

G. Smoothness

Pavement smoothness will be accepted only after the Engineer determines that the work was performed according to this and other specifications. The completed pavement, including corrective work, must meet the applicable profile index value requirements.

Perform smoothness testing as follows:

1. Ensure that the mainline riding surface produces a profile index value no greater than 7 in./mile (100 mm/km) on each travel lane. Conduct tests according to GDT 78.
2. Determine a profile index value for each tracing for each 0.25-mile (0.5 km) segment. Correct individual bumps or depressions that exceed the blanking band by more than 0.2 in. (5 mm) at no additional expense to the Department.
3. If a paving operation exceeds a profile index value of 7 in./mile (100 mm/km) per lane for any segment, suspend the paving operation and take corrective action approved by the Engineer.
4. Use GDT 78 to test ramps and acceleration and deceleration lanes to attain an average profile index value no greater than 12 in./mile (200 mm/km) by Rainhart Profilograph for the entire section length. Correct individual bumps or depressions that exceed 0.2 in. (5 mm) from the blanking band at no additional expense to the Department.
5. Take pavement profiles that are 4 ft. (1.2 m) away from and parallel to the new pavement edges on pavements greater than 16 ft. (4.8 m) wide and up to 24 ft. (7.2 m) wide.

   Test pavement 6 to 16 ft. (1.8 to 4.8 m) wide parallel to and at the center line of the pavement section.
6. Begin the 0.25-mile (0.5 km) record segments at the first day's placement and continue until project completion, except as noted in this specification.
7. Combine pavement sections less than 700 ft. (200 m) long that approach a bridge. Use the previous 0.25-mile (0.5 km) segment to determine the profile index.

   Calculate as a separate record segment 700 ft. (200 m) sections or greater that approach a bridge. This exception applies also to sections at project limits.

8. Determine a separate profile index value using GDT 78 for the 100 ft. (30 m) of roadway approaching each end of a bridge up to and including the joint with the approach slab.

   Average the profile index from the right and left wheel paths for each 100 ft. (30 m) segment for each lane for each approach. The average profile index value shall not exceed 30 in./mile (500 mm/km).
9. Before paving farther, perform and evaluate profiles from the first day's placement.
   a. After completing and evaluating this test run, adjust equipment as required by the Engineer to improve smoothness before paving continues.
   b. Complete the report form furnished by the Engineer and attach to the profilograph tracings of each day. Include the following information in each trace:
      - Project number
      - Beginning and ending station numbers
      - 500 ft. (150 m) paving stations
      - Traffic direction
      - Lane number
      - Date paved and tested
      - Construction joint locations

   Have the certified profilograph operator obtain and evaluate the traces and submit the evaluation to the Engineer. Provide results no later than the end of the second work day following placement.
10. For mainline pavement, correct 0.25 mile (0.5 km) segments not meeting the profile index requirement using one of these methods:
   a. Grind the entire lane surface of the 0.25-mile (0.5 km) segment to a profile index value less than 7 in./mile (100 mm/km). Use equipment that meets requirements in Section 431.

b. Grind roughness in small segment areas no more than 50 ft. (15 m) of full lane width to produce a profile index value no greater than 7 in./mile (100 mm/km).

If more than 50 ft. (15 m) of grinding is required, grind the complete 0.25-mile (0.5 km) segment according to Method a, above.

11. Correct ramps and acceleration and deceleration lanes that do not meet the profile index requirement to a profile index no greater than 12 in./mile (200 mm/km). Prevent individual bumps from exceeding 0.2 in. (5 mm) from the blanking band. Use equipment specified in Section 431.

12. Correct 100 ft. (30 m) bridge approach sections that do not meet the profile index requirement.

a. Grind according to Section 431.

b. If appropriate, use a bump grinder to correct bumps with a baseline of 5 ft. (1.5 m) or less.

c. Grind the full lane width even when grinding including individual bumps.

d. Retest pavement segments containing corrective slab replacements for Final Acceptance.

13. Correct segments that do not meet the profile index criteria of this specification at no additional expense to the Department. Retest segments after correction with the Rainhart Profilograph.

14. Notify the Engineer before profile testing. The Engineer will verify the results by randomly selecting a minimum of 1 out of every 10 consecutive record segment profiles to compute the profile index and to compare with Contractor results.

The Engineer may conduct profilograph tests at any time to verify Contractor results. The Department may test record segments if the Engineer determines that the Contractor test results are inaccurate. See Subsection 430.5.01, *Adjustments*.

H. Thickness

The Engineer shall determine the pavement thickness using average core measurements tested according to GDT 31.

The following table contains units for paving widths:

Paving Widths – Feet (meters)	Length of Unit (Bridges Excluded)—Feet (meters)
0 – 24.0 (0 – 7.2)	1000 (300)
24.1 – 36.0 (7.2 – 10.8)	750 (225)
36.1 – 48.0 (10.8 – 14.4)	500 (150)

Areas of equal depth in intersections, entrances, crossovers, ramps, etc. are considered one unit, and the thickness of each unit is determined separately. If appropriate, include small irregular areas as part of another unit.

15. Take one core for each 2,000 yd^2 (1675 m^2) of pavement, or fraction of pavement, in each unit where the Engineer selects.

The Department will take one core at random in each unit.

a. When the core measurement is deficient 0.2 in. (5 mm) or less from the plan thickness, full payment is made.

b. When the measurement is deficient more than 0.2 in. (5 mm) and not more than 1 in. (25 mm) from the plan thickness, two additional cores are secured from the unit and used to determine the average thickness.

c. A random selection process determines where to secure additional cores. However, do not secure cores within 50 ft. (15 m) of other thickness measurement cores. The adjusted Unit Price in Subsection 430.5.01.A, *Concrete Pavement Thickness Deficiency* is used to determine payment for the unit.

16. Consider pavement more than 0.2 in. (5 mm) thicker than the specified thickness to be the specified thickness plus 0.2 in. (5 mm). Measurements more than 1 in. (25 mm) less than the specified thickness are not included in the average.
17. When the core measurement is at least 1 in. (25 mm) less than the specified thickness:
    a. Determine the pavement thickness in the affected location by taking additional cores at no less than 10 ft. (3 m) intervals parallel to the center line in each direction.
    b. Continue until a core is found that is not deficient by more than 1 in. (25 mm).
    c. Have the Engineer evaluate areas more than 1 in. (25 mm) deficient in thickness. Remove deficient areas and replace with concrete pavement of the thickness shown on the plans, if the Engineer requires.

    Exploratory cores for deficient thickness are not used in averages for adjusted Unit Price.

430.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

430.4 Measurement

The area that will be paid for under this Item is the number of square yards (meters) of concrete pavement accepted as measured complete in place. The pavement width measured is shown on the typical cross section of the plans, including additional widening as required or widening directed in writing by the Engineer.

The length is measured along the pavement surface.

Work is accepted lot-to-lot according to Section 106 and this specification.

430.4.01 Limits

General Provisions 101 through 150.

430.5 Payment

Concrete pavement completed and accepted that meets the Specification requirements will be paid for at the full Contract Unit Price per square yard (meter).

Payment for other accepted concrete pavement will be based on an adjusted Unit Price per square yard (meter). This price will be adjusted for payment for concrete pavement accepted but deficient in depth or compressive strength at 28 days. Price adjustments are specified in Subsection 430.5.01, *Adjustments*.

No additional payment over the Contract Unit Price will be made for pavement units with an average thickness greater than on the Plans. No additional payment over the Contract Unit Price will be made for a lot of concrete that develops more strength at 28 days than the compressive strength established in Subsection 430.3.06.F, *Concrete Strength Acceptance*.

Payment is full compensation for furnishing and placing materials, reinforcements, dowel and joint materials, supplies, and incidentals to complete the work.

Payment will be made under:

Item No. 430	Plain Portland cement concrete pavement, class no. 1 concrete ______ in (mm) thick	Per square yard (meter)
Item No. 430	Plain Portland cement concrete pavement class no. 2 concrete _____ in (mm) thick	Per square yard (meter)
Item No. 430	Plain Portland cement concrete pavement, class HES concrete _____ in (mm) thick	Per square yard (meter)
Item No. 430	Continuously reinforced concrete pavement, class no. 1 concrete ______ in (mm) thick	Per square yard (meter)
Item No. 430	Continuously reinforced concrete pavement, class no. 2 concrete ______ in (mm) thick	Per square yard (meter)
Item No. 430	Continuously reinforced concrete pavement, class HES concrete ______ in (mm) thick	Per square yard (meter)

430.5.01 Adjustments

The Contract Unit Price per square yard (meter) of concrete pavement will be adjusted for concrete pavement accepted but deficient in thickness or compressive strength at 28-days. Adjusted Unit Prices per square yard (meter) of concrete pavement are based on one or both of the following conditions:

A. Concrete Pavement Thickness Deficiency

1. If the core is deficient 0.2 in. (5 mm) or less from the plan thickness, full payment will be made. If the core is deficient in thickness more than 0.2 in. (5 mm), but not more than 1 in. (25 mm) from the Plan thickness, 2 additional cores will be taken from the area.
    a. If the average measurement of these 3 cores is deficient 0.2 in. (5 mm) or less from the plan thickness, full payment will be made.
    b. Where the average pavement thickness is deficient by more than 0.2 in. (5 mm), but not more than 1 in. (25 mm), payment will be made at a portion of the Unit Price per square yard (meter) of concrete pavement as shown in the following table:

Concrete Pavement Deficiency	
Deficiency in Thickness Determined by Cores–in. (mm)	**Proportional Part of Contract Price Allowed**
0.0 through 0.20 (0.0 through 5.0)	100 percent
0.21 through 0.25 (5.1 through 6.4)	95 percent
0.26 through 0.30 (6.5 through 7.6)	91 percent
0.31-0.40 (7.7 through 10.0)	86 percent
0.41-0.50 (10.1 through 12.8)	80 percent
0.51-0.75 (12.9 through 19.2)	70 percent
0.76-1.00 (19.3 through 25.0)	60 percent

c. When the thickness of pavement is deficient by more than 1 in. (25 mm) and the Engineer determines that the deficient area should not be removed or replaced, 50 percent of the Contract Unit Price will be paid.

2. No payment or compensation for cost will be made for removing concrete according to this provision.

B. Compressive Strength Deficiency

When the compressive strength at 28-days, expressed as an average strength (X) for a lot of concrete pavement is less than the values established by the Pay Factor Table, payment will be made at a reduced Unit Price per square yard (meter) as shown in the Pay Factor Table.

C. Combined Deficiencies

When a pavement section is deficient in thickness and compressive strength, the Contract Unit Price will be adjusted by the total reduction from applying the percentages in Subsections 430.5.01.A and Subsection 430.5.01.B, above.

For combined deficiencies of 50 percent or more, the Engineer may leave the pavement in place at the combined payment reduction or order the deficient areas removed and replaced at no additional cost to the Department.

If the Engineer orders removal of the pavement, payment will not be made for the original pavement or removal. Pavement replaced will be paid for at the appropriate Unit Price.

D. Profilograph Testing

If, based on the Department’s profilograph tests, the Engineer determines that the Contractor profilograph test results are inaccurate, the Contractor will be charged for profilograph testing at $1500 for each trace mile ($750 for each trace kilometer), with a minimum charge of $1500.

Section 439—Portland Cement Concrete Pavement (Special)

Replace Section 439 with the following:

439.1 General Description

This work includes constructing pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or subbase course.

Follow the requirements of these Specifications and conform with the lines, grades, thicknesses, and typical cross-sections shown on the Plans or established by the Engineer.

439.1.01 Definitions

General Provisions 101 through 150.

439.1.02 Related References

A. Standard Specifications

Section 152—Field Laboratory Building

Section 430—Portland Cement Concrete Pavement

Section 431—Grind Concrete Pavement

Section 461—Sealing Roadway and Bridge Joints and Cracks

Section 500—Concrete Structures

Section 800—Coarse Aggregate

Section 801—Fine Aggregate

Section 830—Portland Cement

Section 831—Admixtures

Section 832—Curing Agents

Section 833—Joint Fillers and Sealers

Section 853—Reinforcement and Tensioning Steel

Section 880—Water

Section 886—Epoxy Resin Adhesives

B. Referenced Documents

AASHTO T 126

AASHTO T 22

AASHTO T 23

ASTM C 94, Requirements for Uniformity

GDT 26

GDT 27

GDT 28

GDT 32

GDT 72

GDT 78

SOP 34

439.1.03 Submittals

A. Profilograph Certification

Before paving, ensure that the profilograph and operator are certified by the Office of Materials and Research in accordance with Standard Operating Procedure No. 34, Certification of Contractor Personnel and Equipment for Smoothness Testing of Portland Cement Concrete Pavement with the Rainhart Profilograph. Certification includes a mechanical check of the profilograph functions and a written examination by the operator.

Request certification in writing to the Office of Materials and Research at least two weeks before it is needed.

B. Report Form

Refer to Subsection 439.3.06.L, *Smoothness Testing* for report form and submittal requirements.

C. Concrete Design

Submit for approval a concrete design prepared by a testing laboratory approved by the Office of Materials and Research. The Contractor will transmit the design to the Engineer for approval at least 35 days before use.

Or, submit for approval concrete mix proportions with commonly used materials without preparation by a laboratory. The Office of Materials and Research may approve proportions based upon the past performance of the material combination.

439.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Portland cement	830.2.01
Portland Pozzolan cement	830.2.03
Water	880.2.01
Fine Aggregate, Size No. 10	801.2.02
Coarse Aggregate, Class A or B Crushed Stone or Gravel, Sizes as Specified	800.2.01
Steel Bars for Reinforcement	853.2.01
Steel Wire for Concrete Reinforcement	853.2.06
Welded Steel Wire Fabric for Concrete Reinforcement	853.2.07
Dowel Bars and Bar Coatings	853.2.08
Curing Agents	832
Air Entraining Admixtures	831.2.01
Fly Ash and Slag	831.2.03
Joint Fillers and Sealers	833
Low Modulus Silicone Sealant for Roadway Construction Joints	833.2.06
Epoxy Adhesive for Repairing Cracks	886.2.01
Chemical Admixtures	831.2.02

A. Fly Ash

Fly ash may be used as a concrete additive to promote workability and plasticity. Use it as a partial replacement for Portland cement in concrete, but follow these limits:

1. Do not replace the cement quantity more than 15 percent by weight.
2. Replace cement with fly ash at the rate of 1.25 to 2.0 lbs. (1.25 to 2.0 kg) of fly ash to 1 lb. (1.0 kg) of cement.
3. Ensure that the fly ash mix conforms to Subsection 430.3.06, *Quality Acceptance.*
4. Do not use Type IP cement in fly ash mixes.

B. Granulated Iron Blast-Furnace Slag

If high early strengths are not desired, use granulated slag as a partial replacement for Portland cement in concrete. Follow these limits:

1. Replace the quantity of cement 50 percent or less by weight if the 5-day forecast of the National Weather Service expects temperatures higher than 60 °F (15 °C).
    a. If the 5-day expected low temperature is less than 60 °F (15 °C) but not less than 40 °F (4 °C), replace the quantity of cement 30 percent or less by weight.
    b. If the 5-day expected low temperature is less than 40 °F (4 °C); do not use granulated slag.
2. Replace cement with slag at the rate of 1 lb. (1.0 kg) of slag to 1 lb. (1.0 kg) of cement.
3. Ensure that the granulated slag mix conforms to Subsection 430.3.06, *Quality Acceptance.*
4. Do not use Type IP cement or fly ash in slag mixes.

C. Composition of Concrete

Design the concrete mix to conform to the following requirements:

1. Coarse Aggregate

   Use coarse aggregate size No. 467, 67, or 57 for plain Portland Cement concrete pavement.

   Use size No. 67 or 57 coarse aggregate for continuous reinforced concrete pavement.

   Separate size No. 467 or 456 in individual stockpiles of size No. 4 and size No. 67. Blend according to approved mix proportions.

2. Fine Aggregate

   Use fine aggregate that meets the requirements for size No. 10.

   When using two sizes or sources of fine aggregate to produce the proper gradation, blend according to the approved design proportions.

439.2.01 Delivery, Storage, and Handling

Store fine aggregate from different sources in different stockpiles.

439.3 Construction Requirements

439.3.01 Personnel

A. Certified Operator

Before paving, have the Office of Materials and Research certify a profilograph equipment operator. Certification includes a written examination by the operator.

439.3.02 Equipment

A. Equipment Requirements

Provide equipment and tools to perform the work. Provide equipment that allows the paver to operate at a constant production rate and minimizes starting and stopping. The Engineer may limit the production rate or batch size if equipment does not keep pace with the other operations or causes poor workmanship.

B. Ramp Screeds and Hand Finishing Tools

Ramp screeds and hand finishing tools may be used instead of conventional mainline paving equipment.

C. Scales

Before use, the Engineer will inspect and approve the scales to weigh concrete materials and the devices to measure water. Tolerances are ± 1.0 percent throughout the operating range. Measure admixtures to ± 3.0 percent.

D. Protective Equipment

Provide materials to protect the concrete edges and surface against rain, including:

- Standard metal forms or wood planks to protect the pavement edges
- Covering material such as burlap or cotton mats, curing paper, or plastic sheeting material to protect the pavement surface

E. Auxiliary Vibrator

Keep one auxiliary vibrator available in case of mechanical malfunctions.

F. Texturing Equipment

Ensure that the tines on the equipment:

- Are the same size and length and are rectangular shaped

- Have approximately 0.5 in (13 mm) of space between them
- Are between 1/16 in and 1/8 in (2 mm and 3 mm) wide

439.3.03 Preparation

A. Prepare the Roadbed

Prepare the roadbed as required by the Plans and Specifications before placing concrete pavement.

B. Observe Condition of Subgrade and Subbase

Check the subgrade and subbase as follows:

1. Prepare the full width of the subgrade and subbase according to the Plans and Specifications.
2. Ensure that the surface immediately under the concrete pavement allows proper pavement thickness and yield.
3. Trim high areas to the proper elevation.
4. Ensure that the subbase can support paving equipment without rutting or bogging.

439.3.04 Fabrication

General Provisions 101 through 150.

439.3.05 Construction

A. Set Forms

Set the forms as follows:

1. Compact the foundation under the forms true to grade. Set the form so that it firmly contacts the foundation for the entire length at the specified grade.
2. Prevent the forms from settling or springing under the finishing machine.
3. Clean and oil the forms before placing the concrete.

B. Place Concrete

After depositing the concrete on the grade, avoid rehandling it. Unload and place it as follows:

1. Unload the concrete into an approved spreading device and mechanically spread it on the grade.
2. Place the concrete continuously between transverse joints without using intermediate bulkheads.
3. Perform any necessary hand spreading of concrete with shovels, not rakes.

NOTE: Do not allow personnel to walk in freshly mixed concrete with shoes coated with dirt or other materials.

4. Thoroughly consolidate the concrete on both sides of joint assemblies.
5. Ensure that vibration does not cause puddling or grout accumulation on the surface.

   For construction or expansion joints, do not use grout that accumulates ahead of the paver.
6. Deposit concrete near the formed joints. Do not dump or discharge concrete on a joint assembly unless the concrete is centered on the joint assembly.
7. Keep reinforcing steel free of dirt, oil, paint, mill scale, and loose or thick rust that could impair the bond of the steel to the concrete.

C. Consolidate and Finish

Ensure that the sequence of operations is continuous from placement to final finish.

1. Consolidation

   Perform vibration for the full width and depth of the pavement as follows:

   a. Do not allow the vibrators to misalign load transfer devices or contact forms or the foundation.

   b. Ensure that the operating frequency is within these ranges.

      Use spud vibrators with an operating frequency of at least 7,000 vibrations per minute.

      Use tube vibrators with an operating frequency of at least 5,000 vibrations per minute.

      Use surface pan vibrators with an operating frequency of at least 3,500 vibrations per minute.

   c. Use hand-held vibrators if needed.

      Ensure that the operating frequency is at least 4,500 vibrations per minute. The intensity shall be sufficient to affect the mass of concrete having a 1 in. (25 mm) slump through a radius of at least 18 in. (450 mm).

   d. Obtain uniform consolidation and density throughout the pavement.

      If the pavement is not uniform, stop the operation and provide methods or equipment that will produce pavement that conforms to the Specifications.

   e. Keep a standby vibratory unit available in case a primary unit malfunctions.

2. Finishing

   After striking off and consolidating the concrete, follow these steps:

   a. The concrete may be smoothed and trued using a hand float.

   b. Ensure that the surface within 6 in. (150 mm) of the pavement edge shows no more than a ¼ in. (6 mm) deviation in 10 ft. (3 m) when tested with a 10 ft. (3 m) straightedge in both transverse and longitudinal directions.

   c. Ensure that mainline riding surface produces a profile index value of less than 7 in./ mile (100 mm/km) on each travel lane.

D. Protection from Rain

Protect the unhardened concrete from rain. See Subsection 439.3.02.D, *Protective Equipment.*

When rain is imminent, stop paving operations and place forms against the sides of the pavement. Cover the surface of the unhardened concrete with the protective covering.

E. Remove Forms

Remove forms from in-place concrete after it has set for at least 12 hours, unless otherwise provided.

1. Remove forms carefully to avoid damaging the pavement.
2. After removing the forms, immediately cure the sides of the slab using the same method used to cure the pavement surface.
3. Remove and replace major honeycombed areas.

F. Work at Night

Provide adequate lighting for work performed at night. If lighting will not be provided at night, stop the concreting operation in time to finish and saw during daylight hours.

G. Provide Joints

Ensure that joints are designed, configured, and located as shown on the Plans or required by the Specifications.

1. At the Engineer's discretion, remove and replace plain concrete pavement that cracks during construction with no additional cost to the Department.
2. When chipping out random cracks for sealing, use nonrigid epoxy that meets Subsection 886.2.01 on cracks that are not under expansion-contraction influence.

3. Seal continuous cracks under movement with sealant that meets Subsection 833.2.06.
4. When removing and replacing a pavement section, replace an area at least 6 ft. (1.8 m) long and the full width of the lane.
   a. Saw to vertical face the sections to be removed and replace the concrete as a construction joint with dowels.
   b. Use deformed bars as dowels in the saw-cut construction joint. Use the size specified for contraction joints in the Plans.
5. Thoroughly clean the drilled holes of contaminants and set the dowels into the hardened concrete face of the existing pavement with a Type VIII epoxy bonding compound. See Section 886 for epoxy bonding compound requirements.
6. For contraction joints, undamaged and properly positioned dowels may be used in existing construction or slab replacement areas. Coat the protruding dowel portions with a thin film of heavy grease.
7. When both sides of an existing construction or contraction joint require slab replacements, slabs may be replaced continuously from saw-cut construction joint to saw-cut construction joint. Use dowels specified for contraction joints.
8. Before placing concrete, uniformly apply a thin coat of heavy grease to epoxy-coated dowels.
9. When placing slabs continuously across transverse contraction joint locations, use saw-cuts to provide planes of weakness according to the requirements of this Specification and the GDOT construction standard for contraction joints.
10. Seal the joints according to the Plans.

H. Determine Types of Joints

1. Longitudinal Joints

   Longitudinal joints shall contain unpainted and uncoated deformed steel bars that are the size and length specified on the Plans.

   Place the bars perpendicular to the joint using a mechanical device, or rigidly secure the bars in place with supports.
2. Longitudinal Formed Joints

   Construct longitudinal formed joints while the concrete is in a plastic state.

   Use methods and equipment that locates the joint reinforcement properly without disrupting it during construction.
3. Longitudinal Sawed Joints

   Cut longitudinal sawed joints with a mechanical saw within three days after the concrete is placed and before traffic or equipment enters the pavement.
4. Transverse Joints

   Transverse joints consist of construction joints, contraction joints, or expansion joints constructed at required locations.
   a. Construct transverse joints in partial width or adjoining lanes to abut the same joint of adjacent lanes unless otherwise specified on the Plans.
   b. Ensure that transverse joints in plain Portland Cement concrete requiring load transfer devices contain either plastic-coated or epoxy-coated dowels.
   c. Before placing concrete, secure dowel bars in place with supporting assemblies.
   d. Secure the assemblies in position on the subbase to keep the dowels from moving during concrete placement.

e. Place dowel bars to a vertical and horizontal tolerance of ± 1 in. (± 25 mm) of the Plan position. Do not misalign the dowel bar more than 3/8 in. per foot (10 mm per 300 mm) in the horizontal or vertical plane.

f. Remove and replace dowel assemblies displaced from the Plan position more than the tolerances in Subsection 430.3.05.J, *Provide Joints.*

g. When using epoxy-coated dowels, coat the entire surface with a thin film of heavy waterproof grease.

h. Ensure accurate positioning of transverse sawed joints by marking the position of dowel bar assembly locations.

5. Construction Joints

Construct transverse construction joints when interrupting concreting operations for more than one hour.

NOTE: Do not construct transverse construction joints within 10 ft. (3 m) of an expansion joint, contraction joint, or transverse plane of weakness.

a. Move an unanticipated construction joint back to the last Plan joint and remove and dispose of excess concrete.

b. Form construction joints by securing in place a removable bulkhead or header board.

1) Place the board so that it conforms to the full cross section of the pavement. Secure it flush with the subbase and parallel to the normal transverse joints.

2) Slot or drill the board to allow placement of reinforcement as required by the Plans.

NOTE: Do not use the roll of laitance and grout that forms in front of the paver adjacent to transverse construction joints.

c. Consolidate to full width and depth concrete adjacent to transverse construction joints with mechanical hand-type spud vibrators. Keep one auxiliary vibrator available in case of mechanical malfunctions.

d. Before applying the final finish to the concrete, stringline and correct variations of the concrete surface within 30 ft. (9 m) on either side of the transverse construction joints. Provide equipment and tools such as:

Work bridges

Personnel

String lines

Straightedges

Lighting

e. While the concrete is in a plastic condition, stringline the surface longitudinally and correct surface deviations greater than 1/8 in. in 15 ft. (3 mm in 4.6 m) in any direction.

f. When using Plain Portland cement concrete pavement, place dowel bars in construction joints. Cast half the length of each dowel bar in the concrete during each phase of joint construction.

g. After the concrete has hardened, dismantle the bulkhead supporting the dowels. Do not disturb the dowels.

h. When using epoxy coated dowels, coat the protruding half of each dowel bar with a thin film of heavy waterproof grease before resuming joint construction. Grease coating is not required on plastic coated dowels.

6. Contraction Joints

Create planes of weakness in plain Portland cement concrete pavement by cutting joints in the pavement surface. Create the planes according to the Plans and as follows:

a. Saw transverse contraction joints before the pavement cracks. Begin sawing when the concrete has hardened enough to prevent surface raveling, usually 4 hours after placement but no more than 24 hours.

b. Continue sawing day and night regardless of weather conditions.

7. Expansion Joints

Transverse expansion joints are required at locations shown on the Plans.

a. Form expansion joints by securing a removable bulkhead that conforms to the full cross section of the pavement. Use bulkheads that can construct a vertical expansion wall without offsets, indentations, or burrs.

b. Use expansion joint filler required by the Plans.

c. Furnish and install preformed joint filler in lengths equal to the pavement width or the width of one lane. Do not use damaged or repaired joint fillers.

d. Position the expansion joint filler vertically in the joint and at the proper grade. Use an installing bar or other device to secure the expansion joint filler at the proper grade and alignment.

I. Seal the Joints

Clean and seal the joints according to Section 461 and the Plans.

Immediately after completing the curing period, fill in the joints with joint sealing material before opening the pavement to traffic.

J. Cure the Concrete

Immediately after finishing the concrete, cure the entire surface when the concrete will not mar. Use one or more of these methods:

1. Impervious Membrane Method

To use this method:

a. Spray the entire surface of the pavement with white pigmented curing compound immediately after finishing the surface and before the concrete has set.

If the pavement is cured initially with cotton mats, burlap, or cotton fabric, apply the compound after removing the mats.

NOTE: Do not apply curing compound during rain.

b. Use mechanical sprayers to apply curing compound under pressure at a minimum rate of 1 gal per 150 $ft.^2$ (1 L per 3.5 m^2).

Use fully atomizing spraying equipment that is equipped with a tank agitator.

c. Thoroughly mix the curing compound immediately before use.

d. During application, use a mechanical device to stir the compound continuously.

e. If required, use a hand sprayer to spray odd widths, odd shapes, and concrete surfaces exposed by removing forms.

f. Do not apply curing compound to the inside faces of joints to be sealed.

g. If the membrane film becomes damaged within the curing period, repair the damaged portions immediately with additional compound.

2. White Polyethylene Sheeting

To use this method:

a. Cover the top surface and sides of the pavement with polyethylene sheeting. Lap the units at least 18 in (450 mm).

b. Place the sheeting and weigh it down so that it contacts the surface.

c. Extend the sheeting beyond the edges of the slab at least twice the thickness of the pavement.

d. Unless otherwise specified, maintain the covering in place for 72 hours after placing the concrete.

3. Burlap, Cotton Fabric, or Other Methods

Contractors may cure the pavement surface with burlap, cotton fabrics, or other materials if the section remains wet for the duration specified by the Engineer.

4. Cold Weather Curing

To use this method:

a. Remove and replace concrete that freezes before the initial set time at no additional cost to the Department.

b. Use polyethylene or canvas to protect concrete that has set but is exposed to freezing temperatures within 24 hours of placement. Ensure that the internal concrete temperature is above freezing for at least 24 hours after placing the concrete.

c. Obtain approval from the Engineer to use other protection methods such as hay, straw, or grass, or to change the duration of the protection.

K. Open Pavement to Traffic

Wait to open the pavement slab to traffic, except for joint sawing vehicles, until the concrete is 14 days old unless representative compressive tests show that the slab has a compressive strength of 2,500 psi (15 MPa).

Prevent pavement slab stress by constructing a ramp of compacted earth or other material to move on and off the pavement. Do not allow equipment that exceeds legal load limits on the pavement.

Protect the pavement against traffic from the public, employees, and agents.

1. Erect and maintain barricades. Employ watchmen to block traffic from the newly constructed pavement for the period required in this Specification.
2. Arrange the barriers away from public traffic on lanes remaining open.
3. Maintain signs that clearly indicate the lanes open to public traffic.
4. If traffic must go across the pavement, construct crossings satisfactory to the Engineer to bridge over the concrete. Construct the crossing without additional compensation.
5. Repair or replace pavement damaged by traffic or other causes before Final Acceptance without additional compensation. Make repairs to the Engineer’s satisfaction.

439.3.06 Quality Acceptance

The typical section sheet in the Plans specifies concrete classifications for specific uses.

This Specification establishes minimum requirements for these concrete classifications for concrete design approval, concrete mix design proportions, batching control responsibilities, and acceptance of hardened concrete based upon compressive strength development.

Produce Portland cement concrete by combining proportions of approved materials in batches according to the construction methods specified in this Specification.

Mix concrete produced in a stationary central mix plant for at least 60 seconds after the materials enter the drum. Mix time may be reduced if the representative tests show that the concrete meets requirements of ASTM C 94, Requirements for Uniformity. Never mix less than 50 seconds.

A. Transit Mixed Concrete

Ensure that transit mixed concrete meets the requirements of Subsection 500.3.04.E.3, *Transit-Mixed Concrete.*

B. Mix Design Criteria

Proportion concrete mix designs using the following requirements:

	Minimum Cement per Cubic Yard Concrete (CWT)	Maximum Water-Cement Ratio (lbs./lb.)	Design Air Content Range (%)	Minimum Compressive Strength at 28 Days (psi)
Class 3	5.64	0.53	4.0 to 5.5	3,000
Class HES	6.58	0.47	4.0 to 5.5	3,500

	Minimum Cement per Cubic Meter Concrete (kg)	Maximum Water-Cement Ratio (kg/kg)	Design Air Content Range (%)	Minimum Compressive Strength at 28 Days (MPa)
Class 3	335	0.53	4.0 to 5.5	20
Class HES	390	0.47	4.0 to 5.5	25

C. Compressive Strength

Prepare and test at least 6 cylinders according to AASHTO T 126 and T 22 to ensure that the demonstrated laboratory compressive strength at 28 days for Class 3 concrete is at least 4,000 psi (30 MPa), and the minimum laboratory compressive strength for Class HES concrete is 3,000 psi (20 MPa) at 72 hours.

D. Field Adjustments on Concrete Mixes

Determine the aggregate surface moisture and apply free moisture corrections to the approved mix design. The Engineer will verify that the corrections are made properly.

Adjustment may be made to the approved proportions of the fine and coarse aggregate and water provided:

- The cement factor is not decreased.
- The water-cement ratio is not increased.
- Adjustments produce concrete proportions according to this Specification.
- The Engineer is notified before use.

E. Concrete Mix Tolerances

Ensure that concrete consistency and air content is maintained within the following limits:

1. Consistency
   Immediately before placement, use GDT 27 to determine concrete slump. Do not use concrete for Portland cement concrete pavement with a slump value greater than 3.5 in. (90 mm).
2. Air Content
   Immediately before placement, use GDT 26, GDT 28, or GDT 32 to determine the air content of the concrete. Concrete will not be accepted that has an air content outside of the following limits:

Lower acceptance limit	3.0%
Upper acceptance limit	6.5%

F. Concrete Strength Acceptance

1. Class 3

   Portland cement concrete pavement strength will be accepted based on compressive strength development at 28 days. The compressive strength value shall be at least 3,000 psi (20 MPa).

   a. Fabricate and cure specimens for field acceptance according to AASHTO T 23.

   b. After curing, the OMR will test the cylinders according to AASHTO T 22. The test frequency is outlined in the Department's Sampling and Testing information.

2. Class HES

   High early concrete strength pavement may be accepted based on compressive strength development at 72 hours. The compressive strength value shall be at least 3,000 psi (20 MPa).

   When concrete is defective based on the 72-hour strength test and the concrete is retained for acceptability judgment, acceptance will be based on test results conducted at 28 days. The acceptance strength value shall be at least 3,500 psi (25 MPa).

   a. Cure specimens fabricated for 72-hour strength for 72 hours under conditions that are similar to those under which the pavement will be cured.

   b. Cure specimens fabricated for 28-day evaluation per AASHTO T 23.

   c. Test all specimens per AASHTO T 22.

G. Depth Measurement

The Engineer will designate pavement areas to be examined for depth measurement compliance with the Plan and Specifications.

Remove and replace areas deficient more than 1/4 in. (6 mm). The Engineer may require a reduction in payment. Correct deficiencies in slab depth as directed by the Engineer.

H. Final Finish

Ensure that the final finish produces a pavement surface that is true to grade, uniform, and free of irregular, rough, or porous areas.

Produce the final surface finish using mechanical or hand-operated equipment to groove the plastic concrete. Use texturing equipment with rectangular-shaped spring steel tines.

I. Texture Depth Testing

Test the pavement surface to determine the texture depth by using GDT 72 at locations selected by the Engineer.

Transversely saw-groove areas that have a surface texture depth less than 0.02 in. (0.5 mm). Ensure that the areas meet the average depth requirement of 0.04 in. (0.9 mm) or greater. Saw-groove the areas to meet these dimensions:

- Width—1/8 in. (3 mm)
- Depth—3/16 in. (5 mm)
- Spacing—3/4 in. center-to-center (19 mm)

J. Smoothness Profile

Include in the Contract Unit Bid Price the cost to furnish and operate a Rainhart (Model 860) Profilograph to measure pavement profile deviations.

Measure and correct pavement profile deviations as follows:

1. Ensure that the mainline riding surface produces a profile index value no greater than 7 in./mile (100 mm/ km) on each travel lane. Conduct tests according to GDT 78.

   Determine a profile index value for each tracing in each ¼ mile (0.5 km) segment.

2. Correct individual bumps or depressions that exceed the blanking band by more than 0.2 in. (5 mm) at no additional expense to the Department.
3. Suspend paving operations if a profile index value exceeds 7 in./mile (100 mm/km) per lane for any segment. Take corrective action approved by the Engineer.
4. Test ramps, acceleration lanes, and deceleration lanes using GDT 78 to ensure that the average profile index value does not exceed 12 in./mile (200 mm/km) for the entire section length.
5. Correct individual bumps or depressions that exceed 0.2 in (5 mm) from the blanking band at no additional expense to the Department.
6. Take pavement profiles 4 ft. (1.2 m) from and parallel to the new pavement edges for pavements greater than 16 ft. (4.8 m) wide and up to 24 ft. (7.2 m) wide. Test pavement 6 to 16 ft. (1.8 to 4.8 m) wide parallel to and at the center line of the pavement section.
7. Begin the 0.25 mile (0.5 km) record segments at the first day's placement and continue until project completion, except as noted in this Specification.

   Combine pavement sections less than 650 ft. (200 m) approaching a bridge with the previous 0.25 mile (0.5 km) segment to determine the profile index.
8. Calculate as separate record segment sections 650 ft. (200 m) or greater approaching a bridge and sections at Project limits.
9. Determine a separate profile index value according to GDT 78 for the 100 ft. (30 m) of roadway approaching each end of a bridge, up to and including the joint with the approach slab.

   Average the profile index from the right and left wheelpaths for each 100 ft. (30 m) segment for each lane for each approach. Ensure that the average profile index value is no greater than 30 in./mile (500 mm/ km).
10. Notify the Engineer before profile testing. The Engineer will verify the results by randomly selecting at least 1 out of every 10 consecutive record segment profiles to compute the profile index and to compare with Contractor results.

K. Pavement Tolerances

For Projects that include weigh-in-motion truck scales, follow these pavement tolerances:

1. Ensure that the Rainhart Profilograph readings do not exceed 5 in/mile (80 mm/km) in the 600 ft. (180 m) approach to the scales and the 200 ft. (60 m) beyond the scales.
2. Ensure that the rolling straightedge measurements show no deviation greater than 1/16 in. (2 mm) within 10 ft. (3 m).

L. Smoothness Testing

Perform smoothness testing as follows:

1. Perform and evaluate profiles from the first day of placement before continuing paving.

   When the test run is complete and evaluated, the Engineer may require equipment adjustments to improve smoothness before paving continues.
2. Complete the report form furnished by the Engineer and attach it to each day's profilograph tracings. Include the following information in each trace:
   - Project number
   - Beginning and ending station numbers
   - 500 ft. (150 m) paving stations
   - Traffic direction
   - Lane number
   - Date paved and tested

- Construction joint locations

3. Have the certified profilograph operator obtain and evaluate traces to be submitted to the Engineer. Provide results no later than the end of the second work day following placement.
4. For mainline pavement, correct 0.25 mile (0.5 km) segments that do not meet the profile index requirement by using one of these methods:
   a. Grind the entire lane surface of the 0.25 mile (0.5 km) segment to a profile index value no greater than 7 in./mile (100 mm/km). Use equipment that meets the requirements in Section 431.
   b. Grind roughness in small segment areas no more than 50 ft. (15 m) of full lane width to produce a profile index value no greater than 7 in./mile (100 mm/km).

      If more than 50 ft. (15 m) of grinding is required, grind the complete 0.25 mile (0.5 km) segment according to Method a, above.
5. Correct ramps and acceleration and deceleration lanes that do not meet the profile index requirement to a profile index no greater than 12 in./mile (200 mm/km). Prevent individual bumps from exceeding 0.2 in. (5 mm) from the blanking band. Use equipment specified in Section 431.
6. Correct 100 ft. (30 m) bridge approach sections that do not meet the profile index requirement.
   a. Grind according to Section 431.
   b. Use a bump grinder to correct bumps with a baseline of 5 ft. (1.5 m) or less.
   c. Grind the full lane width even when grinding individual bumps.
   d. Retest pavement segments containing corrective slab replacements for Final Acceptance.
7. Correct segments that do not meet the profile index criteria of this Specification at no additional expense to the Department. Retest segments after correction with the Rainhart Profilograph as specified.
8. The Engineer may conduct profilograph tests at any time to verify Contractor results. The Department may test record segments if the Engineer determines that the Contractor test results are inaccurate. If this occurs, see Subsection 439.5.01, *Adjustments.*

M. Acceptance

Pavement smoothness will accepted when:

- The Engineer determines that the work was satisfactorily performed according to the Specifications.
- The completed pavement, including corrective Work, meets the applicable profile index value requirements.

439.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

439.4 Measurement

Portland cement concrete pavement (special) complete, in-place and accepted, is measured by the square yard (meter).

439.4.01 Limits

General Provisions 101 through 150.

439.5 Payment

Concrete pavement completed and accepted will be paid for at the full Contract Unit Price per square yard (meter).

Payment is full compensation for furnishing and placing materials, reinforcements, dowels, joint materials, supplies, and incidentals to complete the work.

Payment will be made under:

Item No. 439	Plain Portland cement concrete pavement, Class 3	Concrete _____ in. (mm) thick	Per square yard (meter)
Item No. 439	Plain Portland cement concrete pavement, Class HES	Concrete _____ in. (mm) thick	Per square yard (meter)
Item No. 439	Continuously reinforced concrete pavement, Class 3	Concrete _____ in. (mm) thick	Per square yard (meter)
Item No. 439	Continuously reinforced concrete pavement, Class HES	Concrete _____ in. (mm) thick	Per square yard (meter)

439.5.01 Adjustments

A. Profilograph Tests

If based on the Department’s profilograph tests, the Engineer determines that the Contractor profilograph test results are inaccurate, the Contractor will be charged for profilograph testing at $1500 for each trace mile ($750 for each trace kilometer) with a minimum charge of $1500.

Section 500—Concrete Structures

Replace Section 500 with the following:

500.1 General Description

This work consists of manufacturing and using Portland cement concrete to construct structures. See the Contract Plans for the specified color and locations for placing integrally colored concrete.

500.1.01 Definitions

General Provisions 101 through 150.

Self-Consolidating Concrete (SCC): a highly workable concrete that can flow through dense reinforcement under its own weight and adequately fill voids without segregation or excessive bleeding and without the need for vibration.

High Performance Self-Consolidating Concrete (HPC-SCC): a highly workable concrete, using High Performance cement, that can flow through dense reinforcement under its own weight and adequately fill voids without segregation or excessive bleeding and without the need for vibration.

500.1.02 Related References

A. Standard Specifications

Section 104—Scope of Work

Section 211—Bridge Excavation and Backfill

Section 431—Grind Concrete Pavement

Section 507—Prestressed Concrete Bridge Members

Section 511—Reinforcement Steel

Section 530—Waterproofing Fabrics

Section 531—Damp proofing

Section 621—Concrete Barrier

Section 800—Coarse Aggregate

Section 801—Fine Aggregate

Section 830—Portland Cement

Section 831 - Admixtures

Section 836—Special Surface Coating for Concrete

Section 838—Graffiti-Proof Coating for Concrete

Section 853—Reinforcement and Tensioning Steel

Section 865—Manufacture of Prestressed Concrete Bridge Members

B. Referenced Documents

ASTM A 653/653M

ASTM A 924/924M

ASTM C 138

ASTM C 231

ASTM C 1610

ASTM C 1611

ASTM C 1621

ASTM C 1712

ASTM C 1758

ASTM C 685

ASTM C 979

ASTM D 260, Type I or Type II

AASHTO C 309

AASHTO C 171

AASHTO M 85

AASHTO M 240

AASHTO M 194M/M 194

AASHTO R 39

AASHTO R 81

AASHTO T 23

AASHTO T 277

AASHTO T 358

AWS D 1.5

SOP 10

SOP 17

SOP 46

American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members

Federal Specification TT-P-641d, Type II

Georgia Standards 4941B and 4949 Series

QPL 10

QPL 17

QPL 100

GDT 134

DOT 525

500.1.03 Submittals

A. Concrete Mix Designs

The Contractor is responsible for all concrete mix designs. Ensure that concrete mixes contain enough cement to produce workability within the water-ratio specified in Table 1—Concrete Mix Table, below.

Design concrete mixes that meet the requirements of the Table 1—Concrete Mix Table, below. The Office of Materials and Testing will determine the concrete properties using the applicable method in Section 500 of the Sampling, Testing, and Inspection Manual.

TABLE 1—CONCRETE MIX TABLE

English								
Class of Concrete	(2) Coarse Aggregate Size No.	(1 & 6) Minimum Cement Factor lb./yd^3	Maximum Water/ Cement ratio lbs./lb.	(5) Slump Acceptance Limits (in) Lower - Upper		(3 & 7) Entrained Air Acceptance Limits (%) Lower - Upper		Minimum Compressive Strength at 28 days (psi)
"AAA"	67,68	675	0.44	2	4	2.5	6	5000
"AA1"	67,68	675	0.44	2	4	2.5	6	4500
"D"	57, 67	650	0.445	2	4	3.5	7	4000
"AA"	56,57,67	635	0.445	2	4	3.5	7	3500
"A"	56,57,67	611	0.49	2	4	2.5 (3)	6	3000
"B"	56,57,67	470	0.66	2	4	0	6	2200
"CS"	56,57,67 Graded Agg.*	280	1.4	-	3½	3	7	1000 (4)

Metric								
Class of Concrete	(2) Coarse Aggregate Size No.	(1 & 6) Minimum Cement Factor kg/m^3	Maximum Water/ Cement ratio kg/kg	(5) Slump Acceptance Limits (mm) Lower - Upper		(3 & 7) Entrained Air Acceptance Limits (%) Lower-Upper		Minimum Compressive Strength at 28 days MPa)
"AAA"	67,68	400	0.44	50	100	2.5	6	35
"AA1"	67,68	400	0.44	50	100	2.5	6	30
"D"	57,67	385	0.445	50	100	3.5	7	28
"AA"	56,57,67	375	0.445	50	100	3.5	7	25
"A"	56,57,67	360	0.49	50	100	2.5 (3)	6	20
"B"	56,57,67	280	0.66	50	100	0	6	15
"CS"	56,57,67	165	1.4	-	90	3	7	7 (4)
	Graded Agg.*							

NOTES:

1. **Portland cement or Portland-limestone cement (Type IL) may be partially replaced with fly ash as provided in Subsection 500.3.04.D.4 or with granulated iron blast furnace slag as provide for in Subsection 500.3.04.D.5.**
2. **Specific size of coarse aggregate may be specified.**
3. **Lower limit is waived when air entrained concrete is not required.**
4. **The mixture will be capable of demonstrating a laboratory compressive strength at 28 days of 1000 psi (7 MPa) + 0.18 R*. Compressive strength will be determined based upon result of six cylinders prepared and tested in accordance with AASHTO T 22 and R 39.**

   *** Where R = Difference between the largest observed value and the smallest observed value for all compressive strength specimens at 28 days for a given combination of materials and mix proportions prepared together.**
5. **Designed slump may be altered by the Office of Materials and Testing when Type "F" water reducers are used.**
6. **Minimum cement factor shall be increased by 50 lbs/yd^3 (30 kg/m^3) when size No. 7 coarse aggregate is used.**
7. **When Class A is specified for bridge deck concrete, the entrained air acceptance limits shall be 3.5% to 7.0%.**

Submit all concrete mix designs to the Office of Materials and Testing (OMAT) for review. The Department will approve mixes that contain materials from approved sources and produce concrete that meets these Specifications.

Submit concrete mix design proportions for approval by one of the following methods:

1. Request Approval of Specific Proportions

   When requesting approval of specific concrete mix design proportions for classes of concrete, include the following information:

   - Source of each material
   - Apparent specific gravity of the cement and the fly ash, if used
   - Bulk specific gravity (saturated surface dry) of each aggregate
   - Percent absorption of each aggregate
   - Amount of each material required to produce a cubic yard (meter) of concrete
   - Proportions of admixtures per cubic yard (meter) of concrete and any use limitations
   - Proposed slump and air content of the design
   - Evidence that the proposed mixture complies with Subsection 500.1.03, .

   Concrete mix designs that do not have a proven performance record and have not been used by the Department must meet minimum laboratory strength requirements.
2. Obtain Ready-Mix Design Proportions for commonly used materials

   Get approved concrete mix designs from authorized ready-mix concrete plants.

   Ready-mix concrete plants approved according to Laboratory Standard Operating Procedure "Quality Assurance for Ready Mix Concrete Plants in Georgia" (SOP 10) are authorized to submit concrete mix designs for approval. See QPL 10 for a list of approved plants.
3. Use Laboratory-Designed Proportions for commonly used materials

   Use laboratory-designed concrete mix proportions from either of the following sources:

a. Laboratory-designed proportions are available for commonly used combinations of materials. Request these mixes in writing from the State Materials and Testing Engineer. Request specific classes of concrete and specify the source of ingredients.

b. Select a combination of materials from approved sources and request that the laboratory determine a mix that meets requirements in the Table 1—Concrete Mix Table above. The laboratory will establish proportions for strength and workability under laboratory conditions.

4. Self-Consolidating Concrete Requirements

The Contractor is responsible for all concrete mix designs. Ensure that concrete mixes contain enough cement to produce performance requirements within the water-cement ratio specified in Table 1A—Self-Consolidating Concrete Mix Design Table.

Submit a mix design for approval to the Office of Materials and Testing. Include the sources, actual quantity of each ingredient, fine and coarse aggregate gradations, including gradation curves, design slump flow, design air and laboratory results that demonstrate the ability of the design to attain both the required compressive strength and chloride permeability.

Include laboratory results of the slump flow (spread) test, T-20 inch (T-500 mm) test, Visual Stability Index (VSI) Rating test (all according to ASTM C 1611), Passing ability by J-Ring according to ASTM C1621, Static Segregation using the Column Method according to ASTM C 1610, Static Segregation of Hardened SCC Cylinders according to AASHTO R 81, Rapid Assessment of Static Segregation according to ASTM C 1712, air content (according to GDT 26 or GDT 32), fresh concrete temperature (according to GDT 122) of at least two or more separate batches.

Include laboratory compressive strength test results tested according to AASHTO T 22 of at least two 1-day, two 3-day, two 7-day and eight 28-day test cylinders. For HPC-SCC, also include six 56-day test cylinders. Ensure these test cylinders are made from two or more separate batches with an equal number of cylinders made from each batch.

For HPC-SCC, include laboratory chloride permeability test results, at 56 days, of at least six test specimens prepared and tested according to AASHTO T 358. Ensure these test specimens are made from two or more separate batches with an equal number of specimens made from each batch.

The Certified Plant shall obtain written approval for each product type and each product size, from the Office of Materials and Testing Concrete Branch prior to producing any product with SCC or HPC-SCC. SCC and HPC-SCC will only be allowed in the fabrication of prestress/precast products.

As part of the mix design approval, the Contractor shall construct a test piece using the proposed SCC or HPC-SCC mix. This test piece shall be a mock-up of the precast element (i.e., beam, pile, etc). The test piece shall have the same dimensions of the precast element, except the minimum length shall be 10 feet (3 m). The test piece shall have the same bar reinforcement, pretensioning strand geometries, block outs and any other items required that will replicate a test pour of the complex portions of the precast element.

The Contractor shall use production equipment and operations to demonstrate concrete production, delivery, placement, finishing and curing. During concrete placement, the proposed mix will be evaluated for workability, flow and bleeding. After the concrete has cured, the forms will be removed and the concrete will be evaluated for surface finish and voids. The mock-up shall not be vibrated.

TABLE 1A—SELF-CONSOLIDATING CONCRETE MIX DESIGN TABLE

<table>
<tr><th colspan="11">English</th></tr>
<tr><th>Class of Concrete</th><th>Maximum Water/ Cement ratio lbs./lb.</th><th>J-Ring (C 1621) (Δ Flow)</th><th>Column Segre-gation (C 1610) (S)</th><th>Rapid Segre-gation (C 1712) (Pd)</th><th>Hardened Visual Stability Index (R 81) (HVSI)</th><th>Slump Flow (C 1611) (in) Minimum</th><th>Entrained Air (%) Min</th><th>Max</th><th>Minimum Compressive Strength at 28 days (psi)</th><th>Surface Resistivity at 56 days (T-358) (kΩ-cm)</th></tr>
<tr><td>“AAA SCC”</td><td>0.40</td><td>Δ Flow ≤ 2 in.</td><td>S ≤ 15%</td><td>Pd ≤ 15mm</td><td>≤ 1</td><td>20 (Time 20 in. = 3 to 8 seconds)</td><td>3.5</td><td>6.5</td><td>5000 or as shown on the plans (28 day)</td><td>N/A</td></tr>
<tr><td>“AAA HPC-SCC”</td><td>0.35</td><td>Δ Flow ≤ 2 in.</td><td>S ≤ 15%</td><td>Pd ≤ 15mm</td><td>≤ 1</td><td>20 (Time 20 in. = 3 to 8 seconds)</td><td>3.5</td><td>6.5</td><td>5000 or as shown on the plans (56 day)</td><td>(4x8 Cylinders)
Beams- ≥16.5
Or as shown on the plans
Piling-≥21
Or as shown on the plans
(6x12 Cylinders)
Beams- ≥13
Or as shown on the plans
Piling- ≥16.5
Or as shown on the plans</td></tr>
<tr><th colspan="11">Metric</th></tr>
<tr><th>Class of Concrete</th><th>Maximum Water/ Cement ratio kg/kg</th><th>J-Ring (C 1621) (Δ Flow)</th><th>Column Segre-gation (C 1610) (S)</th><th>Rapid Segre-gation (C 1712) (Pd)</th><th>Hardened Visual Stability Index (R 81) (HVSI)</th><th>Slump Flow (C 1611) (mm) Minimum</th><th>Entrained Air (%) Min</th><th>Max</th><th>Minimum Compressive Strength at 28 days (Mpa)</th><th>Surface Resistivity at 56 days (T-358) (kΩ-cm)</th></tr>
<tr><td>“AAA SCC”</td><td>0.40</td><td>Δ Flow ≤ 50 mm</td><td>S ≤ 15%</td><td>Pd ≤ 15mm</td><td>≤ 1</td><td>500 (Time 500 mm = 3 to 8 seconds)</td><td>3.5</td><td>6.5</td><td>35 or as shown on the plans (28 day)</td><td>N/A</td></tr>
<tr><td>“AAA HPC-SCC”</td><td>0.35</td><td>Δ Flow ≤ 50 mm</td><td>S ≤ 15%</td><td>Pd ≤ 15mm</td><td>≤ 1</td><td>500 (Time 500 mm = 3 to 8 seconds)</td><td>3.5</td><td>6.5</td><td>35 or as shown on the plans (56 day)</td><td>(4x8 Cylinders)
Beams- ≥16.5
Or as shown on the plans
Piling-≥21
Or as shown on the plans
(6x12 Cylinders)
Beams- ≥13
Or as shown on the plans
Piling- ≥16.5
Or as shown on the plans</td></tr>
</table>

B. Delivery Tickets

Have the concrete plant transmit delivery tickets (DOT Form 525) with each load of concrete delivered to the work site. Give the Engineer one of these delivery tickets.

Ensure that the following information is on the delivery ticket:

- Project designation
- Date
- Time
- Class and quantity of concrete
- Actual batch proportions
- Free moisture content of aggregates
- Quantity of water withheld
- Concrete mixing revolutions

If available forms do not provide the required information, ask the Engineer to provide one.

C. Formwork Plans

The Engineer may require detailed formwork plans for review. If so prepare the formwork plans and submit them to the Engineer. In no case will the Contractor be relieved of responsibility for the formwork plans.

When constructing permanent steel bridge deck forms, submit bar support details and types to the Department for approval before placing the deck form reinforcement.

D. Falsework Plans

Submit, for review by the Engineer, detailed falsework plans for spans under which traffic flows.

The Engineer may require plans for spans that do not accommodate traffic.

E. Shop and Erection Drawings

Submit fabricators' shop and erection drawings to the Engineer for review and approval. Indicate the following in the drawings:

- Grade of steel
- Physical and section properties for permanent steel bridge deck form sheets
- Locations where the forms are supported by steel beam flanges subject to tensile stresses

F. Hauling Vehicle Information

Before hauling starts on new bridges, submit the following information for each vehicle:

- Weight on each axle, empty
- Weight on each axle, fully loaded
- Center-to-center distances of axles
- Center-to-center distances of wheels measured parallel to each axle

G. Cold Weather Concrete Curing and Protection Plan

Secure the Engineer's approval of a "Cold Weather Concrete Curing and Protection Plan" for bridges and structures. Emphasize protection for the underside of bridge decks when using metal forms and include the protection procedures to be used.

Protection procedures shall keep the concrete above 50 °F (10 °C) for 72 hours after placement and above freezing for 6 days after placement. Choose the protection method from Table 2 based on the expected temperature within 48 hours after concrete placement. The contractor shall provide a suitable curing box for structural concrete to protect the cylinders. The box may be constructed of plywood and lined with insulation or a commercially made device.

TABLE 2—COLD WEATHER PROTECTION

Protection Procedure	Expected Temperatures Within 48 Hours
Heated enclosures	Below 25 °F (-4 °C)
Commercial blankets	Below 25 °F (-4 °C)
Batt insulation	Below 25 °F (-4 °C)
Heavy-duty polyethylene	25 °F (-4°C) or above

H. Color Additives

Submit to the Engineer the following:

1. Product Data: Manufacturer's specifications and instructions for color additives.
2. Samples for Concrete Color Selection: Submit sample chip of specified color indicating color additive number and required dosage rate. Submittals are for general verification of color.

500.2 Materials

Ensure that materials meet the Specification requirements of Table 3:

TABLE 3—MATERIALS SPECIFICATIONS

Material	Section
Coarse Aggregate (1)	800.2.01
Fine Aggregate Size No. 10	801.2.02
Damp proofing or Waterproofing Material (Bituminous)	826.2.01
Portland Cement and Blended Hydraulic Cement (2)	830.2.01
Portland-Pozzolan Cement (2)	830.2.03
Admixtures:	
Air-Entraining Admixtures	831.2.01
Retarding Admixtures	831.2.02
Water Reducing Admixtures	831.2.02
Granulated Iron Blast-Furnace Slag	831.2.03.A.3
Fly Ash	831.2.03.A.1
Raw or Calcined Natural Pozzolan (4) (5)	831.2.03.A.2
Microsilica (Silica Fume)	831.2.03.A.4
Curing Agents	832
Joint Fillers and Sealers	833
Special Surface Coating	836
Linseed Oil	870.2.06.A.1&2
Mineral Spirits	870.2.06.A.4
Water	880.2.01
Graded Aggregate (3)	815.2.01
Graffiti Proof Coating	838.2.01
Concrete used in Bridge Construction	500.3.04.F
1. Use either Class A or Class B coarse aggregate of the designated size, except when using limestone or dolomite in bridge structures. When using limestone or dolomite, use Class A coarse aggregate.	
2. Use Type I or Type II Portland cement, Type IL Portland-limestone cement, or Type IP Portland-Pozzolan cement unless otherwise specified. Do not use air-entraining cement.	
3. The gradation requirements of graded aggregate are modified to require 30% to 45% by weight passing the No. 10 (2.00 mm) sieve.	
4. Use Type I or III Portland cement or Blended Hydraulic Cement (Type 1L) in High Performance Self Consolidating concrete. Do not use air-entraining cement.	
5. Use Metakaolin as the raw or calcined natural Pozzolan unless otherwise specified.	

Construct bridge sections containing duct enclosures for stressing tendons using concrete with a maximum stone size of No. 7.

Use concrete manufactured at plants that qualify as approved sources according to the Standard Operating Procedure for Ready Mix Concrete (SOP 17). See QPL 10 for a list of approved plants.

Use colored concrete additive made with pure, concentrated mineral pigments especially processed for mixing into concrete and complying with ASTM C 979.

If adding color additives to the mix at the jobsite, furnish color additives in pre-measured Mix-Ready disintegrating bags to minimize jobsite waste.

Do not use accelerator admixtures containing calcium chloride in colored concrete mix.

Use aggregates manufactured to meet the gradation at the quarry. The blending of aggregates at the plant must be requested and approved by OMAT Concrete Branch 30 days prior to production and only used for SCC/HPC-SCC concrete mixes used in prestress/precast products. Use aggregates that are well graded without gradation gaps.

500.2.01 Delivery, Storage, and Handling

A. Aggregate Stockpile

Stockpile aggregate as follows:

1. Keep stockpile areas firm, reasonably level, well-drained, clean, and free of sod or foreign matter.
2. Stockpile aggregate separately by type and source.
3. Form stockpiles using methods and equipment that do not cause the aggregate to segregate, become contaminated, or degrade. The Engineer may reject improperly formed stockpiles.
4. Stockpile aggregate long enough for the moisture content to stabilize.
5. Do not use aggregates stored in pits or silos that contain water.

B. Aggregate Handling

Operate aggregate handling equipment carefully to minimize segregation, breaks, spills, contamination, and mixing of the sizes and types of aggregates.

C. Cement Storage

Store cement as specified below. Reject all caked, lumpy, or contaminated cement.

1. Bulk Cement

   Use bulk cement unless the Engineer allows bag cement to be used.

   Store bulk cement in bins or silos designed for this purpose. Provide moisture-proof storage containers with a mechanism that allows cement to flow freely from the discharge opening.

2. Different Brands

   Store and use cement of different brands and types, or from different mills separately.

D. Admixture Storage and Handling

Carefully store and dispense admixtures as recommended by the manufacturer to prevent contamination.

E. Concrete Handling and Placing

Handle and place concrete according to the following:

1. Haul Time Limitations

   Ensure that concrete reaches its final position in the forms within one hour after adding the cement to the aggregates.

If retarders or water reducers are used, the allowable time limit increases to 1-1/2 hours. Test concrete immediately for acceptance tolerances before placing in forms using limits established in Table 1—Concrete Mix Table.

2. Placement Limitations

After delivering the concrete to the job site or the staging area at the site or after mixing the concrete at the site, transport it carefully to the placement point to prevent excessive slump loss or segregation. Use any of the following equipment:

- Buckets
- Buggies
- Pumps
- Other approved means

F. Form Storage

Store forms off the ground.

G. Precast Unit Handling

Except as noted below, the applicable portions of Subsections 507.2.01, "Delivery, Storage, and Handling," 507.3.05.A, *Prepare Bearing Areas*, 507.3.05.B, *Erecting PSC Bridge Members*, and 507.3.05.D, "*Concrete Finish*, shall govern.

Handle precast, non-prestressed units as follows:

1. Do not lift the units from the casting bed until the concrete reaches a strength of at least 1,500 psi (10 MPa).
2. Do not transport or erect the units until they reach a strength of at least 3,000 psi (20 MPa).
3. Restrict live loads (including erection equipment) on the units until they reach a minimum strength of 4,500 psi (30 MPa).

H. Color Additives

Comply with manufacturer's instructions. Deliver to site or batch plant in original, unopened packaging. Store color additives in dry conditions.

500.3 Construction Requirements

500.3.01 Personnel

A. Supervision, Personnel, and Skilled Workers

Provide enough supervision, personnel, and skilled workers to do the following:

1. Properly produce, place, and finish concrete in each pour unit according to Subsection 500.3.05.P, Table 5—Minimum Placement Rates or as required by the Plans.
2. Check screed clearances and tolerances before beginning deck pours.
3. Place concrete without delays.
4. Provide Technicians possessing both a GDOT Plant Concrete Tester certification and an ACI Self Consolidating Concrete certification. The testing technicians shall be on site during mixing and placement operations of SCC/HPC-SCC and is responsible for all the required testing of SCC/HPC-SCC.

B. Plant Operator Certification

Volumetric proportioning requires that the operator be certified by the Office of Materials and Testing. The volumetric truck may be approved on a per project basis or listed on the Qualified Products List (QPL-100).

500.3.02 Equipment

A. Equipment Restrictions

Do not use delivery, conveyance, or vibratory units that leak grout, water, oil, or gas.

Provide enough equipment, tools, and materials to properly produce, place, and finish concrete in each pour unit according to the Subsection 500.3.05.P, Table 5—Minimum Placement Rates or as required by the Plans.

The Engineer may prohibit equipment that delays concrete placement.

B. Volumetric Proportioning Equipment

When concrete ingredients are proportioned volumetrically, equipment needs to be listed on QPL-100 or obtain the Engineer's approval for the equipment and its calibration and operation.

Ensure the following:

- The equipment meets the specifications in ASTM C 685.
- The concrete producer conducts calibration tests at least every 6 months.
- The equipment is calibrated for each new concrete mix before production.

C. Batching Plant Equipment

Ensure that batching plants have the following equipment and that the equipment meets the standards listed.

1. Bins

   Ensure that bins and bin compartments meet the following standards:
   - Adequate capacity for the required concrete production
   - Supported on a rigid framework on a stable foundation capable of holding the bins securely
   - Designed to discharge efficiently and freely into the weigh hopper
   - Positive means of control that slows down and shuts off the material flow when the weigh hopper has the correct quantity.
   - Discharging mechanisms that prevent material leaks when closed
   - Leak-free aggregate storage bins
   - Divided aggregate storage bins for fine aggregate and each size of coarse aggregate
   - Partitioned aggregate storage bin compartment that prevents the materials from mixing
   - Leak-proof, moisture-proof cement bins with a vibrator or other mechanism to discharge cement
2. Weigh Hoppers

   Ensure that weigh hoppers meet the following standards:
   - Have suitable containers freely suspended from scales
   - Have adequate capacity to maintain the Subsection 500.3.05.P, Table 5—Minimum Placement Rates
   - Have a discharge mechanism that prevents material leaks when closed
   - Have vents to permit air to escape
   - Have vibrators or other equipment that ensures complete and efficient discharge of materials
   - Have a dust seal and a port or valve for sampling cement
3. Scales

   Scales used for weighing concrete materials shall have accuracy within plus or minus one percent under operating conditions.

   Ensure the following:
   - When directed by the Engineer, the owner demonstrates the accuracy of the scales.
   - Scales are kept clean and in good operating condition.

- The scale operator can clearly see indicating devices.
- The scale operator can easily access controls.

D. Mixers and Agitators

Ensure that mixers and agitators meet the following requirements:

1. General Requirements for Mixers and Agitators

Provide mixers and agitators that meet these requirements:

a. Capacity Plates

Ensure that the mixer or agitator has a legible metal plate or plates attached in an easily visible location. The plates shall indicate the rated capacity in cubic yards (meters) for mixing and agitating.

b. Concrete Production

The mixer shall produce concrete that meets the requirements in the Table 1—Concrete Mix Table.

c. Mixer Performance Test

The mixer or agitator may be required to pass a mixer performance test. Mixer performance will be evaluated at the discretion of the Engineer.

Mixer performance tests will include the following by the OMAT:

1) Taking samples of concrete at the one-quarter and three-quarter points of the batch discharge

2) Measuring the slumps of each concrete sample

If the two slump values differ by more than 2 in. (50 mm), do not use the mixer or agitator until it meets the requirements of the test.

The Engineer may permit the equipment to be used if the 2 in. (50 mm) tolerance can be met by using a longer mixing time or a smaller batch.

2. Mixing Speed

Follow these guidelines for mixing speed:

- Do not exceed 150 revolutions at mixing speed.
- Discharge all concrete from truck mixers before drum or blades reach 300 revolutions, including revolutions at agitating speed.
- Use the mixing speed defined by the manufacturer for the mixing equipment.
- If the manufacturer’s definition of mixing speed is not available, use a mixing speed of 6 to 18 revolutions per minute.

3. Mixer and Agitator Maintenance

Maintain mixers and agitators as follows:

a. When mixers and agitators are discharged, remove the entire contents before adding materials for the next batch.

b. Clean mixers and agitators often to prevent concrete and grout accumulation.

c. Do not discharge cleaning water into any pipe, catch basin, or structure.

d. If cement or aggregates accumulate in mixers and agitators when cleaning water is discharged, remove them immediately at no expense to the Department.

4. Mixer Types

Use stationary mixers or truck mixers.

a. Stationary Mixers

Ensure that stationary mixers meet the following standards:

1) Combine the concrete ingredients into a homogeneous, uniform mass within the specified time and when loaded to capacity.

2) Efficiently and uniformly discharge the concrete within the tolerances allowed in Subsection 500.3.02.D.1.c, *Mixer Performance Test*.

3) Permit discharge only after the specified mixing time has elapsed using a locking device.

b. Truck Mixers

Ensure that truck mixers meet the following standards:

- Meets the requirements listed in Subsection 500.3.02.D.4.a, *Stationary Mixers*
- Has an approved revolution counting device in good operating condition
- Does not haul more than the rated capacity in cubic yards (meters) as shown on the attached capacity plates

5. Agitator Types

Use truck agitators or truck mixers operating at agitating speed.

Ensure that agitators meet the following requirements:

a. Keeps the mixed concrete in a homogeneous, uniform mass
b. Efficiently and uniformly discharges the concrete within the tolerances allowed in Subsection 500.3.02.D.1.c, *Mixer Performance Test*

E. Concrete Buckets

Keep concrete buckets clean and in good working condition.

F. Concrete Buggies

Keep concrete buggies clean and in good working condition.

G. Concrete Pumps

Concrete pumping equipment is subject to the Engineer’s approval. Use pumping equipment that has adequate capacity and is suitable for the proposed work.

H. Chutes and Troughs

Do not use chutes longer than 50 ft. (15 m) without the Engineer’s permission.

Flush chutes and troughs with water after each run. Do not discharge this water into freshly placed concrete or into conveyance unit.

Promptly remove hardened concrete from chutes and troughs.

Ensure that chutes and troughs meet the following requirements:

1. Metal or metal lined
2. Slope not exceeding one vertical to three horizontal
3. Baffles or a series of short lengths placed to reverse the direction of the concrete flow, when used on steep slopes

I. Pipes or Tubes

Use pipes or tubes to place concrete when the operation requires dropping the concrete more than 5 ft. (1.5 m). Thoroughly clean the pipes or tubes after each pour.

Use pipes made of metal or other approved material and long enough to deposit the concrete as close to its final position as possible.

J. Vibrators

Provide enough vibratory units, including at least one additional stand-by unit in good working condition, to compact concrete immediately after it is placed. Have a stand-by unit at the site before each pour is started.

On Projects consisting entirely of small pours (10 yd^3 [8 m^3] or less), the Engineer may waive the stand-by requirement.

Ensure that vibrators meet the following conditions:

- Approved internal rotation-type design
- A power supply that constantly vibrates the concrete at frequencies of not less than 4500 impulses per minute
- A vibration intensity that visibly affects a mass of concrete with a 1 in. (25 mm) slump through at least a 18 in. (460 mm) radius

The use of internal vibrators is permitted in congested reinforcing areas of prestress products for no longer than 3 seconds during the handling or placement of Self Consolidating Concrete. Any vibration must be approved, and supervised, by the on-site Quality Control Supervisor. No form vibrators are allowed.

K. Screeds

Do not use vibratory screeds (screeds that use a transverse strike-off motion) without the Engineer's approval. Use screeds that are:

- Mechanically operated
- Designed and constructed to screed with the strike-off parallel to the center line
- Readily adjustable
- Capable of maintaining proper adjustment throughout the screeding operation

The two screed types are:

1. Longitudinal Screeds

   Unless otherwise noted on the Plans, use longitudinal screeds only on pour lengths of 70 ft. (20 m) or less.

2. Transverse Screeds

   Use transverse screeds on any pour, unless otherwise noted on the Plans. However, transverse screeds are required on pour lengths above 70 ft. (20 m).

Support screeds outside the pour area that will receive a surface finish. Do not use intermediate supports or guides.

Adjust screeds to the camber specified on the Plans. Check the camber as often as necessary.

Have the Engineer approve the following for screeds and their supports:

- Weight
- Durability
- Adjustability
- Accuracy
- Mechanical condition
- Operational results

Furnish the equipment necessary to check screed clearances and tolerances before pouring decks.

L. Underwater Placement Equipment

Place concrete under water using the following underwater placement equipment:

1. Tremie

   Use a tremie when depositing concrete in water above 10 ft. (3 m) deep. Ensure that tremie is:

   - At least 8 in. in (200 mm) diameter
   - Constructed in sections with watertight couplings

2. Bottom Dump Bucket

   Where the Engineer permits, use a bottom dump bucket in water up to 10 ft. (3 m) deep.

Ensure that the bottom of the bucket opens only when it touches the surface that receives the charge and that the top of the bucket has a lid or cover.

M. Fogging Equipment

To supply additional moisture to the concrete, use fogging equipment with the following characteristics:

- A heavy-duty pump capable of delivering 2-gal (7.6 L) of water per minute to a 0.062 in. (1.6 mm) diameter tip at an air pressure of 100 psi (700 kPa).

  An example of a suitable pump is the Alemite Pump 7878-A.
- The ability to consume approximately 22 ft³/min. (0.6 m³/min) of compressed air
- A 3/8 in. (10 mm) inside diameter hose long enough to reach all areas of the deck
- An adjustable spray gun and tip to provide various patterns of atomized spray or fog for changing finishing conditions

  An example of a suitable spray gun is the Gun Jet No. 43 with a 120-2 Multi Jet Nozzle.

If necessary, substitute other equipment that is capable of equal performance.

500.3.03 Preparation

A. Pre-Pour Conference

Before beginning deck placement operations on each Project, and for individual deck pours of an unusual nature, the Engineer will schedule a pre-pour conference with Project supervisory personnel, and a representative of the concrete supplier, if applicable. Project supervisory personnel will coordinate with a representative from the Concrete Branch of OMAT.

Conference topics of discussion include the following:

- Reinforcing steel support method
- Final screed setting check
- Anticipated placement rate
- Personnel number
- Equipment type
- Curing methods
- Adverse weather placement procedures
- Emergency procedures
- Other Work-related details

500.3.04 Fabrication

A. Measure Materials

Measure materials as follows:

1. **Cement.** Weigh bulk cement on scales to plus or minus one percent of the designated weight. If the Engineer allows bag cement, proportion the batch to use only whole bags.
2. **Aggregates.** Weigh all aggregates on scales to plus or minus two percent of the designated weight. Apply the proper corrections for aggregate surface moisture.
3. **Water.** Measure water by volume or weight to within plus or minus one percent.
   a. Construct the measuring system to be independent of water pressure fluctuation.
   b. Ensure that measuring systems have outside taps and valves to facilitate plant calibrations.
   c. You may use recycled wash water provided that it meets the requirements of Subsection 880.2.02.
4. **Admixtures.** Measure admixtures by weight or volume within plus or minus three percent of the required amount.

B. Control Concrete Batching

Control batching as follows:

1. Mix batches of concrete according to the proportions of an approved mix design.
2. Ensure that concrete materials are from the designated sources.
3. Correct the batch weights to account for surface moisture in aggregates.
4. Conduct batching control tests according to the procedures in the Sampling, Testing, and Inspection Manual.

C. Prestressed Concrete Deck Panel Requirements

Do not use prestressed concrete deck panels unless approved by the Engineer.

D. Add Admixtures to Concrete

Additives are required when specified herein or as directed by the Engineer.

1. Air-Entraining Admixtures

    a. All bridge structure concrete uses air-entraining additives, except for seal concrete and non-exposed footings.
    b. The Contractor may use air-entraining additives in other concrete to improve workability when job or material conditions dictate.

    When using air-entraining additives as an option to improve workability or when required, do not exceed the upper limit of the entrained air content requirement in the Table 1—Concrete Mix Table.

2. Retarding Admixtures

    Use concrete-retarding additives in bridge concrete when the average temperature is above 65 °F (18 °C) (the average of the expected high and the predicted low).

    a. Normally, concrete-retarding additives are not required for bridge curbs, handrails, crosswalks, or other appurtenances constructed separately from the decks.
    b. The Engineer may waive the use of retarders in substructure concrete when concrete can be placed within one hour after batching.

3. Water-Reducing Admixtures

    The Contractor may use water-reducing admixtures in Class AA or Class D concrete for bridge decks when conditions do not require a retarder. The Contractor may use water-reducing admixtures in other concrete when job or material conditions dictate a reduction in water requirements or when minimal set retardation is desired.

    The laboratory may allow Type F water-reducing admixtures when the Contractor requests it. The Contractor may construct bridge sections containing duct enclosures for stressing tendons with concrete using Type F (AASHTO M 194/ M 194M) water reducer as approved by the laboratory.

    The Contractor may use Type F or G high range water-reducing admixtures in combination with water-reducing admixtures or mid-range water-reducing admixtures in the production of SCC/HPC-SCC for prestress/precast products at the discretion of OMAT Concrete Branch.

    Ensure that the SCC/HPC-SCC mix meets the requirements of Subsection 500.1.03.A.4 and that water-reducing admixtures meet the requirements of Subsection 831.2.02, “Chemical Admixtures for Concrete”.

4. Fly Ash

    The Contractor may use fly ash as an additive in concrete to promote workability and plasticity. The Contractor may use fly ash as a partial replacement for Portland cement in concrete if the following limits are met:

    a. Replace no more than 15 percent of the cement by weight.
    b. Replace cement with fly ash at the rate of 1.0 to 1.5 lbs. (1.0 to 1.5 kg) of fly ash to 1.0 lb. (1.0 kg) of cement.

c. Ensure that the fly ash mix meets the requirements of Subsection 500.1.03.A, Subsection 830.2.03, *Portland Pozzolan Cement* and Subsection 831.2.03.A, *Fly Ash*.

d. Calculate water-cement ratio based on the total cementitious material in the mix including fly ash.

e. Do not use Type IP cement in mixes containing fly ash.

5. Granulated Iron Blast-Furnace Slag

If high-early strengths are unnecessary, the Contractor may use granulated iron blast-furnace slag as a partial replacement for Portland cement in concrete if the following limits are met:

a. Replace no more than 50 percent of the cement by weight.

b. Replace the cement with slag at the rate of 1.0 lb. (1.0 kg) of slag to 1.0 lb. (1.0 kg) of cement.

c. Ensure that the slag mix meets the requirements of Subsection 500.1.03.A.3, Subsection 830.2.02, *Portland Blast-Furnace Cement* and Subsection 831.2.03.A.3, *Granulated Iron Blast-Furnace Slag*

d. Calculate the water-cement ratio based on the total cementitious material in the mix including granulated iron-blast furnace slag.

e. Do not use Type IP cement or fly ash in slag mixes.

6. Viscosity Modifying Admixtures

The Contractor may use viscosity modifying admixtures (VMA) to attain the desired SCC performance.

When using a VMA, ensure that the SCC mix meets the requirements of Subsection 500.1.03.A.4 and that the VMA causes no harmful effects in the hardened concrete.

Chemical admixtures may be used to increase the slump of the concrete if this is shown on the approved mixture design. Chemical admixtures may be used to alter the slump flow and stability of self-consolidating concrete if these admixtures are shown on the approved mix design sheet.

7. Supplementary Cementitious Materials

The Contractor may use supplementary cementitious materials (SCMs) as additives in SCC to promote workability, plasticity, and high-early strengths. The Contractor may use SCMs as a partial replacement for Portland cement in SCC if the following limits are met:

a. No more than three SCMs can be used in a SCC mixture.

b. When one SCM is used, replace no more than 20 percent of the cement by weight.

c. When two or three SCMs are used, replace no more than 40 percent of the cement by weight.

d. The SCMs can be fly ash, ground iron blast furnace slag, microsilica or metakaolin used singly or in combination.

e. Calculate the water-cement ratio based on the total cementitious material in the mix including all SCMs.

f. Fly Ash

- If Class F or Class C fly ash is used, the loss of ignition of the fly ash shall not exceed 3 percent.
- Ensure that the fly ash mix meets the requirements of Subsection 500.1.03.A.4 and Subsection 831.2.03.A.1, “Fly Ash”.

g. Granulated Iron Blast-Furnace Slab

Ensure that the slag mix meets the requirements of Subsection 500.1.03.A.4 and Subsection 831.2.03.A.3, “Granulated Iron Blast-Furnace Slag”.

h. Microsilica

Ensure that the microsilica mix meets the requirements of Subsection 500.1.03.A.4 and Subsection 831.2.03.A.4, “Microsilica”.

i. Metakaolin

Ensure that the metakaolin mix meets the requirements of Subsection 500.1.03.A.4 and Subsection 831.2.03.A.2, “Raw or Calcined Natural Pozzolan”.

E. Mix Concrete

1. Central-Mixed Concrete

Mix central-mixed concrete as follows:

a. Establish the mixing time.

The Engineer will determine the mixing time for central mixed concrete, but the minimum mixing time will be one minute for stationary mixers of up to 1 yd^3 (1 m^3) capacity. Mixing time may be adjusted in the following situations:

- The Engineer will increase the minimum time by 15 seconds for each additional cubic yard (meter) or fraction thereof.
- For mixers with a capacity above 3 yd^3 (2 m^3), the minimum mixing time may be 90 seconds if the resulting mixture is homogeneous and meets the requirements of Subsection 500.3.02.D.1.c, *Mixer Performance Test*.
- The Engineer may waive mixing time requirements for stationary mixers of improved types or new designs that produce homogeneous concrete in less time than that established for a particular capacity by the foregoing. For these types of mixers, the Engineer may establish a minimum mixing time of one minute.

b. Start the mixing time when all cement and aggregates have been placed in the mixer.

c. Add some water to the mixer before adding the cement and aggregates, but ensure all water is in the mixer by the end of the first 1/4 of the specified mixing time.

2. Shrink-Mixed Concrete

Mix shrink-mixed concrete as follows:

a. Mix the batches as specified in Subsection 500.3.02.D.2. *Mixers and Agitators*.

b. Do the initial mixing in a stationary mixer for at least 30 seconds to thoroughly mix the ingredients. Do the final mixing in truck mixers.

c. Discharge all concrete before the drum or blades exceed 300 revolutions.

d. Do not allow truck mixing at mixing speed to exceed 100 drum or blade revolutions except as allowed when adding water according to Subsection 500.3.05.M, *Add Water to Concrete*.

3. Transit-Mixed Concrete

Mix transit-mixed concrete as follows:

a. For concrete mixed completely in a truck mixer, place all concrete ingredients into the mixer at the concrete plant except the quantity of water that may be withheld according to Subsection 500.3.05.M, *Add Water to Concrete*.

b. After loading the truck, begin operating at either agitating or mixing speed; however, start the mixing speed within 30 minutes after loading the truck mixer.

c. Mix the concrete for 70 to 150 revolutions at mixing speed.

For revolutions above those specified for mixing speed, use agitating speed.

d. Discharge all concrete before exceeding 300 drum or blade revolutions.

4. Colored-Mixed Concrete

a. Proportion, batch and mix color additives in accordance with manufacturer’s instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.

b. If mixed at batch plant, schedule delivery of concrete to provide consistent mix times from batching until discharge.

F. Concrete Used in Construction

1. Requirements

Use Type I or Type II Portland cement, Type IL Portland-limestone Cement or Type IP Portland-Pozzolan cement for bridge construction, unless otherwise specified.

> **NOTES:**
>
> **1. Do not use air-entraining cement.**
>
> **2. Do not use accelerators (24-hour accelerated strength concrete) that contain chlorides in any bridges where the concrete containing the additive will contact the reinforcing steel.**
>
> **3. Type IL Portland-limestone Cement may be used anywhere that Type I or Type II Portland cement is specified.**

Concrete Types: Use the tabulated results from the Table 1—Concrete Mix Table for the classes and specific requirements for each class of concrete. Use the appropriate class of concrete shown in the Plans or specifications for each component of a structure, of the type as follows:

a. Class AAA–Prestressed concrete and precast concrete as called for on the plans.

b. Class AA1–Precast concrete as called for on the plans

If approved by the Engineer, you may use this class as high early-strength concrete and may use Type III cement in concrete used for this purpose.

The Engineer may also specify the rate of compressive strength development when this concrete is used

> **NOTE: The Department will not add compensation to the Contractor for Class AA1 concrete when it is used at the request of the Contractor.**

c. Class D – Bridge superstructure concrete as called for on the plans.

d. Class AA–Bridge concrete, cast in place concrete, or precast concrete as called for on the plans

e. Class A–General purposes

> **NOTE: Do not air-entrain Class A concrete deposited in water (seal concrete). Ensure that the concrete has 10 percent additional cement and sufficient water to provide a 6- to 8-in. (150- to 200-mm) slump.**

f. Class B–Massive sections or lightly reinforced sections or miscellaneous non-structural concrete

g. Class CS– (Portland cement concrete subbase). Use this class as a subbase where required by the Plans. Concrete subbase may be composed of a mixture of Portland cement and graded aggregate or Portland cement, aggregate, and sand.

2. Acceptance of Design

Determine laboratory acceptance strength by at least 8 compressive test specimens prepared and cured according to AASHTO R 39.

a. Make the specimens from two or more separate trial batches.
b. Make an equal number of specimens from each batch.

c. Calculate the minimum average strength or acceptance strength (X) as follows:

$X = f'c + 2.0s$

Where:

f ‘c = required minimum compressive strength for each class of concrete from the Table 1—Concrete Mix Table

s = average standard deviation of all 28-day specimens made in the field representing concrete of a given class from all ready-mix plants

Use the standard deviations shown in Table 4:

Table 4—Standard Deviations for Calculating Acceptance Strength

Class of Concrete	Standard Deviation (s)	
	Psi	(MPa)
B	370	(2.5)
A	650	(4.5)
AA	620	(4.3)
D	590	(4.0)
AA1	540	(3.7)
AAA	500	(3.4)

500.3.05 Construction

A. Meet General Responsibilities

General construction responsibilities include:

1. Batch, mix, deliver, and place concrete according to the Specifications.
2. Have enough production and placement capacity to continuously mix, place, and finish the concrete in each pour unit during daylight hours.

   If necessary, place concrete at night when adequate lighting facilities exist, and the Engineer approves of the operations and facilities.
3. If a pour cannot be completed, do the following:
   a. Form an approved construction joint.
   b. Remove the partial pour.
   c. Take other remedial measures directed by the Engineer at no additional expense to the Department.
4. Schedule placement to minimize exposure of freshly poured concrete to potentially harmful drying elements such as wind and sun before curing materials are applied and protect freshly poured concrete from exposure to excess moisture and freezing for a minimum of 24 hours when such weather conditions exist.

B. Construct Falsework

Accept responsibility for the design, construction, protection, and performance of falsework. Repair or remove and replace (as the Engineer directs) concrete, other material, or portions of the structure that are damaged or destroyed due to falsework failure.

Construct falsework for prestressed post-tensioned concrete structures according to the Contract Special Provisions.

Construct falsework for structures other than post-tensioned box girders as follows:

1. Meet Design Criteria

   Ensure that falsework structural components that have similar functions in an individual permanent span have the same geometric properties and are made of the same materials.

   When designing and centering formwork, treat concrete as a liquid, and use the following weights:

- 150 lbs./ft.^{3} (23.6 kN/m^3) for vertical loading
- 85 lbs./ft.^{3} (13.4 kN/m^3) for horizontal loading
- 75 lbs./ft.^{2} (3.6 kN/m^2) live load for deck placement operations

Use the following falsework design criteria:

- Design and construct falsework logically so the Bridge Design Office can analyze it using a commonly accepted structural design theory.
- Avoid exceeding safe working values for material stresses.
- Provide support for the imposed loads, without settling or deforming and a way to compensate for settlement, if it occurs.

2. Support Falsework

Support falsework using one of these methods:

- Support on piling driven and removed as directed
- Found on a footing approved by the Engineer

3. Construct Falsework

Construct and set falsework to provide the finished structure the specified camber and finished grade.

Place “telltales” at locations directed by the Engineer to observe how much the falsework settles.

C. Meet Form Design Criteria

Ensure that forms meet the following design criteria:

- Provide wet concrete and other loads and forces of construction support without bulging between the supports or bracing and without deviating from the lines and contours shown on the plans.
- Meet the design criteria for falsework in Subsection 500.3.05.B.1, *Meet Design Criteria*.
- Account for the use of retarded concrete.

Ensure that bracing, ties, and supports are placed accurately.

If the formwork appears to be inadequately supported, tied, or braced (before or during concrete placement), the Engineer may require that the Work stop until the defects are corrected.

D. Use Acceptable Form Materials

Except as noted, fabricate forms from the following materials:

- Lumber
- Plywood
- Metal
- Plastic
- Combinations of these

Use material free of defects that materially affect form strength or materially impair the accuracy or appearance of the concrete surface.

Use the form materials as follows:

1. Lumber Forms

Construct wood forms as follows:

a. Size and dress the lumber.
b. Use lumber at least 1 in. (25 mm) thick.
c. Use lumber for header forms used as screed supports and for curb face forms at least 2 in. (50 mm) thick.
d. Avoid using scrap material or doing patchwork.
e. Stagger all joints but those between abutting panels.
f. Line the lumber used to form outside vertical surfaces of exterior beams or girders with an approved form liner.
g. Use chamfer strips mill-produced from high-quality lumber, free of defects.

   h. Dress and finish chamfer strips on all three sides.
   i. Size chamfer strips to the proper dimensions.
2. Plywood Forms

   Construct plywood forms as follows:

   a. If plywood is the type made for general concrete forms and is at least 5/8 in. (16 mm) thick, use it in place of 1 in. (25 mm) thick lumber to construct forms, if necessary.
   b. Ensure that plywood used to form open joints and to line forms is at least 1/4 in. (6 mm) thick.
   c. When nailing plywood directly to form studs, do not space the studs more than 16 in. (400 mm) apart.
   d. Use plywood in full sheets wherever practical. Do not do patchwork with small, irregular pieces.
   e. Have the Engineer inspect and approve plywood sheet layout.

3. Metal or Plastic Forms
   a. Construct metal or plastic forms as follows:
   b. Use metal or plastic to form concrete only if the Engineer approves the forms and if the forms produce satisfactory results.
   c. Use metal forms that produce finished concrete equal to or superior to concrete made from comparable wooden forms.
   d. Countersink bolts and rivets in the surfaces of metal forms that touch concrete.
   e. Grind welds smooth in the surfaces of metal forms to provide a smooth plane surface.
4. Other Material Uses

   Use tempered fiberboard for form liners when necessary if it is at least 1/4 in. (6 mm) thick. Use tempered fiberboard 1/8 in. (3 mm) thick only to form open joints. Support the fiberboard with suitable spacers arranged properly.

   Use approved synthetic materials for forming open joints and for other special uses, if necessary.

E. Construct Form Supports

Construct form supports using metal ties, anchors, and hangers as follows:

1. Construct supports that will remain in the finished concrete so they can be removed from the concrete face to a depth of at least 1 in. (25 mm) without damaging the concrete.
2. Weld form supports to girder or beam flanges in continuous or cantilever spans only in the flange areas which are in compression.
3. When ordinary wire ties or snap ties are permitted, cut them back at least 3/8 in. (10 mm) from the face of the concrete.
4. Design metal tie fittings that minimize the cavities made when they are removed. Fill all cavities after removing metal tie fittings.

F. Construct Temporary Forms

Construct temporary forms as follows:

1. Construct and maintain forms in a mortar-tight condition.
2. Construct forms so that they can be removed easily without damaging the concrete, unless using forms that will remain in place.
3. Build, line, and brace forms so that the formed concrete surface conforms with the dimensions, lines, and grades shown on the plans.
4. Build headwall forms for skewed pipe parallel to the roadway centerline or at right angles to the radius on curves. Construct headwall forms as follows:
   a. Lay enough pipe to extend through the headwall form.

b. After the concrete is poured and hardened, carefully cut and dress the protruding pipe ends so no ragged edges remain.

The Contractor may choose, as an alternate to the above method, to build a circular form that exactly fits the pipe circumference and face of the headwall form.

5. Construct form liner using plywood or other approved form liner as follows:
    a. Use form liner in large sheets. Do not do patchwork.
    b. Avoid irregular joint location in form liners.
    c. Have the Engineer inspect and approve the proposed liner layout.
6. Bevel forms at beam copings, girders, and other projections to ease removal.
7. Place chamfer strips to chamfer exposed edges of the concrete by the required amount. Use ¾ in. (19 mm) chamfers unless otherwise shown on the plans.
8. Patch with tin or other metal only in those areas of the superstructure lying between and including the inside faces of the exterior beams.
9. When shown on the plans, splice water stops to form continuous water-tight joints. Hold stops in position while placing concrete.
10. Immediately before erecting forms or just before placing bar reinforcement steel, coat forms with a clear oil or other bond breaker to keep concrete from sticking to the forms.
    a. Do not allow the substance to stain or soften the concrete surface.
    b. Do not apply by reaching or pouring through previously placed reinforcement steel.
11. Wait to place concrete in any form until the Department inspects and approves the form.

    Inspection and approval does not diminish the responsibility to produce concrete surfaces free of warping, bulging, or other defects.
12. When removing forms, remove chamfer strips, blocks, and bracing.
13. Do not leave any part of a wooden form in the concrete.
14. If concrete surfaces do not meet finish specifications, correct the problems with the following steps, as directed by the Engineer:
    - Repair the defects using approved methods.
    - Remove and replace the affected portion of the work.

G. Reuse Forms

Reuse forms and form material in good condition and satisfactory as determined by the Engineer. Do not use forms or form materials that are warped, cracked, split, bulging, have separated plies, or have unsatisfactory form liner.

Ensure that used forms are mortar tight and produce a finished concrete equivalent to that produced by new forms.

H. Construct Permanent Steel Bridge Deck Forms for Concrete Deck Slabs

Unless otherwise designated on the Plans, construct and use permanent steel bridge deck forms for concrete bridge deck slabs according to these Specifications. Do not use permanent steel bridge deck forms in panels where longitudinal deck construction joints are located between stringers.

Provide a structurally satisfactory slab when using permanent steel bridge deck forms.

1. Fabricate permanent steel bridge deck forms and supports from steel that conforms to ASTM A 653/653M Designation SS, Grade 60/400, Coating Designation G-165/Z-500 and ASTM A 924/924M.
2. Design permanent steel bridge deck forms as follows:
    a. Account for the dead load of the following:
        - Form
        - Reinforcement steel

- Plastic concrete

b. Add 50 lbs./ft² (2.4 kN/m²) for construction loads.

c. Ensure that the unit working stress in the steel sheet does not exceed 0.725 of the specified minimum yield strength for the material furnished. However, do not allow the unit working stress to exceed 36,000 psi (250 MPa).

d. Account for deflection under the weight of the forms, the plastic concrete, and the reinforcement as follows:

1) If deflection exceeds 1/180 of the design span or 1/2 in. (13 mm), whichever is less, use intermediate supports.

2) Do not base deflection on a total load of less than 120 lbs./ft² (5.7 kN/m²).

e. Base the permissible form camber on the actual dead load condition.

f. Do not use camber to compensate for deflection that exceeds the above limits.

g. Compute the form sheets design span using the clear span of the form, plus 2 in. (50 mm), measured parallel to the form flutes.

h. Compute physical design properties according to the requirements of the latest published edition of the American Iron and Steel Institute Specification for the Design of Cold Formed Steel Structural Members.

i. Ensure that all bottom reinforcement has a minimum concrete cover of 1 in. (25 mm) as shown in Figure 1. (Figure 1 metric).

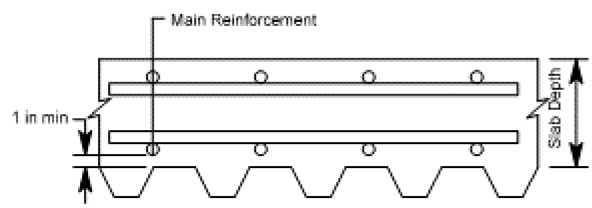


FIGURE 1

j. Maintain the Plan dimensions of both layers of primary deck reinforcement from the top surface of the concrete deck.

k. Do not use precast mortar blocks to support the deck reinforcement.

l. Do not treat permanent steel bridge deck forms as lateral bracing for the compression flanges of supporting structural members.

3. Do not weld to flanges in tension or to structural steel bridge elements fabricated from non-weldable steel grades.

Have welders certified by the Department weld metal deck forms or supports for metal deck forms.

I. Install Forms

Install and maintain forms in a mortar-tight condition and according to approved fabrication and erection Plans.

Place transverse construction joints at the bottom of a flute. Field drill 1/4 in. (6mm) weep holes no less than 12 in. (300 mm) on center along the line of the joint.

1. Highway Bridge Forms

Install highway bridge forms with a 1 in. (25 mm) minimum clearance between the top of the form and the bottom of the main deck reinforcement. See Figure 1.

2. Railroad Bridge Forms

Install railroad bridge forms as follows:

a. Place the forms so the tops of the form ribs adjacent to the beam flange are at the bottom of the deck slab specified by the plans.
b. Maintain the full slab depth detailed on the plans.
c. Do not allow form ribs to project above the plan bottom of the deck slab.
d. Do not place form sheets directly on top of the stringer or floor beam flanges.
e. Securely fasten form sheets to form supports using self-drilling screw fasteners, not by welding. If the Engineer approves, use fastener pins driven into place by a power tool.
f. Ensure that form sheets have a minimum bearing length of 1 in. (25 mm) at each end.
g. Do not leave loose sheets or accessories on the deck at the end of a day's work.
h. Place form supports so that they contact the flange of the stringer or floor beam.
i. Attach form supports using welds, bolts, clips, or other approved means.
j. Do not weld form supports to the flanges of non-weldable steel or to portions of the flange subject to tensile stresses.
k. Ensure that welding and welds comply with AWS D 1.5 for fillet welds. However, 1/8 in. (3 mm) fillet welds are permitted.

J. Repair Damaged Forms

Repair permanently exposed form metal to the Engineer's satisfaction if the galvanized coating is damaged.

1. Clean the damaged area.
2. Go over the damaged area with a wire brush.
3. Paint the area with two coats of zinc oxide-zinc dust primer that meet Federal Specification TT-P-641d, Type II and has no color added.
4. Do not touch up minor heat discoloration in weld areas.

K. Construct Runways

Provide runways into a deck pour area for moving buggies. If the Engineer approves, use runways to bridge a previous pour that has not reached the minimum strength or age requirements in Subsection 500.3.05.AF.4, *Live Loads—Pouring Equipment*.

Construct and support runways to protect the forms and the reinforcement steel position.

L. Construct Work Bridges

Provide a work bridge on deck pours. Support the bridge outside the area of the pour receiving a surface finish. If two or more spans will be poured on the same day, the Engineer may require two work bridges.

Design and construct work bridges to meet the following:

- Do not allow the bridge to sag into the fresh concrete.
- Construct the bridge so that transverse finish and curing material can be applied easily regardless of the screed type.

M. Add Water to Concrete

Add water to the concrete at the concrete plant. Do not add indiscriminate amounts of water at the job site.

If placement conditions require concrete of a more workable consistency, add small amounts of water at the job site if approved by the Engineer.

Add water at the job site as follows:

1. Determine the quantity of water required to provide the necessary consistency.

   The Engineer will not approve additions of water that cause the total amount of water to exceed the maximum water/cement ratio established in the Table 1—Concrete Mix Table .

The Engineer will reject concrete with water added to it that produces a higher slump than specified in the Table 1—Concrete Mix Table .

2. Do not add water to concrete that has begun to set because of excessive mixing or to concrete that has exceeded mixing or haul time limitations.
3. When adding the water, carefully control the conditions.
4. Position the delivery so the measuring operation is not affected.
5. Measure the water carefully.
6. Inject the water into the mixer forcefully to facilitate uniform mixing.
7. Add water before discharging an appreciable amount of concrete.
8. Do not add more water after concrete discharge begins.
9. After adding the water, mix the concrete an additional 30 revolutions.
10. Finish mixing the concrete before the total revolutions at mixing speed exceed 150.

N. Volumetrically Proportion Concrete

Concrete ingredients may be proportioned volumetrically when non-air entrained concrete is used in miscellaneous concrete, non-exposed footings, culverts smaller than bridge culvert size, or when approved by the Engineer.

O. Prepare for Concrete Placement

Prepare for concrete placement as follows:

1. Ensure that an adequate supply of concrete will be furnished and placed to meet the requirements specified in Subsection 500.3.05.P, Table 5—Minimum Placement Rates for Bridges, Culverts and Retaining Walls.
2. To ensure a full bond between prestressed concrete deck panels and the cast-in-place concrete, clean the panel before placing the slab concrete.
3. Immediately before placing cast-in-place slab concrete, saturate the prestressed concrete deck panels with water.
4. Immediately before placing concrete in the forms, the concrete will be measured for acceptance tolerances. Acceptance tolerances for each class of concrete are listed in the Table 1—Concrete Mix Table .

   Conduct the applicable tests according to the procedures in the Sampling, Testing, and Inspection information.

P. Meet the Minimum Placement Rates

If concrete is not produced, placed, and finished according to the minimum placement rates, the Engineer may reject the pour. Concrete pours of a similar nature and size will not be allowed until the problem is corrected and the placement rate met.

The minimum placement rates are listed in Table 5:

TABLE 5—MINIMUM PLACEMENT RATES FOR BRIDGES, CULVERTS AND RETAINING WALLS

1. Bridge Substructure

Pour Size in Cubic Yards (Meters)	Minimum Placement Rate in Cubic Yards (Meters) per Hour
0-25 (0-19)	10 (8)
26-50 (20-39)	15 (12)
51-75 (40-59)	20 (15)
76-100 (60-75)	25 (20)
101 and over (76 and over)	30 (25)or as designated on the Plans or in the Special Provisions

The minimum placement rate for columns shall be the same as for culvert sidewalls and wingwalls.

2. Bridge Superstructure

Pour Size in Cubic Yards (Meters)	Minimum Placement Rate in Cubic Yards (Meters) per Hour
0–25 (0-19)	15 (12)
26–50 (20–39)	20 (15)
51–75 (40–59)	25 (20)
76 and over (60 and over)	30 (25) or as designated on the Plans or in the Special Provisions

Pour handrail, parapet, curb, and barriers at a rate satisfactory to the Engineer.

3. Culverts

Structure	Minimum Placement Rate in Cubic Yards (Meters) per Hour
Footings and slabs	Same as for bridge substructures
Sidewalls and wingwalls	Use placement rates so that fresh concrete is not placed on concrete that has attained its initial set. Cover all concrete with fresh concrete within 45 minutes.

4. Retaining Walls

Structure	Minimum Placement Rate in Cubic Yards (Meters) per Hour
Footings	Same as for bridge substructures
Walls	Same as for culvert sidewalls and wingwalls

Q. Place Concrete

Place concrete as follows:

1. Do not allow aluminum to touch the concrete while mixing, transporting, handling, or placing it.
2. Transport, handle, and place concrete quickly so that it reaches its final position in the forms within the haul time limitations in Subsection 500.2.01.E.1, *Haul Time Limitations*.
3. Manipulate the delivery or conveyance unit to avoid vibration damaging to partially set concrete.
4. Immediately before placing the concrete, thoroughly clean and wet the forms.
5. Place concrete as close as possible to its final position in the forms.
6. Use chutes, troughs, or tubes to pour the concrete in the forms, without displacing reinforcement steel.

7. Modify or stop using the equipment if chutes, troughs, or tubes cause honeycombed or otherwise inferior concrete.
8. When placing concrete by pumping, operate the pumping equipment so that the concrete is produced in a continuous stream without air pockets.

> **NOTE: Convey and place concrete by pumping only when specified in the Contract or when authorized by the Engineer.**

9. When concrete placement requires dropping the concrete more than 5 ft (1.5 m), use pipes or tubes to place the concrete.

   Do not allow concrete to free-fall more than 5 ft. (1.5 m) from the pipe or tube.
10. Place concrete in horizontal layers no more than 18 in. (0.5 m) thick.
11. Place and compact succeeding batches in each layer before the preceding batch takes its initial set.
12. Place each succeeding layer before the underlying layer sets.
13. Consolidate the concrete to avoid cold joints between layers.
14. If the forms sag or bulge while concrete is being placed, remove the concrete causing the distortion and the concrete in adjoining areas if the Engineer requires. Removal prevents cold joints and displaced or damaged reinforcement.
15. Work the concrete around reinforcement bars without displacing them.
16. Compact concrete using suitable tools and vibration.
17. Vibrate concrete where it is deposited and vibrate other concrete while it is fresh. Vibrate as follows:
    - a. Insert and withdraw vibrators slowly.
    - b. Manipulate vibrators to work the concrete around reinforcement and embedded fixtures and into corners of forms.
    - c. Vibrate sufficiently to compact the concrete but avoid causing the concrete to segregate.
    - d. Stop vibrating before local areas of grout are formed.
    - e. Apply vibrators no farther apart than twice the radius through which the vibration is visibly effective.
    - f. Do not use vibrators or any other means that could cause segregation to move masses of concrete in the forms.
    - g. Do not apply vibrators to sections of concrete that are no longer plastic.
    - h. Vibrate concrete-filled steel grid floors by applying the vibrators to the steel.
    - i. Vibrate concrete for precast or prestressed units as specified above in steps **a through g**, unless the Engineer approves alternate methods.
    - j. Stop vibration when a mortar line appears on the face of the form and when the coarse aggregate particles are submerged in the concrete mortar.
18. Supplement vibration with spading to ensure smooth surfaces and dense concrete along form faces and in locations difficult to reach with vibrators.
19. After concrete sets initially, do not disturb the forms or the projecting reinforcing bars.

R. Create Construction Joints

Place construction joints according to the Plans or as directed by the Engineer.

If an emergency affects continuous placement, the Engineer will decide if a construction joint is allowed. If allowed, the Engineer will provide instructions about where and how to make the joint.

The Engineer may eliminate certain construction joints if placement, finishing and forming methods can produce satisfactory results.

Create construction joints as follows:

1. Remove mortar splashed on form surfaces and projecting reinforcement steel before concrete reaches its initial set.
    a. Do not puddle dried mortar chips and dust into the plastic concrete.
    b. If excess mortar is not removed from reinforcement steel before the concrete reaches its initial set, delay cleaning until the concrete is thoroughly hardened.
2. If joining fresh concrete and hardened concrete, clean the hardened surface of laitance and incompletely bonded, loose, or foreign material.

    Ensure that laitance is completely removed from the following:

    - Joints between decks and curbs
    - Tops of seal courses
    - Construction joints in concrete exposed to sea water
3. Ensure that the surface of the concrete is dry before pouring the concrete against it.
4. Immediately before placing fresh concrete, tighten the forms against the existing concrete.
5. Use tremies or pumps to coat areas where fresh concrete will be poured with mortar or cement grout.
6. Begin placing concrete immediately after placing the mortar or grout.
7. Apply enough vibration to blend the material with the concrete at the construction joint.

S. Protect Fresh Concrete

Do not drive pile, blast, or perform other operations that vibrate the formwork or the concrete noticeably before the concrete reaches a strength of 2,000 psi (15 MPa) and is 3 days old.

Protect fresh concrete from rainfall with waterproof material such as tarpaulins or plastic film. Ensure that the waterproof material is ready before pouring and is sufficient to cover the area of the pour.

T. Place Bridge Deck Concrete

Do not use calcium chloride or any other admixture containing chloride salts in concrete placed on permanent steel bridge deck forms.

Ensure that the tolerances are accurate for bar reinforcement placement in cast-in-place concrete so the top clearance to the bar reinforcement complies with Subsection 511.3.05.G.6, *Bridge Deck Slab Tolerances*.

Place bridge deck concrete according to the Contract Specifications and as follows:

1. Before pouring decks, set substantial bulkheads or headers and shape them to the required deck surface cross-section.
2. Ensure that pouring sequences, procedures, and mixes comply with the plans and specifications.
3. Pour the deck according to the numbered sequence as follows:
    a. Unless otherwise shown on the Plans, pour each deck in one continuous operation.
    b. When dividing deck pours within any one complete unit (a simple span or a continuous or cantilever unit), pour and finish the concrete in the numbered sequence shown on the plans, beginning with the lowest number.
    c. Make pours with the same number before pours with higher numbers. Make pours with the same number in any sequence.
    d. The numbered sequence shown on the plans also applies to sidewalk pours, but it need not apply to curb, parapet, and handrail pours.
    e. Pour diaphragms between steel or prestressed concrete roadway beams at least 24 hours before pouring the deck slab.
    f. Unless otherwise authorized by the Engineer, pour all diaphragms within a complete unit before pouring decks.
    g. When constructing concrete T-Beams, place girder stems in uniform layers before placing slabs.

   h. If T-Beam spans are supported without intermediate false bents, begin deck placement as soon as the first four stems are placed. After the first four stems, avoid getting more than three stems ahead of the advancing line of the deck pour and lagging by more than the space between stems.
   i. If T-Beam spans are supported by intermediate false bents, place decks and stems the same as for T-Beam spans supported without intermediate false bents. However, ensure that the slab is placed before a cold joint develops between the stem and slab.
4. Do not make the deck pour until any previously poured concrete in the complete unit has set for 24 hours.

   This requirement may be waived under certain conditions if the succeeding pour can be completed (except for final finishing) within four hours of the initial placement of the day. The Engineer must give written approval for this requirement to be waived.

   Unless otherwise shown on the plans, do not place handrail, sidewalks, parapets, and curbs in a complete unit until all the deck slabs in the unit have been poured.
5. Ensure that the pour is the same as the overlap direction (as shown in the shop drawings).
6. Use the following deck pour method:
   a. If there is super-elevation, begin deck pours on either the high or the low side.
   b. Dump each batch against previously placed concrete.
   c. Pour at a rate that ensures fresh concrete along the advancing line of the pour.
   d. Vibrate or tamp concrete dumped on fresh concrete to make the grout flow as follows:
      - Forward with or slightly ahead of the concrete
      - Along the bottoms and sides of the forms
      - Around the reinforcement steel
7. Once the concrete is poured, vibrate it enough to avoid honeycomb and voids, especially at the following locations:
   - Construction joints
   - Expansion joints
   - Valleys and ends of form sheets Screed the concrete as follows:
   a. Use finishing devices operating parallel to the center line. As pouring proceeds, keep the concrete surface screeded to the required grade.
   b. Fill depressions ahead of the screed, and keep a small roll of grout on the leading edge of the screed. Perform further screeding with minimum disturbance to the surface already brought to the grade.
   c. Take care during the placement and screeding to obtain sound concrete at the construction joint located where the slab joins the curb, parapet, or sidewalk.
   d. Do not place excess grout on the leading edge of the screed and do not allow it to remain in this area.
   e. Use either a longitudinal screed or a transverse screed.
      - Longitudinal Screed

        Before doing the final screeding, place enough concrete in front of the screeding position to deflect the dead load.
      - Transverse Screed

        On beam or girder-supported spans with skew angles of 65° or less, place and operate the truss or beam supporting the strike-off parallel to the skew and make the advancing pour line parallel to the skew.

        On beam or girder-supported spans with skew angles between 65° and 90°, position the screed either on the skew or at right angles to the bridge center line.

        On superstructures supported by non-deflecting falsework and on beam- or girder-supported spans with a total dead load deflection no more than 1/2 in. (13 mm), position the screed at right angles to the bridge center line and make the advancing line of pour at right angles to the bridge center line.

f. As the pouring proceeds, keep the concrete surface screeded to the required grade.
g. Fill depressions ahead of the screed. Keep a small roll of grout on the leading edge of the screed.
h. Continue to screed without disturbing the surface already brought to the required grade.
i. Avoid producing unsound concrete where the slab joins the curb, parapet, or sidewalk. Remove excess grout from the leading edge of the screed at these construction joints.

8. Edge joints to be sealed, including dummy joints, as follows:
    a. Edge before the initial set or after the final set.
    b. If edging before the initial set, use edging tools of the proper radius as shown on the plans.
    c. Carefully remove concrete from pouring operations on adjacent pours to achieve the required rounded edge.
    d. If edging after the final set, allow the joints to harden. After at least 12 hours, grind joints to approximate the plan radius either by hand or by mechanically operated grinding stones.
    e. To achieve full and uniform bearing, finish areas that are recessed for receiving joint members.
9. Finish bridge decks as follows:
    a. As soon as the concrete is hard enough and standing water and moisture sheen disappear, give the concrete a final finish by belting, brooming, or dragging.
        - Belt longitudinally using a wet canvas belt. Limit belting to spans no longer than 40 ft. (12 m).
        - Drag transversely or longitudinally with a wet burlap drag.
        - Broom transversely using a stiff-bristled broom.
    b. Finish the following areas carefully:
        - Gutter lines
        - Joints
        - Drains
    c. After belting, dragging, or brooming and when shown on the plans, groove the bridge deck and approach slabs perpendicular to the center line as follows:
        1) Do not begin grooving until the bridge deck is cured according to Subsection 500.3.05.Z, *Cure Concrete*.
        2) If necessary, groove in conjunction with planing required to make the surface corrections specified in Subsection 500.3.06.D, *Bridge Deck Surface Check*. Wait until the concrete is hard enough to support the equipment without distorting.
        3) Cut grooves into the hardened concrete using a mechanical saw device capable of producing grooves 0.125 in. (3 mm) wide, 0.125 in. (3 mm) deep, and 0.50 in. (13 mm) apart, center-to-center.
        4) Extend the grooves across the slab to within 1ft. (300 mm) of the gutter lines.
        5) Do not groove within 3 in. (75 mm) of bridge joints, including “dummy” joints detailed in the plans.

U. Place Concrete Parapet on Bridge Decks

Place concrete barrier or parapets on bridge decks. The slip form method with an approved self-propelled extrusion machine as specified in Section 621 is optional.

V. Place Seal Concrete

Deposit concrete in water only when required by the Plans or when considered necessary by the Engineer.

When depositing the seal concrete, follow these guidelines:

- Keep the water as motionless as possible.
- Place the concrete continuously from beginning to end.

- Ensure that the concrete surface remains as horizontal as possible.

Place seal concrete as follows:

1. Place seal concrete carefully in a compacted mass as near to its final position as possible using a tremie, a bottom dump bucket, or other approved means.
    a. Use tremies to place seal concrete as follows:
        1) Support tremies so that the discharge end can move freely over the entire top surface of the work.
        2) Support tremies so that they can lower rapidly to stop or retard the flow of concrete.
        3) At the beginning of the work, close the discharge end to keep water out of the tube.
        4) Keep the tube sealed.
        5) Keep the tremie tube full to the bottom of the hopper.
        6) When dumping a batch into the hopper, induce concrete flow by slightly raising the discharge end and keeping it within the previously deposited concrete. This maintains a seal and forces the concrete to flow into position by hydraulic head.
    b. Use bottom-dump buckets to place seal concrete as follows:
        1) Ensure that the bottom-dump bucket is level full.
        2) Open the bucket only when it rests on the surface that will receive the charge.
        3) In lowering and raising the bucket, do not move the water unnecessarily.
    c. When approved by the Engineer, place seal concrete by pumping.
2. Wait at least 24 hours after placement to begin dewatering seal concrete, unless the Engineer determines a longer waiting period is necessary.
3. Remove laitance from the seal concrete before placing the footing.
4. Bore seals under spread footings the entire depth of the seal as specified for foundations in Subsection 211.3.05.C, *Boring of Foundations and Seals*.
5. If laitance buildup on seals under spread footings exceeds 1/4 in./ft. (20 mm/m) of seal depth, the Engineer may decide to core the seal to determine acceptability.
6. When placing concrete exposed to sea water, control the water content to produce concrete of maximum density and create construction joints and prepare their surfaces according to the requirements of Subsection 500.3.05.R, *Create Construction Joints*.

W. Pour CS Concrete

Pour CS concrete as follows:

1. Meet CS concrete depth and surface finish requirements.
    - Ensure that the minimum depth is the same as shown on the plans.
    - Do not vary the depth variation more than 1 in. (25 mm).
    - Ensure that the surface finish is generally smooth and uniform.
    - Smooth or fill float marks, voids, and other deformities exceeding 1/2 in. (13 mm) before placing approach slabs.
2. To prevent bonding:
    a. Lay clean polyethylene sheeting uniformly over the CS concrete in the approach slab area before placing the slabs.
    b. Use new, unused polyethylene sheeting free of holes, rips, and tears.
    c. Use polyethylene bond-breaking material at least 8 mils (0.2 mm) thick with an overlap of at least 6 in. (150 mm).
3. Maintain polyethylene sheeting in good condition throughout the construction process.

    Repair or replace sheeting deemed unsatisfactory as directed by the Engineer.

4. Cure CS concrete with the polyethylene sheeting used for bond breaking.

X. Pour Concrete in Cold Weather

When pouring concrete in cold weather, keep the concrete temperature at the point of delivery at least 50 °F (10 °C). Do not use accelerator-containing chlorides.

Mix and pour concrete in cold weather as follows:

1. Keep concrete materials at the right temperatures.
   - Do not use materials in concrete mix that contain frozen lumps.
   - Do not incorporate water and aggregates into the mix with temperatures more than 150 °F (65 °C).
   - If aggregates or water temperatures are above 100 °F (40 °C), discharge the aggregates and water into the mixer and allow the temperatures to equalize before adding the cement.
   - Heat aggregate with steam, hot water coils, or other methods that do not damage the aggregates. Do not heat aggregates with direct flame.
2. Protect the poured-concrete.
   - Keep concrete above 50 °F (10 °C) for at least 72 hours after placement.
   - Protect concrete from freezing for 6 days after placement.

Y. Pour Concrete in Hot Weather

Reduce hazards and difficulties related to placing and finishing concrete in hot weather before pouring. The Engineer may require measures to prevent concrete workability reduction, losses from cement hydration, evaporation, drying, or elevated concrete temperatures.

1. Place Concrete

   Cool forms and reinforcement with water immediately before placing concrete. Meet the minimum placement rates specified in Subsection 500.3.05.P, Table 5—Minimum Placement Rates for Bridges, Culverts, and Retaining Walls.
2. Keep Concrete Cool

   Keep concrete cool as follows:
   a. Keep the concrete used for construction at no more than 90 °F (32.2 °C) when measured at the point of discharge from the delivery unit.
   b. If the concrete temperature might exceed 90 °F (32.2 °C) during concrete placement, begin placement when the air temperature cools if the Engineer requires.
   c. Cool the aggregates by fogging or other means that do not affect moisture content.
   d. Use chipped or crushed ice in the mix as a portion of the mixing water on a pound (kilogram) basis. If using ice, ensure that the ice melts before the batch is discharged from the mixing unit.
   e. If necessary, cool water by refrigeration to provide a lower concrete temperature.
3. Finish Concrete

   Do not "splash on" water to aid screeding or finishing operations.

   For bridge decks, fog the surface when required, according to Subsection 500.3.05.Z.3, *Bridge Deck Curing*.

   If needed, use wind screens to prevent thermal or shrinkage cracks caused by rapid concrete surface drying.

Z. Cure Concrete

Concrete curing is an integral part of the concrete placement operation. Improperly cured concrete will be considered defective.

If the Engineer determines that curing procedures do not comply with these Specifications, stop placing concrete. Resume concrete placement after taking remedial measures to ensure proper curing.

Begin curing unformed surfaces when the water sheen disappears from the surface or immediately after applying the surface finish. Continue curing for 5 days.

Cure the formed surfaces after removing the forms. Remove them within 5 days after placing concrete. Continue curing until the concrete is 5 days old (from the time it is poured).

Cure concrete surfaces exposed to air using methods that prevent premature drying or moisture loss. Ensure that curing conditions are the same throughout separate curing areas.

Use either or a combination of the two methods specified for curing concrete except bridge decks. Cure bridge decks as described in Subsection 500.3.05.Z.3, *Bridge Deck Curing*.

Cure colored concrete in accordance with manufacturer's instructions.

1. General Curing—Supplying Additional Moisture

   Do not use a method that causes the concrete to be alternately wet and dry.

   Cure concrete properly by supplying additional moisture through ponding, sprinkling, or fogging and then retaining the moisture as follows:

   a. Use cotton mats, burlap, sand, hay, or straw coverings.

      Cover with at least 2 in. (50 mm) of sand. Cover with at least 3 in. (75 mm) of hay or straw.

   b. Do not use sawdust or coverings that cause unsightly discoloration of concrete.
   c. Place coverings after completing the finishing operations when there is no danger of surface damage.
   d. Keep coverings moist continuously.

2. General Curing—Preventing Moisture Loss

   Keep concrete moist before and during the rubbing from the Type III—Rubbed Finish.

   Start curing immediately after the rub using approved waterproof paper, plastic sheets, or membrane-forming curing compounds, except when curing compounds are prohibited.

   a. Waterproof Paper or Plastic Sheets

      Ensure that the sheets and paper meet the requirements of AASHTO C 171 and use them as follows:

      - Use the widest possible widths.
      - Lap adjacent sheets at least 6 in. (150 mm).
      - Seal the laps with tape, mastic, glue, or other approved methods to form a waterproof cover of the entire area.
      - Keep the curing material from being displaced by wind.
      - Immediately replace or repair sheets or paper that tear, break, or become damaged during the curing period.

   b. Membrane-Forming Curing Compounds

   Use as the curing agent AASHTO C 309, membrane-forming curing compounds, Type 1-D, Class A or B, or Type 2, Class A or B, white pigmented. Use the curing agent as follows:

      - Do not use membrane-forming curing compounds on bridge decks or prestressed concrete bridge members, or in construction joint areas.
      - When the water sheen disappears from the concrete surface, apply the curing compound uniformly to unformed areas.
      - Apply the compound to formed surfaces if the forms are removed during the 5-day curing period.
      - Cure the areas to be rubbed with liquid membrane-forming compounds for curing concrete, Type1-D, Class A or B (non-acrylic).
      - Apply curing compound with fine-spraying equipment.
      - Thoroughly agitate the compounds just before using them.
      - Spray the surface again immediately after the first application at right angles to the first application.

        Apply at least 1 gal (1 L) for each 150 ft.^{2} (3.7 m^2) of surface.

      - Do not apply curing compound to the following:

    - Joints where a concrete bond is required
    - Reinforcement steel
    - Joints where joint sealer will be placed
  - Close the surface to pedestrian or vehicular traffic for 7 days unless the surface is protected by planks, plywood, or a layer of sand at least 1 in. (25 mm) thick.

    Do not place this protection until at least 12 hours after applying the curing compound.

3. Bridge Deck Curing

   Cure bridge deck concrete as follows:

   a. Immediately after the water sheen disappears and the surface finish is applied, fog the surface to keep a film of water on the surface.
   b. If surface damage occurs, delay fogging.
   c. Keep the surface wet until after applying the sheet curing covers.
   d. Thoroughly soak curing covers on the fabric side.
   e. As soon as the concrete sets enough to prevent damage, apply the covers with the white-poly side up.
   f. Use two-layer sheet curing material for bridge concrete according to AASHTO C 171.

      For the bottom layer, use a polyethylene film. For the top layer, use a white, burlap polyethylene sheet or a white, co-polymer-coated, absorbent, non-woven synthetic fabric.
   g. Ensure that sheet curing material for bridge concrete meets Specification requirements for reflection and moisture retention and has no holes or tears.
   h. Use enough sheet curing material to cover the deck surface.
   i. Place the curing covers so that adjoining sheets overlap at least 18 in. (450 mm).
   j. Weight all laps and side edges to prevent cover displacement before curing is completed.
   k. Weight and overlap covers so the curing sheets maintain intimate contact with the concrete surface.
   l. If there is no moisture under the curing covers during the 5-day curing period, apply additional moisture.

4. Parapet, Sidewalk, End Post, and Curb Face Curing

   The surface of parapets, sidewalk, end post, and horizontal and vertical faces of curbs are not considered part of the bridge deck. Cure these structures using the general curing methods in Subsections 500.3.05.Z.1, *General Curing—Supplying Additional Moisture*, and 500.3.05.Z.2, *General Curing—Preventing Moisture Loss*, unless the surfaces will receive a special surface coating (Subsection 500.3.05.AB.4, *Type III—Special Surface Coating Finish*).

   Do not cure surfaces receiving a special surface coating with membrane-forming curing compounds.

   Do not cure surfaces receiving protection surface treatment (75 percent boiled linseed oil and 25 percent mineral spirits solution) with membrane-forming curing compounds that contain acrylics.

AA. Prevent Plastic Shrinkage Cracking

Take precautions to prevent plastic shrinkage cracking of concrete by doing the following:

- Provide wind screens
- Provide fogging equipment
- Apply temporary wet coverings before moisture loss begins

The Engineer will evaluate the effects of plastic shrinkage cracks and will require repair of cracks that create structural defects and corrode reinforcement steel.

AB. Finish Concrete

Concrete surface finishes are classified according to whether the surfaces are formed or unformed. Refer to Table 6.

When other Sections of the Specifications for concrete work state that the requirements of Section 500 apply, finish the concrete according to the other sections.

TABLE 6—CONCRETE FINISH TYPES

Surface	Finish Type
Formed	Type I—Ordinary Formed Surface Finish
	Type II—Special Formed Surface Finish
	Type III—Rubbed Finish
	Type III—Special Surface Coating Finish
Unformed	Type IV–Floated Surface Finish
	Type V–Sidewalk Finish
	Type VI–Stair Tread Finish

Except for bridge deck finishes, which are covered in Subsection 500.3.05.T, *Place Bridge Deck Concrete*, step 9, finish all structural concrete surfaces with one or more of the finishes described here, unless otherwise shown on the plans.

1. Type I—Ordinary Formed Surface Finish

   Complete formed concrete surfaces with this finish. However, leave concrete exposed directly to sea water undisturbed unless the Engineer requires additional work. See Subsection 500.3.05.V, *Place Seal Concrete*, step 6.

   Achieve a Type I finish as follows:

   a. Immediately after removing the forms, remove fins and surface irregularities.
   b. Fill or point up the following:
      - Cavities produced by forms or ties
      - Holes
      - Broken corners or edges
      - Defects
      - Honeycombed edges
   c. Remove and patch honeycombed areas to sound concrete.
   d. Use patch mortar that consists of the same sand and cement as the concrete. Use the sand and cement in the same ratio as in the concrete.

   Use epoxy mortars in areas where heat generation and moisture will not decrease patch performance.

   e. Cure the patches using one of the general curing methods specified in Subsection 500.3.05.Z.1, *General Curing—Supplying Additional Moisture* and 500.3.05.Z.2, *General Curing—Preventing Moisture Loss*.
   f. Produce a sound and uniform finish.
   g. If the Type I finish is not satisfactory, give the surfaces a Type III—Rubbed Finish where the Engineer considers it necessary to achieve a uniform and pleasing appearance.

2. Type II—Special Formed Surface Finish

   Give a Type II finish to the following:

   - Exposed portions of pipe headwalls and culverts

- Parapets and wingwalls
- Ends of culvert slabs and walls

Achieve a Type II finish as follows:

a. Use a form liner unless the forms are made of plywood or steel.

b. Rub only when necessary if the surface has a pleasing, uniform appearance after completing the Type I finish and blending all pointed and patched areas.

c. If the surface finish is not satisfactory, give surfaces the Type III—Rubbed Finish where the Engineer considers it necessary to achieve a uniform and pleasing appearance.

3. Type III—Rubbed Finish

Apply a Type III finish to bridge areas checked in the table of Bridge areas Requiring a Type III Finish, below and to exposed areas of retaining walls, unless the Plans specify otherwise.

Achieve a rubbed finish as follows:

a. Begin the first rub immediately after removing forms, completing the Type I finish, and ensuring that all patches are thoroughly set, but before applying the required curing compound.

If finishing is postponed or there is not enough labor to keep it up-to-date, the Engineer will order a stop to any other work until the finishing is satisfactory.

b. Rub chamfered surfaces only once, but not during the first rubbing. Rub chamfered surfaces during either the second or the final rubbing.

c. To rub, wet the moist concrete on the curing surface with a brush and rub with a medium-coarse carborundum stone or equal abrasive until a paste comes to the surface.

Keep the entire concrete surface moist during rubbing to assure adequate curing.

d. Continue rubbing until all form marks and projections disappear, leaving a smooth, dense surface with no pits or irregularities.

e. Spread the paste material carefully and uniformly over the entire surface and leave it.

f. No earlier than 24 hours after the first rub, do the final rub with a fine carborundum stone or equal abrasive, leaving a smoothly textured surface that is uniform in color.

g. Finish the final rub before applying protective surface treatment required by the plans.

h. Do not “whitewash” finished areas by using separately mixed grout or paste on the rubbing stone or by spreading it on the surface to be rubbed.

i. Thoroughly clean and blend into the surrounding surfaces any areas that are disfigured by drips from concrete placement or rubbing.

Bridge Areas Requiring a Type III Finish (X)								
	Single Bridge Over Stream	Multiple Bridges Over Stream	Single Bridge Over Railroad	Multiple Bridges over Railroad	Single Bridge over Traffic Artery	Multiple Bridges Over Traffic Artery	Railroad Bridge Over Traffic Artery	Pedestrian Bridge Over Traffic Artery
All exposed substructure areas, except tops and bottoms of caps. (5)					X	X	X	X
Outside surface of any exterior concrete beam, Lt. or Rt. (1), (2)		X		X				
Outside surface of any exterior concrete beam, LT. and Rt. (1), (3)					X	X	X	X
Vertical surfaces of overhangs, curb, or sidewalk	X	X	X	X	X	X	X	X
All vertical surfaces outside exterior beam, Lt. or Rt. (2)		X		X				
All vertical surfaces outside exterior beam, Lt. and Rt. (3)					X	X	X	X
End bent cap beyond outside beam or girder	X	X	X	X				
End bent end walls beyond outside beam or girder	X	X	X	X	X	X	X	X
End bent posts and end bent wingwalls all exposed surfaces	X	X	X	X	X	X	X	X
Traffic face of curbs	X	X	X	X	X	X		X
Entire handrails and posts, handrail parapets, and barriers (4), (5)	X	X	X	X	X	X	X	X
All other locations specified on Special Provisions	X	X	X	X	X	X	X	X
Notes:								
(1) - Including Prestressed Concrete Bridge Members								
(2) - "Lt. or Rt." - Rub the applicable surface when it can be seen from any adjoining/adjacent bridges.								
(3) - "Lt. and Rt." - Rub the applicable surfaces on both sides of centerline of each bridge.								
(4) - Rubbing of bottom surface of rail not required.								
(5) - Bottoms of Caps and handrails shall be given a Type II finish.								

> For bridges using PSC Beams or PSC Deck Units, a Type III Special Surface Coating Finish shall be used where a Type III finish is required for exterior beams. For bridges using PSC Beams or PSC Deck Units, a Type III Special Surface Coating Finish shall be used where a Type III finish is required for exposed substructure areas. The Type III Special Surface Coating Finish shall also be used on the exterior vertical faces of the parapet, barrier, and overhangs where PSE Beams or PSC Deck Units are used.

4. Type III—Special Surface Coating Finish

A Type III—Special Surface Coating Finish may be substituted for a Type III—Rubbed Finish.

The special surface coating finish consists of either a Class A or a Class B coating system, applied to produce a masonry-like textured finish on concrete surfaces.

For contiguous structures, whether in the same Contract or in separate Contracts, use the same brand of special surface coating.

If contiguous structures are in separate contracts, coordinate the Work with the other Contractor so that coating is applied as near as possible to the same time.

If contractors cannot coordinate Work, the one who finishes the work last shall use the same brand or shall recoat all contiguous areas to provide a uniform appearance.

Achieve a special surface coating finish as follows:

- **a.** Ensure that surface coating material meets the requirements of Section 836.

  Select coating material from the QPL 17.
- **b.** Do not use form oils that affect the bonding of surface coatings.
- **c.** Do not use wax-based or other curing compounds incompatible with surface coatings.

  Have the coating manufacturer or the laboratory determine compatibility.
- **d.** Use the coating color required in Section 836.
- **e.** On surfaces that will receive a coating finish, do not cure with membrane-curing compound or remove forms with bond-breaking agents or excessive oil.
- **f.** Apply coatings as follows:
  - Class A coatings at a rate that develops a 1/16 in. (1.5 mm) thick coating.
  - Apply Class B coatings at a maximum rate of 60 ft.^{2} per gallon (1.5 m^2 per liter).
  - Ensure that the temperatures of the air, concrete, and compound are above 50 °F (10 °C).
  - Apply a test section as directed by the Engineer to determine the acceptance of a coating under field conditions.
  - Apply the coatings using a method that produces an acceptable finish, such as spraying, rolling, or a combination of these.
- **g.** Protect coated surfaces from rain or freezing temperatures for 24 hours after application.
- **h.** Ensure that the final coating produces a smoothly textured surface that is uniform in color, thickness, and appearance.
- **i.** Remove and reapply coatings that chip, crack, blister, peel, or present an unsatisfactory appearance.
- **j.** If the final appearance is unsatisfactory, apply a rubbed finish to slip-formed and formed walls and barriers.

5. Type IV—Floated Surface Finish

Use a Type IV finish only on the horizontal surfaces of the following:

- Curbs and sidewalks
- Tops of caps and footings
- Surface of slope paving
- Other similar structures

Apply the Type IV finish as follows:

   a. After compacting the surface and screeding to the correct cross sections, float the surface with a wood float.
   b. While floating the surface, bring enough mortar to the surface to achieve the desired finish, but do not reduce the wearing quality of the surface.
   c. Make the final finish with a wood float or stiff-bristle broom.
   d. If brooming, make the marks transverse to the traffic.

6. Type V—Sidewalk Finish

   Apply a Type V finish as follows:

   a. After placing and compacting the concrete, strike it off and give it a Type IV finish.
   b. Use an edging tool on all edges and along expansion joints unless the Plans require chamfers.
   c. Mark off sidewalk surfaces in blocks with suitable grooving tools when required by the plans or the Engineer.
   d. Extend the rubbed finish on the traffic face of the curb to include the horizontal area of sidewalk between the curb corner and the longitudinal sidewalk groove.

7. Type VI—Stair Tread Finish

   Achieve a Type IV finish using a stiff-bristled broom.

AC. Remove Forms

Do not remove forms and their supports, including falsework, until the Engineer approves. Use a removal method approved by the Engineer. Approval does not relieve responsibility for the safety of the Work.

1. Form Removal Time

   Use a removal time shown on the Plans or specified by the Engineer.

   Use Table 7 to help establish when forms can be removed safely. However, do not count days where the temperature at any time during the day is at or below 40 °F (4 °C), unless the cold weather concrete protective measures described in Subsection 500.1.03.G, *Cold Weather Concrete Curing and Protection Plan* were used.

TABLE 7—ESTIMATE OF FORM REMOVAL TIME

Form	Time Required
Bottom of beams	10 days
Bottom of caps, trestle pile bents	4 days
Bottom of all other caps	7 days
Overhangs and slabs, including culverts	7 days
Columns and retaining walls	18 to 48 hours
Sides of beams, posts, rails, caps, footings, wingwalls, and parapets	12 to 24 hours
Bottoms of cast-in-place rails and diaphragms	48 hours
Front face of curbs	3 hours

   If using high-early strength concrete, the Engineer may reduce the time limitations if the concrete develops satisfactory strengths.

2. Form Removal Method

   Remove forms and falsework without injuring the concrete surface or overstressing the concrete members.

Ensure that the stress from the weight of the removal process is transferred gradually and uniformly to the concrete.

At the Contractor's request, time of removal may be controlled by field tests on cylinders, subject to the following conditions:

- **a.** No tests will be performed until concrete is a least 3 days old.
- **b.** Required strengths will be shown on the Plans, as noted elsewhere in these Specifications, or as determined by the Engineer.
- **c.** The Engineer may specify a minimum time in conjunction with minimum strength requirements.
- **d.** Falsework and forms for culverts may be removed at such time as 75% of the concrete design strength is achieved.

AD. Apply Protective Surface Treatment

When the Plans specify a protective surface treatment, apply a boiled linseed oil mixture of 75 percent boiled linseed oil and 25 percent mineral spirits by volume to the concrete surfaces.

Use linseed oil that meets the requirements of ASTM D 260, Type I or Type II. Use a quality commercial mineral spirit that passes infrared spectroscopic analysis to the satisfaction of the laboratory.

Unless otherwise noted on the Plans or the manufacturer's recommendations, apply the mixture as a preservative seal coat to the top surfaces of bridge decks, curbs, and sidewalks and to the inside vertical faces of curbs, parapets, and end posts. Protect metal handrailing and metal handrail posts from treatment.

Apply the protective surface treatment as follows:

CAUTION: Because the linseed oil-petroleum spirits mixture has a low flash point and is readily flammable, protect the mixture from fire, especially cigarettes and sparks. Prohibit traffic from the treated area until the Engineer determines the concrete has regained its dry appearance.

1. Do not place the protective surface treatment until concrete work, including final rubbing, is completed and expansion joint sealing compound is placed.
2. Do not apply the treatment until the concrete is at least 14 days old.
3. Unless otherwise permitted by the Engineer, apply the treatment when the temperature of the concrete and air is at least 50 °F (10 °C).
4. Apply in time to allow the treatment to dry thoroughly before allowing traffic, including haul traffic, on the structure.

   If the structure meets the following exceptions, apply the treatment after using the structure for hauling.

   - Temperature limitations prohibit application.

     The Engineer will send a written notification to the Contractor (or Bridge Contractor) if temperature requirements prohibit application.

   - The structure is absolutely required for hauling to complete a Contract.

     Request a written approval from the Engineer if hauling across a structure before the treatment is placed.

5. If applying the treatment after using the structure for hauling, thoroughly clean the surfaces to be treated to allow the treatment to penetrate completely.
6. If there are separate bridge and roadway Contracts, have the roadway Contractor clean the surfaces immediately upon request by the Engineer.
7. Prepare the surface for the treatment as follows:
   - **a.** Clean off oil, grime, and loose particles that prevent the mixture from penetrating.
   - **b.** Ensure that the concrete surfaces have at least 48 hours to dry after rainfall or wet cleaning operations.
   - **c.** Immediately before applying the treatment, direct an air blast over the surfaces to remove dust.

   d. Mask the exposed plates of joints.

8. Apply the mixture by hand or by spraying in one application at the rate of 1 gal (1 L) of mixture per 37.5 yd^2 (8.5 m^2).
   a. Thoroughly clean the inside of spraying equipment before putting the surface treatment in.
   b. Keep spray nozzles within 18 in. (600 mm) of the concrete unless otherwise directed by the Engineer, plans, or manufacturer.

AE. Apply Graffiti-Proof Coating

When the Plans specify a graffiti-proof coating, apply the coating system to concrete surfaces or over special surface coatings. Use material that complies with Section 838.

Apply the coating as follows:

1. Clean loose particles, dirt, grease, oil, and other foreign particles off the surface.
2. Apply the coating according to the manufacturer's recommendations for:
   - Weather conditions
   - Material preparation
   - Coating application
   - Number of coats

AF. Expose New Concrete to Loads

Prohibit dead or live loads during or after construction except as described in this section. If using high early strength concrete, the Engineer may reduce time limitations if the concrete develops adequate strength.

1. Dead Loads on the Substructure

   After pouring footings, do not begin work on columns or piers for at least 12 hours.

   After pouring columns, do not begin cap construction for at least 24 hours.

   Do not place beams on caps or place falsework and forming for concrete T-Beam construction before the cap concrete reaches a minimum strength of 2,500 psi (17 MPa).

2. Dead Loads on the Superstructure

   If necessary, stockpile construction materials on decks within a complete unit (a simple span or continuous or cantilever unit) if the following conditions exist:

   - The deck concrete of the complete unit reaches its 28-day cylinder strength.
   - The deck concrete is at least 10 days old.
   - The curbs are at least 5 days old.

   The Engineer must approve the location, height, and spread of the loads.

   On composite-design bridges (those that have prestressed concrete beams or steel beams with shear connectors), do not pour curbs, parapets, or sidewalks until the deck concrete reaches a minimum strength of 1,500 psi (10 MPa) or is at least 3 days old.

3. Dead Loads on Concrete Box Culverts and cast-in-place walls

   Do not backfill any section of a concrete box culvert or cast-in-place wall until the last concrete placed in that section is at least 14 days old, unless early cylinder breaks indicate otherwise.

   If early cylinder breaks indicate that design strength has been achieved, backfill sections of culverts or cast-in-place walls when the concrete placed last is at least 7 days old.

4. Live Loads—Pouring Equipment

   Do not allow power-operated concrete buggies to cross a deck until the concrete reaches a minimum strength of 1,500 psi (10 MPa) or is at least 3 days old.

   Allow hand-operated buggies to cross after the concrete is 24 hours old.

5. Live Loads—Mixing and Lifting Equipment

Do not place mixers on a deck in a complete unit (a simple span or continuous or cantilever unit) until the deck concrete of the complete unit reaches its 28-day cylinder strength and is at least 10 days old.

When deck concrete reaches its 28-day cylinder strength and is at least 10 days old, allow mixer trucks on the unit during the curb concrete pour only if the pour is completed within 45 minutes of being started.

Do not allow any equipment on the unit for 5 days after curb pours.

The Engineer may allow concrete placement procedures that use heavy lifting equipment on the decks if the following conditions exist:

- The deck concrete reaches its 28-day cylinder strength.
- The deck concrete is at least 14 days old.
- The curbs on the deck are at least 10 days old.

6. Live Loads—Hauling over Bridges

Use a new bridge for hauling only if no other practical haul routes are available and only if the Engineer permits it.

a. Govern hauling by the restrictions and requirements listed in Table 8. If any of the restrictions and requirements are violated, the Engineer will limit loads to the following:

   - Single 32,000 lb. (14 515 kg) axle when the bridge design loading is HL-93 or HS 20-44 Single 24,000 lb. (10 886 kg) axle when the bridge design loading is HS 15-44 or H 15-44

TABLE 8—WEIGHT LIMITS FOR HAULING ON NEW BRIDGES

Axle Criteria	Bridge Design Loading	
	HL-93 or HS 20-44 Loading	HS 15-44 or H 15-44
Maximum Axle Load Per Axle	60,000 lbs. (27 216 kg)	44,000 lbs. (19 958 kg)
Maximum Axle Load on Dual Axles Per Axle	45,000 lbs. (20 412 kg)	33,000 lbs. (14 969 kg)
Maximum Total Load	100,000 lbs. (45 360 kg)	73,000 lbs. (33 113 kg)

b. Ensure that bridge concrete, including curbs, parapets, barriers and sidewalks, is at least 14 days old and has a minimum compressive strength of 3,000 psi (20 MPa).

c. Apply the linseed oil special protective treatment, if required see (Subsection 500.3.05.AD, *Apply Protective Surface Treatment*).

d. After applying the protective treatment (if required), apply water-repellent silicone materials to the handrail, handrail posts, end posts, and curb faces before hauling begins.

e. Do not allow more than one vehicle at a time on a simple or multiple-span unit.

f. Ensure that vehicle speeds, loaded or unloaded, do not exceed 5 miles/hr. (8 km/hr.) when the following loads occur:

   - Bridges designed for HL-93 or HS 20-44 Loading:
     — Loads on single axles exceed 32,000 lbs. (14 515 kg)
     — Loads on each dual axle exceed 24,000 lbs. (10 886 kg)
   - Bridges designed for HS 15-44 or H 15-44 loading:
     — Loads on single axles exceed 24,000 lbs. (10 886 kg)
     — Loads on each dual axle exceed 16,000 lbs. (7257 kg)

   When axle loads do not exceed these loads, ensure that vehicle speeds are 15 mph (24 kph) or less.

g. Place temporary guides on beams so wheels will track directly.

h. Keep earth approaches smooth and level with the bridge floor or approach slab to minimize impact.

Stabilize sandy and other unstable soils (at no expense to the Department) with crushed stone or other suitable material for at least 10 ft. (3 m) from the end of the bridge or approach slab.

i. Protect the ends of bridges or approach slabs with a timber strip at least 4 in. (100 mm) wide, cut to rest on either the paving rest of the bridge end or the pavement subgrade at the end of the approach slab. Keep the strip in place for protection during incidental hauling. Remove it before constructing the adjacent pavement.

Keep the top of each timber strip flush with the top of the concrete surface. Fit the strip tightly against the end of the bridge or approach slab. If the timber strip is displaced, stop hauling until the strip is reset or replaced.

j. Clean spills off the bridge floor.

AG. Complete Corrective Work

After the Department gives the deck surface a Ride Quality Test described in Subsection 500.3.06.E, “Ride Quality Test,” complete corrective work at no cost to the Department and before doing the final surface texturing.

Complete corrective work as follows:

1. Plane the deck according to Section 431.
2. Limit concrete removal by planing so that the final bar cover is not less than the Plan cover minus 1/2 in. (13 mm).
3. If the final bar cover limits cannot be met, perform the corrective work as directed by the Engineer.
4. Ensure that the final riding surface complies with this Specification and the requirements for a grooved finish.
5. If necessary, use a bump grinder to correct bumps with a profile base line of 5 ft. (1.5 m) or less.
6. Have planed decks retested as described in Subsection 500.3.06.E, *Ride Quality Test*, to ensure that the ride quality meets the requirements of this Specification.

AH. Plane the Deck

The Contractor shall schedule the ride quality test at least 7 days before needed by contacting the Office of Materials and Testing, Concrete Branch. Ensure that the area to be tested is clean and clear of obstructions.

When possible, delay expansion joint installation and temporarily bridge the joint to operate Lightweight Profiler and planing equipment across the joint.

Planing responsibilities are shown in Table 9:

TABLE 9—PLANING RESPONSIBILITIES

Area Planed	Person Responsible
Bridge decks	Bridge Contractor
Approach slabs constructed under the bridge Contract	Bridge Contractor
Approach slabs constructed under the roadway Contract	Roadway Contractor

AI. Perform Retaining Wall Incidentals

Retaining wall incidentals are as follows:

1. Drainage

Unless otherwise shown on the Plans or in the Special Provisions, ensure that drainage for retaining walls is either Alternate A or Alternate B on Georgia Standards 4941B and 4949 Series.

Ensure that the Number 10 concrete sand complies with Subsection 801.2.02, *Fine Aggregate for Portland cement Concrete of All Types and for Mortar* and has a permeability coefficient of at least 100 ft. (30 m) per day.

The Engineer may waive the grading requirement for Number 10 concrete sand if the permeability coefficient of the material does not exceed 500 ft. (150 m) per day.

Omit the drainage blanket and stone for retaining walls only when the height does not exceed 6 ft. (1.8 m).

When the Plans specify different drainage details, furnish, place, or build the various items according to the plan requirements.

2. Waterproofing and Damp proofing

   When waterproofing and damp proofing are specified in the Plans, comply with the requirements of Sections 530 and 531.

AJ. Place Utility Installation Hardware

When the Plans require placing utility installation hardware, the utility company involved will furnish the items.

Place the items as directed on the plans or Shop Drawings. All other work, including painting as required, is the utility company's responsibility.

AK. Widen Bases and Pavement

When using narrow sections of Portland cement concrete to widen existing bases or bases and pavements, use Class B concrete as shown on the Plans or as directed by the Engineer.

AL. Open the Structure to Traffic

Open a structure to traffic other than haul traffic after all concrete in the decks, parapets, or curbs (sidewalks) reaches its 28-day cylinder strength and is at least 14 days old.

500.3.06 Quality Acceptance

A. Strength Requirement Tests

1. At the Contractor's request, the Department will determine the removal time for forms by conducting field tests on cylinders.

   Tests are subject to the following:

   a. Tests will be performed when the concrete is at least three days old.
   b. The Plans will show the required strengths.
   c. At the Contractor's request, the Engineer may specify a minimum time with minimum strength requirements.

2. When job site test specimens fail to meet the 28-day strength requirements in the Table 1 – Concrete Mix Table, determine the Final Acceptance at a reduced price (% of the latest Item Mean Summary as unit cost) or rejection/removal of concrete in place by coring for structural concrete materials or by conducting non-destructive testing for non-structural concrete materials, as specified by the Engineer:

   a. 1.00 pay factor will be applied if the average 28-day strength of the cylinder set meets strength requirements in the Table 1 – Concrete Mix Table.
   b. If average strength of the cylinders set does not meet 28-day strength requirements in the Table 1, but meets these requirements at 56 days strength requirements, then the following pay factors for the amount the 28-day compressive strength is less than specified strength, will be applied:

psi (below 28-day compressive strength)	Pay Factor
1-499	0.90 (90%)
500-549	0.80 (80%)
550-599	0.70 (70%)
600 or above	Remove & Replace

c. If average strength of the cylinders set does not meet 28-day strength requirements in Table 1 (the cylinders marked with “A” and “B”) and also does not meet them at 56 days (the cylinders marked with “C” and “D”), then core samples (for structural concrete), or non-destructive test (for non-structural concrete) should be obtained within 7 calendar days – three at a time, for each strength test/non-destructive test. If the core or non-destructive test meets the strength requirements in the Table 1, then reduce price concrete with the pay factor in Section 500.3.06.A.2.b above may be accepted.

(1) Coring for Determination of Structural Adequacy: Notify the Engineer 48 hours prior to taking core samples. The Engineer will select the size and location of the drilled cores so that the structure is not impaired and does not sustain permanent damage after repairing the core holes. Sample three undamaged cores taken from the same approximate location where the questionable concrete is represented by the low strength concrete test cylinders. Repair core holes after samples are taken.

(2) Core Testing: Test the cores in accordance with ASTM C 42. Test the cores after obtaining the samples within three calendar days.

d. If average strength of the cores does not meet a minimum pay factor of 0.70 (or 70%), then concrete will be rejected, and will be removed and replaced at no additional cost to the Department. For all concrete materials including both structural concrete and non-structural concrete, core samples have to be obtained for testing and for the decision of rejection. Non-destructive test results will not be used for the decision of rejection of the concrete in-place.

B. Honeycombed Area Check

If there are honeycombed areas that extend beyond the reinforcement steel, the Engineer may reject the entire pour with the honeycombed area.

C. Bridge Deck Slab Concrete Inspection

The Engineer will carefully observe the construction methods used during all phases of the bridge deck slab construction. These phases include the following:

- Metal form installation
- Reinforcement location and fastening
- Concrete item composition
- Mixing procedures
- Concrete placement and vibration
- Bridge deck finishing

Provide the needed facilities for the Engineer to safely and conveniently inspect the concrete.

The concrete inspection procedure is as follows:

1. After the deck concrete has been in place for at least two days, the Engineer will sound a hammer on at least two areas of the deck for each slab pour. This test checks for concrete soundness and form bonding.

   The two areas will encompass at least 10 percent of the total area of the deck pour.
2. The Engineer will sound other areas of the deck randomly.
3. If the Engineer doubts the soundness of an area, or if the Engineer decides that the concrete placement procedures used call for an inspection of the underside of the deck, remove at least one section of the forms for each span in the Contract.
4. Remove the form section after the pour is strong enough and when the Engineer desires to provide visual evidence that the concrete mix and the placement procedures are acceptable.
5. Remove another form section if the Engineer decides changes in the concrete mix or in the placement procedures warrant additional inspection.

6. Where form sections are removed, do not necessarily replace the forms, but repair the adjacent metal forms and supports neatly and securely.
7. When the form is removed, the Engineer will examine the concrete surfaces for cavities, honeycombing, and other defects.
8. If the Engineer finds irregularities but determines that the irregularities do not justify rejection of the Work, repair the concrete as the Engineer directs and give it an ordinary surface finish according to the Contract Specifications.
9. If the concrete where the form is removed is not acceptable, remove additional forms as necessary to inspect and repair the slab.
10. Modify the construction methods as required by the Engineer to create satisfactory slab concrete.
11. Remove or repair all unsatisfactory concrete as the Engineer directs.

    If the construction methods used and the inspection results indicate that the slabs have sound concrete, the Engineer may moderate the amount of random sounding and form removal after a substantial amount of slab has been constructed and inspected.

D. Bridge Deck Surface Check

After the final strike-off of the concrete and as close behind the final strike-off as possible, the Engineer will check the surface with a 10 ft. (3 m) straightedge.

Attach the straightedge to a broom-type handle for easy control and use.

Bridges and approach slabs must meet a 1/8 in. in 10 ft. (3 mm in 3 m) straightedge check made longitudinally and transversely.

E. Ride Quality Test

After the bridge decks and approach slabs are completed, the Contractor will contact the Department's Office of Materials and Testing, Concrete Branch to schedule to have a Ride Quality Test performed using the Lightweight Profiler and a profile index value determined according to GDT 134.

The Department will conduct the test as follows:

1. Obtain Profile Index Values for all bridge decks and approach slabs not detailed to include an overlay.
2. Bridges and approach slabs must meet the straightedge check limits described in Subsection 500.3.06.D, *Bridge Deck Surface Check*.
3. Obtain profiles in the wheel paths and in safety areas to within 6 ft. (1.8 m) of barrier or curb lines.
4. Average the profile index values for bridge decks including the approach slabs for the left and right wheel path for each lane.

    The average value must not exceed 15 in./mile (235 mm/km) for each lane.

After the test is complete, correct individual bumps or depressions that exceed 2/10 in. (5 mm) from the blanking band on the profiler trace.

The deck surface must then meet a 1/8 in. in 10 ft. (3 mm in 3 m) straightedge check made transversely.

Correct bridge decks and approach slabs that do not pass the Ride Quality Test as described in Subsection 500.3.05.AG, *Complete Corrective Work*.

F. Cap Step Elevations

Ensure that the constructed bridge bearing seat elevations conform to the Plan elevations within an acceptable tolerance of ± 1/4 in (± 6mm). The differential elevation between any two adjacent bridge bearing seat elevations shall not exceed ± 3/8 in (± 10 mm).

G. Concrete Mix Acceptance Tolerances of Fresh Concrete

Immediately before placement of Self-Consolidating Concrete or HPC Self-Consolidating Concrete, perform and record the results of the following tests:

1. Concrete temperature tested according to ASTM 1064 will be 50 °F (10 °C) to 95 °F (35 °C).
2. Slump flow (spread) tested according to ASTM C 1611 will be +/- 2 in (50 mm) from design slump flow.
3. Air content tested according to ASTM C 138 or ASTM C 231 will be 3.5% to 6.5%.
4. Visual Stability Index according to ASTM C 1611 will be ≤ 1.
5. Rapid Assessment of Static Segregation Resistance according to ASTM C 1712 will be ≤ 15mm.

500.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

500.4 Measurement

This work is measured for payment either per cubic yard (meter), per Lump Sum, or per linear foot (meter), whichever is shown on the plans.

- **Seal Concrete.** The quantity of seal concrete to be measured for payment is calculated using the horizontal seal dimensions specified on the Plans.
- **Grooving.** Grooving on bridge decks and approach slabs, completed acceptably according to Subsection 500.3.05.T, *Place Bridge Deck Concrete*, step 9.c, will be measured and paid for by the square yard (meter). Payment is full compensation for furnishing the necessary equipment and performing the Work.
- **Class B Concrete.** Class B concrete used for base and pavement widening will be measured and paid for by the cubic yard (meter) complete in place and accepted.

500.4.01 Limits

A. Measurement for Separate Payment

There will be no separate measurement and payment for the following:

1. On permanent steel bridge deck forms for concrete deck slabs:
   - Extra reinforcing
   - Extra concrete
   - Other costs incurred because of the requirements of this specification

   All costs are included in the Lump Sum prices bid for superstructure concrete and superstructure reinforcement.

B. Payment per Cubic Yard (Meter)

Measurement limits on payment per cubic yard (meter) are:

1. Bridges, Concrete Culverts, Headwalls, and Retaining Walls

The quantity of concrete measured for payment is the algebraic summation of the Base Pay Quantity and authorized quantity changes.

If additional quantities are necessary because of any of the following, these quantities are measured separately for payment:

- Rocks were removed carefully but additional quantities are needed because footing depth and keyway dimension are irregular from unanticipated rock removal.
- Voids or crevices exist within the spread footing area.
- The Engineer authorized filling trenches cut in rock outside footing areas to ease dewatering.

These additional quantities will be paid as filler concrete per cubic yard (meter).

2. Seals

When the Plans do not require a seal but a seal becomes necessary, or when the Plans do not show seal dimensions, the maximum pay dimensions in each direction will be the Plan dimension of the structural footing plus 3 ft. (1 m), with 18 in. (460 mm) on each side.

If the Contractor uses lesser dimensions, measurement is based on the lesser dimensions. Concrete placed beyond the maximum pay limits are not measured.

C. Payment per Lump Sum

For Lump Sum payment, determine the quantities required before submitting the bid.

The concrete quantity must conform to the Plan dimensions. Measurement is made as a unit, complete in place, and includes the following:

- Diaphragms
- Sidewalks
- Concrete parapets

Measurement does not include concrete in the following items that will be paid for separately:

- Concrete handrailing
- Barriers
- Prestressed bridge members.

Payments for parapets placed by slip-form method is included in the Lump Sum price bid for superstructure concrete.

Unless otherwise shown on the Plans, the cost of steel joints and metal bearing assemblies used in structures where there is no structural steel Pay Item are included in the Contract Price for superstructure concrete.

D. Retaining Wall Incidentals

Retaining wall incidentals will be measured for payment as follows:

1. Drainage Systems

Drainage items required by Special Plans are measured for payment by the unit specified on the plans only when they are set up as specific Pay Items and are paid for separately. Otherwise, their costs are included in the Contract Price for concrete.

Payment is full compensation for the costs of excavation and backfill necessary to place the drainage items required by Special Plans.

The following are not measured for separate payment. Costs are included in the Contract Price for concrete.

- Sand blankets
- Crushed or broken stone
- Weep holes

2. Miscellaneous

The following are not measured for separate payment. Costs are included in the Contract Price for concrete.

- Expansion material
- Rubber or polyvinyl plastic water stops

E. Utility Installation Hardware

The cost of placing utility hardware items is included in the Contract Price for the class of concrete the items are placed in.

500.5 Payment

This Work will be paid for at the Contract Price per cubic yard (meter), per Lump Sum, or per linear foot (meter), each complete in place and accepted.

Payment is full compensation for all things, including incidentals, and direct and indirect costs, to complete the Work.

Payment will be made under:

Item No.	Item	Payment
500	Superstructure concrete class_____, Bridge no._____	Per lump sum
500	Concrete handrailing (designation)	Per linear foot (meter)
500	Class_____concrete	Per cubic yard (meter)
500	Class_____concrete, high-early strength	Per cubic yard (meter)
500	Seal concrete	Per cubic yard (meter)
500	Class B concrete base or pavement widening	Per cubic yard (meter)
500	Class_____concrete including reinforcement steel	Per cubic yard (meter)
500	Class A concrete—filler	Per cubic yard (meter)
500	Class_____concrete—retaining wall	Per cubic yard (meter)
500	Grooved concrete	Per square yard (meter)
500	Concrete barrier	Per linear foot (meter)

500.5.01 Adjustments

A. Contractor Costs

Assume the following costs:

1. Costs related to rejected concrete and removing rejected concrete
2. Costs of forming an approved construction joint, removing a partial pour, or completing other remedial measures requested by the Engineer unless the fault lies solely with the Department
3. Costs of repairing, removing, and replacing falsework as directed by the Engineer
4. Costs of repairing, removing, or replacing forms
5. Costs of air-blown mortar to repair honeycombed areas, if required by the Engineer
6. Costs of using a higher class of concrete to widen existing bases or bases and pavements
7. Costs related to obtaining an approved specialty mix design.

B. Ride Quality Testing

The Department will conduct ride quality testing of bridge decks and approach slabs only twice per bridge at no cost to the Contractor.

The Department will conduct additional ride quality testing at the cost of $2000 per test.

The Department may issue a pay reduction based on the square yards (meters) of the span not passing the required 15 in./mi (235mm/km), and not having any bumps or depressions greater than 2/10 in. (5mm) required in Subsection 500.3.06.E. This pay reduction will be calculated based on SOP 48 for Bridge and Approach Penalties. A minimum of $1500.00 per bridge will be assessed for any pay reductions.

C. Plastic Shrinkage Crack Repair

The Engineer will determine how to repair cracks caused by plastic shrinking. Repair cracks at no cost to the Department.

D. Plan Quantities

For all bridges (except seal concrete), concrete culverts, headwalls, and retaining walls, the quantities shown on the Contract Plans, including Standard Plans, will be considered the Base Pay Quantity.

For seal concrete, the Plan quantities are approximate and are for estimating purposes only. The quantities will not be considered as Base Pay Quantities.

Calculated additions or deductions will be applied to the Base Pay Quantity when the Engineer makes authorized changes. Changes include, but are not limited to, authorized changes in the following:

- Footing dimensions
- Lengthening or shortening of concrete culverts
- Correcting Plan Quantities
- Dimension errors
- Multi-barrel culvert wall thicknesses
- Lengthening or shortening bridge columns
- Raising or lowering foundations

Calculations of the Base Pay Quantity and any changes will be made as follows:

1. No deductions will be made for the volume of concrete used by scorings, panels, and chamfers if the individual areas are less than 1 in.^{2} (645 mm^2).

   The volume of concrete in fillets of the same area will be neglected.
2. The volume of structural steel and of steel and concrete piling encased in concrete will be deducted.
3. The volume of timber piling encased in concrete will be deducted on the basis of 0.8 ft.^{3}/linear foot (0.07 m^3/linear meter) of pile.
4. No deduction will be made for the volume of concrete displaced by the following:
   - Steel reinforcement
   - Shear connectors
   - Floor drains (unless they are paid for as separate Pay Items)
   - Incidentals such as expansion material
   - Joint sealing compound
   - Utility thimbles and hangers

E. Filler Concrete

Filler concrete, measured as described in Subsection 500.4.01.B.1, *Bridges, Concrete Culverts, Headwalls, and Retaining Walls*, will be paid at 40 percent of the Contract Price per cubic meter for Class A Concrete or Class AA Concrete.

F. Seal Concrete

If there is no Contract Price for seal concrete, payment will be per cubic yard (meter), measured as described in Subsection 500.4.01.B.2, *Seals*, and will be paid at 60 percent of the Contract Price per cubic yard (meter) for Class A concrete.

G. Lump Sum Payment Adjustments

Adjust the payment as follows:

1. Authorized Change Adjustments

   When authorized changes are made as described in Subsection 500.5.01.D, *Plan Quantities,* the lump sum payment may be adjusted on a pro rata basis or according to Section 104 and as determined by the Engineer.

   The Plans show tabulated quantities as a service. This does not relieve any responsibility to conform to plan details.

2. Optional Plan Feature Adjustments

   If exercising an optional Plan feature, the Base Pay Quantity will not be changed if it is the only quantity change involved.

   However, if other changes are necessary, the quantity change resulting from the optional feature will be considered in the necessary quantity adjustments.

3. Falsework for Post-Tensioned Box Girder Bridge Adjustments

   When the falsework is completed for post-tensioned box girder bridges, 20 percent of the Lump Sum superstructure concrete price will be paid.

   Additional payments made as the concrete is placed must be adjusted for the payment for falsework. In other words, payment for concrete placed will be based on 80 percent of the superstructure bid price.

4. When Metal Deck Forms are used and have been placed, payment in the amount of 5% of the Lump Sum Superstructure Concrete price will be made. For Post-Tensioned Box Girder Bridges, this percentage (5%) will apply to that part of the superstructure

Section 501—Steel Structures

Replace Section 501 with the following:

501.1 General Description

This work includes furnishing and building with structural steel and miscellaneous metals to the lines, grades, and dimensions shown on the plans or established by the Engineer.

The work does not include bearing devices for prestressed concrete bridge members, utility installation hardware, or any metal covered under another Pay Item.

501.1.01 Definitions

HTS Bolts: High Tensile-Strength bolts.

501.1.02 Related References

A. Standard Specifications

Section 109—Measurement and Payment

Section 500—Concrete Structures

Section 512—Shear Connectors

Section 535—Painting Structures

Section 851—Structural Steel

Section 852—Miscellaneous Steel Materials

Section 854—Castings and Forgings

Section 857—Bronze Bushings, Bearings, and Expansion Plates

Section 870—Paint

Section 881—Fabrics

Section 885—Elastomeric Bearing Pads

B. Referenced Documents

ANSI/AASHTO/AWS D 1.5

AISC Manual of Steel Construction

ANSI B1.13 Class 2A

ANSI 2.5, 3.2, 6.3, 12.5, 25, 46, 46.1 Part 1, 50

ASTM A 6/A 6M

ASTM A153/A 153M

ASTM A 325 (A 325M)

ASTM A 490 (A490M)

ASTM A 919

ASTM F 568M Class 4.6

501.1.03 Submittals

A. Pre-Inspection Documentation

Furnish documentation required by the latest ANSI/AASHTO/AWS D 1.5 under radiographic, ultrasonic, and magnetic particle testing and reporting to the State's inspector before the quality assurance inspection.

B. Shop Drawings

Prepare Shop Drawings for structural steel and other metal materials to be fabricated. Show the details necessary for shop fabrication and field erection.

1. **Description.** Use the standard sheet size of the Department's Bridge Office. Submit at least two complete sets of preliminary prints marked *NOT FOR FIELD USE* to the Department's Bridge and Structural Design Engineer (the Bridge Engineer) for review before fabricating materials.

   As an option, shop drawings may be submitted on plan sheet sizes of 12 in. x 18 in. (305 mm x 457 mm) or 11 in. x 17 in. (279 mm x 432 mm) for review and approval. Information contained on these sheets must be legible.

   After shop drawings have been approved, submit an electronic file that is compatible with Bentley MicroStation J (Version 7) CADD operating system, or an electronic file in Adobe Acrobat Portable Document Format (.pdf) to the Engineer. For bridges carrying railroads only, after shop drawings have been approved, submit one full size set of reproducible drawings to the Department.

2. **Review Process.** After the preliminary prints have been reviewed and revisions have been made, submit 5 or more complete sets of the final drawings to the Bridge Engineer. The Bridge Engineer will mark each drawing with a conditional approval stamp and return one stamped set to the fabricator. Furnish the Bridge Engineer with as many additional sets of final prints as required.

   The Bridge Engineer's review and conditional approval of Shop Drawings is a service for the Contractor. The Department assumes no responsibility for the accuracy of the drawings, and the Contractor will not be relieved of any responsibility for conforming to the specifications and plans.

3. **Railway Structures.** For structures carrying railway traffic and for other structures when specifically designated, furnish the Bridge Engineer a full set of permanent reproducibles of the final Shop Drawings.

4. **Welded Construction.** On Shop Drawings for welded construction, use the standard welding symbols of the American Welding Society. Explain special conditions in notes or details. Show the sequence and techniques for areas where shrinkage stress and distortion control is necessary.

5. **Changes and Substitutions.** Do not change a Shop Drawing after it has been conditionally approved unless the Bridge Engineer gives written consent. List and symbolize revisions on each drawing.

   Obtain written consent from the Bridge Engineer before substituting materials with dimensions and weights other than those shown on the plans. Make changes associated with an approved substitution at no expense to the Department.

6. **Alternate Locations of Splices and Connections.** If splices or connections are desired at locations other than those shown on the plans, submit a proposal and Shop Drawings to the Bridge Engineer to get written approval before proceeding.

7. **Steel Identification.** Upon request, furnish an affidavit certifying the identification of steel is maintained throughout fabrication.

   On the Shop Drawings, show the grade of steel to be used and identify each piece. Give pieces made of different types or grades of steel different assembly or erection marks.

   Maintain the identity of the mill test report number when assembly-marking individual pieces and when giving cutting instructions to the shop.

C. Fabrication Schedule

Ensure that the fabricator submits a proposed fabrication schedule to the State Materials and Research Engineer that includes the following:

- Correct project number, including county
- Bridge number
- Starting date

- Estimated completion date

D. Quality Control Program

Before fabrication begins, submit the fabricator's written Quality Control program to the Office of Materials and Research for approval. This program and its personnel will be subject to verification when the Department's Materials and Research Engineer deems necessary.

Even with a State inspection, continue to perform Quality Control (QC) on all nonfracture-critical and fracture-critical members and components.

E. Mill Orders and Shipping Statements

Furnish the number of copies of mill orders and shipping statements covering fabricated materials and related miscellaneous materials the Engineer directs. Show the weights of individual members on the statements.

F. Mill Test Reports

Furnish the Engineer two certified, legible copies of mill test reports that show the results of physical tests and complete ladle analyses for each heat and grade of steel ordered. Refer to the ASTM designation of tests used. Furnish mill test reports at no expense to the Department.

G. Welding Procedures

Before structural steel fabrication begins, submit welding procedures to the Engineer for review and approval.

H. Electrode Testing

Furnish a manufacturer's certification showing that the material requirements used for manufacturing the tested electrodes and furnished electrodes were the same for each lot of electrodes on the Project.

I. Falsework

If required, prepare and submit falsework plans for the Engineer's review. Continue to assume the responsibility to produce safe falsework. When erection is completed, remove falsework to the Engineer's satisfaction.

J. Camber Diagram

Furnish the Engineer a diagram showing the camber at each splice point for each girder. Base the diagram on measurements taken during shop assembly. In the case of partial shop assembly, base the camber diagram on theoretical calculated values.

501.2 Materials

Ensure that materials meet the requirements of the following specifications:

Material	Section
Structural Steel	851.2.01
Cold-Finish Carbon Shafting	854.2.06
Steel Castings	854.2.07
Paints	870
Steel Bolts, Nuts, and Washers	852.2.01
Anchor Bolts	852.2.02
High Tensile-Strength Bolts, Nuts, and Washers	852.2.03
Shear Connectors	512
Elastomeric Pads	885.2.01
Plain Cotton Duck	881.2.01

Material	Section
Rubber-Impregnated Cotton Duck	881.2.02
Self-Lubricating Bronze Bearing and Expansion Plates Galvanizing and Bushings	857.2.03 ASTM A 153/A 153M

1. **Fasteners.** Use fasteners in their lubricated, as-delivered condition. Use black bolts oily to the touch. With galvanized assemblies, use nuts with a clean, dry lubricant that contrasts with the color of the zinc coating.
2. **Self-Lubricating Bronze Plates.** Use cast-bronze plates of the type shown on the Shop Drawings, unless otherwise shown on the plans.

501.2.01 Delivery, Storage, and Handling

A. Fasteners

Store fasteners to protect them from dirt and moisture. Take from storage only enough fasteners to install and tighten during a work shift. Return unused fasteners to protective storage at the end of the shift.

B. Structural Steel Members

1. Delivery

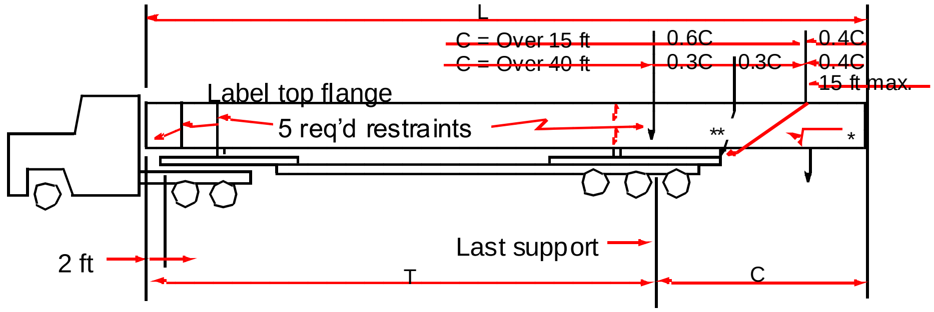
   Load, transport, and unload girders without excessive stress or damage.

   The Engineer will observe the delivery of beams or girders and will immediately notify the Contractor of damaged or unsatisfactory material before the material is unloaded or as soon as the damage is discovered.

   If members are improperly handled, the Inspector may withhold or remove the final stamp of approval.

   Use Figure 1, Figure 2, and the following loading specifications and shipping details for truck, rail, or barge transportation.

   a. Use chains and chain binders to secure beams and girders during shipping only if using a protective shield to prevent gouging flanges and if providing adequate bracing to prevent bending the top flanges.
   b. Keep the center of gravity of beams, girders, and heavy haunch sections as low as possible.
   c. Use access roads to safely deliver beams and girders to the site.



C = 0.2L min.
C = 0.3L max.

For short beams or girders supported on a flat bed the min. C may be disregarded.

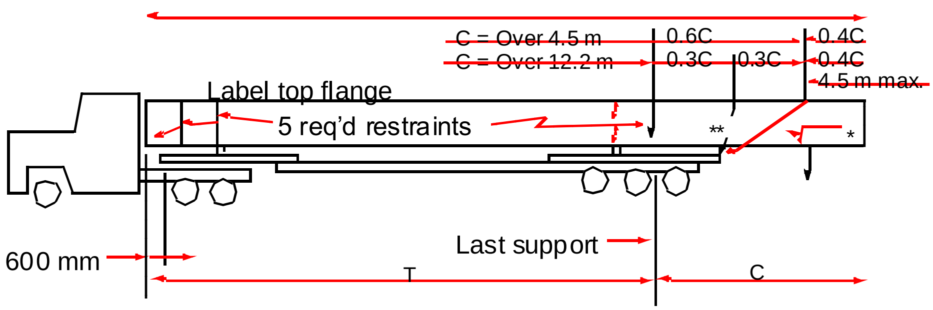
* If C = over 15 ft use additional restraint here.

** If C = over 40 ft use another restraint here.

0.4C may be increased to 15 ft to cut down or restraint length, or where angle is too flat.

Beam of overhang ends shall be restrained against flapping horizontally and vertically.

FIGURE 1



C = 0.2L min.
C = 0.3L max.

For short beams or girders supported on a flat bed the min. C may be disregarded.

* If C = over 4.5 m use additional restraint here.

** If C = over 12.2 m use another restraint here.

0.4C may be increased to 4.5 m to cut-down or restraint length, or where angle is too flat.

Beam of overhang ends shall be restrained against flapping horizontally and vertically.

FIGURE 1 (METRIC)

Table of Dimensions—Feet					
1	Min. C & T		Remarks	Min. C & T	
75	15	60		22.5	16.5
80	16	64		24	17
85	17	68		25.5	18.1
90	18	72	Max C for 30 in WF →	27	19.2
95	19	76	Max C for 33 in WF →	28.5	20.3
100	20	80	Max C for 36 in WF →	30	21.3
105	21	84		31.5	22.4
110	22	88		33	23.5
115	23	92		34.5	24.5
120	24	96	Preferred Max C for PLG →	36	25.6
125	25	100		37.5	26.7
126	26	100		37.8	88.2
127	27	100		38.1	88.9
128	28	100		38.4	89.6
129	29	100		38.7	90.3
130	30	100		39	91
131	31	100		39.3	91.7
132	32	100		39.6	93.1
133	33	100		39.9	93.1
134	34	100	Max C for PLG →	40.2	93.8

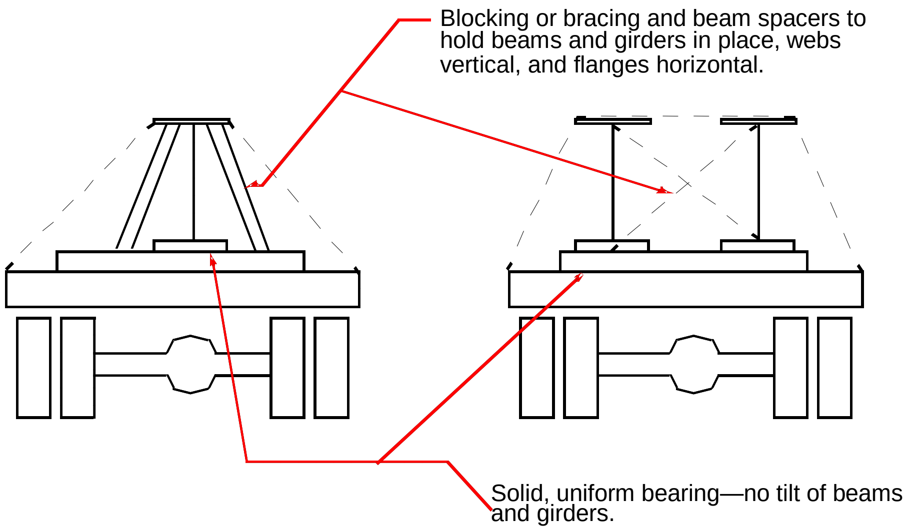


FIGURE 2

Table of Dimensions—Feet					
1	Min. C & T		Remarks	Min. C & T	
23	4.5	18.2		6.9	16
24	4.9	19.5		7.3	17
26	5.2	20.7		7.8	18.1
27	5.5	21.9	Max C for 760 mm WF →	8.2	19.2
29	5.8	23.2	Max C for 838 mm WF →	8.7	20.3
30	6.1	24.3	Max C for 914 mm WF →	9.1	21.3
32	6.4	25.6		9.6	22.4
34	6.7	26.8		10	23.5
35	7	28		10.5	24.5
37	7.3	29.3	Preferred Max C for PLG →	11	25.6
38	7.6	30		11.4	26.7
38.4	7.9	30		11.5	26.9
38.7	8.2	30		11.6	27.1
39	8.5	30		11.7	27.3
39.3	8.8	30		11.8	27.5
39.6	9.1	30		11.9	27.7
39.9	9.4	30		12	28
40.2	9.7	30		12.1	28.2
40.5	10	30		12.2	28.4
40.8	10.4	30	Max C for PLG →	12.3	28.6

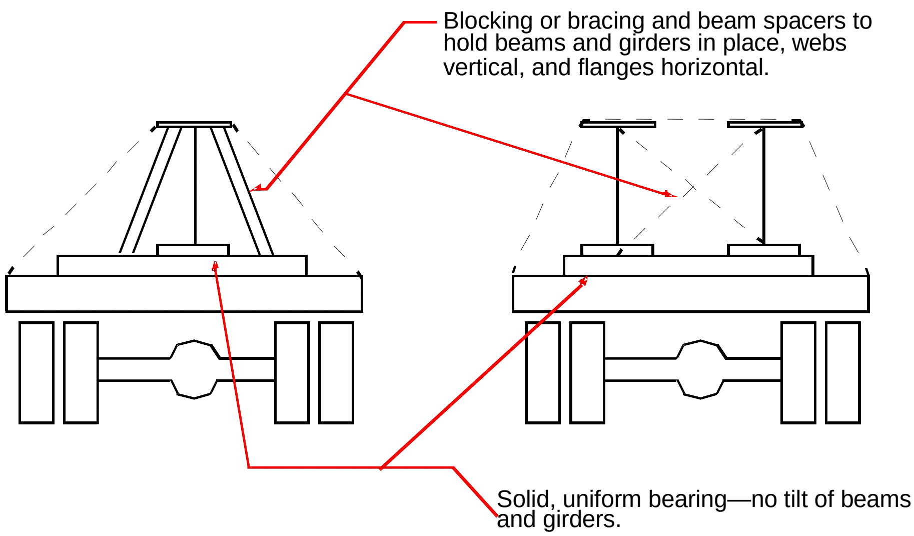


FIGURE 2 (METRIC)

2. Storage

Handle structural steel during storage in the same manner as during fabrication. See Subsection 501.2.01.B.2.a, *General* and Subsection 501.2.01.B.3, *Handling*.

a. General

Place beams and girders with their webs vertical. Shore, brace, or clamp beams and girders to resist lateral forces during storage. Keep steel free from dirt, oil, grease, or other contaminants and protect it from corrosion. Pitch trough sections to provide water drainage.

Do not stack beams and girders on each other.

Place long members on supports close together to prevent damage from deflection.

The Engineer will observe the storage and handling of beams or girders and ensure that they are satisfactory before erection.

b. Supports

The material on which the beams and girder supports are placed shall be firm, well-drained, unyielding, and not allow excessive or uneven settlement when the supports are loaded.

Store beams and girders on platforms, skids, or other supports on the ground above high-water elevation.

Shore supports with firm, well-drained unyielding material. Use material that settles evenly when the supports are loaded.

Support beams and girders adjacent to the bearings and at intervals of no more than 25 ft. (7.5 m). Use enough intermediate supports to prevent damage from deflection.

3. Handling

Handle steel members with clamps, plate hooks, or devices to avoid nicks, gouges, or depressions. Do not use chains and chokers to handle steel members unless using a protective shield between the chain or choker and the member.

a. Beam and Girder Pick Up

Use spreader bars to lift beams and girders over 50 ft. (15 m) in length.

One-point pickups are allowed for beams and girders less than 50 ft. (15 m) long.

Use two-point pickups so the amount of overhang and distance between hooks does not exceed the distances in the following table:

Beam Size	30 in. (760 mm) WF	33 in. (840 mm) WF	36 in. (920 mm) WF	Plate Girders
2-point pick-up distance between hooks linear feet (meters) maximum	74 (22)	80 (24)	85 (26)	100(30)
2-point pick-up overhang linear feet (meters) maximum	25 (7)	28 (8)	30 (9)	35 (10)
WF = Wide Flange				

If using pick-ups that cause long overhangs, attach lines at beam ends to control movement.

b. Beam and Girder Protection

Keep webs of beams and girders vertical while handling. Never drop, throw, or drag beams and girders.

Do not allow beams or girders to bend about the weak axis, even under their own weight. When shipping beams or girders upside-down, use caution when turning them over for shipment and turning them right-side up at their destination. Use enough blocking and pick-up points to prevent excess stress on the girder.

501.3 Construction Requirements

501.3.01 Personnel

A. Fabricators

Employ structural steel fabricators certified under the AISC Certification Program, Category III—Major Steel Bridges.

B. Welders

Qualify field welders according to ANSI/AASHTO/AWS D 1.5. Employ certified welders who possess a current welding certification card issued by the Department’s Office of Materials and Research.

501.3.02 Equipment

A. Tension Measuring Device

Have a tension measuring device at all job sites where High Tensile-Strength bolts are installed and tightened. Use the tension-measuring device to:

- Confirm the proper snug tight and final installation bolt tension
- Calibrate wrenches properly
- Ensure the bolting crew understands the importance of proper bolt tensioning

At least once a year, have an approved testing agency calibrate the tension-measuring device to confirm its accuracy.

B. Wrenches

If using the calibrated wrench method to tighten HTS bolts, calibrate the wrench at least once each working day for each diameter, length, and grade of bolt to be installed. Recalibrate the wrench when adding or deleting the air hose, changing compressors, or performing similar tasks.

Use the wrench in job-site tightening under the exact conditions that it was calibrated. Recalibrate wrenches if a significant difference is noted in the surface condition or level of lubrication of the bolt threads, nuts, or washers.

C. Ovens

Use electric drying ovens approved by the Engineer to dry electrodes according to ANSI/AASHTO/ AWS D 1.5.

D. Lifting Equipment

Use proper lifting equipment that can carefully handle steel members without bending, twisting, damaging, or excessively stressing parts. Use cranes that have at least a two-part line for lifting.

The Department will terminate shop inspection if lifting equipment is operated or maintained in a hazardous manner.

E. Erection Equipment

Proposed erection equipment is subject to the Engineer’s review. Even with this review, assume responsibility for providing adequate and safe equipment and for carrying out the work according to the plans and specifications. Begin erection only after the Engineer’s review.

501.3.03 Preparation

A. Installation Method Testing for Bolted Construction

Before beginning the bolting operation, the Engineer will verify the Contractor’s installation method. Verification will determine if the method used (calibrated wrench or turn-of-nut) will produce the correct bolt tension in the HTS structural bolts of the completed connection.

If the method is successful, the total clamping force of bolts will be transferred to the connected members and will resist slipping through friction.

Do not use bolts tightened during installation method tests or use other previously used HTS structural bolts in the work.

1. Verification Procedures for Both Methods

   Test both methods of tightening (calibrated wrench or turn-of-nut) with the following procedures:

   a. Select three assemblies (bolt, nut, and washer) from each diameter, length, and grade to be installed.
   b. Install each bolt, nut, and washer into the tension-measuring device.
   c. Install enough spacers or washers so that at least 3 but not more than 5 full threads are between the nut face and the underside of the bolt head.
   d. Use the same type of element (nut or bolt head) as will be used in the work. Place a hardened washer under the turned element.
   e. Snug tighten each assembly using the procedure that will be used in the work.
   f. After snug tightening, place appropriate marks on the end of the bolt stick out and nut, bolt head and tension calibrator, or drive socket and tension calibrator.

2. Calibrated Wrench Method Verification

   a. Impact Wrench

      When using an impact wrench:

      1) Tighten each of the three assemblies beyond snug tight.
      2) Adjust the wrench to cut out at a tension no less than 5 to 10 percent higher than the appropriate tension shown in Table A: Required Fastener Tension.

         Bolts tightened to this cut-out point should consistently develop the required minimum tension. This cut-out point shall be the actual job-site setting.

   b. Manual Torque Wrench

      When using a manual torque wrench:

      1) Tighten each of the three assemblies beyond snug tight.
      2) Note the torque required to induce a bolt tension 5 to 10 percent higher than the appropriate tension shown in Table A: Required Fastener Tension.
      3) Measure torque with the nut in rotation.
      4) Average the three tests to find the minimum torque to use for job-site installation tightening.
      5) If the torque wrench produces erratic results, do not use that wrench.

3. Turn-of-Nut Method Verification

   When using the turn-of-nut method, tighten the three assemblies beyond snug tight to the appropriate rotation shown in Table B: Nut Rotation from Snug Tight. Ensure that at this rotation, the minimum bolt tension is 5 to 10 percent higher than the appropriate tension shown in Table A: Required Fastener Tension.

Table A: Required Fastener Tension		
Nominal Bolt Diameter and Thread Pitch	Minimum Tension (1) in kips (kN)	
	ASTM A325 (A 325M)Bolts	ASTM A490 (A 490M) Bolts
1/2	12	15
5/8 (M 16 x 2)	19 (91)	24 (114)
3/4 (M20 x 2.5)	28 (142)	35 (179)
7/8 (M22 x 2.5)	39 (176)	49 (221)
1 (M24 x 3)	51(205)	64 (257)
1-1/8 (M27 x 3)	56 (267)	80 (334)
1-1/4 (M30 x 3.5)	71(326)	102(408)
1-3/8	85	121
1-1/2 (M36 x 4)	103 (475)	148 (495)

(1) Equal to 70 percent of specified minimum tensile strengths of bolts (as specified in ASTM specifications for tests of full-size A 325 (A 325M) and A 490 (A 490M) bolts with UNC (metric) threads loaded in axial tension) rounded to the nearest kip (kN).

Table B: Nut Rotation(1) from Snug Tight			
Bolt Length (measured from underside of head to end of bolt)	Both faces normal to bolt axis	One face normal, one faced sloped not more than 1:20	Both faces sloped not more than 1:20
4 x bolt diameter or less	1/3 turn	1/2 turn	2/3 turn
Greater than 4 but no more than 8 x bolt diameter	1/2 turn	2/3 turn	5/6 turn
Greater than 8 but no more than 12 x bolt diameter	2/3 turn	5/6 turn	1 turn

(1) Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by 1/2 turn or less, the tolerance of plus 30 degrees, minus 0 degrees applies. For bolts installed by 2/3 turn and more, a tolerance of plus 45 degrees, minus 30 degrees applies.

501.3.04 Fabrication

A. Straightening Material

Ensure that rolled material is straight to the mill tolerances provided in ASTM A 6/A 6M before it is laid off or worked. Use straightening methods that do not injure the metal. Sharp kinks and bends will be cause for rejection the material.

B. Using Stock Material

The fabricator may use stock materials for minor Items whose quantity for the Project is less than the minimum required for mill rolling if the following requirements are met:

1. Mill test reports show that the stock material meets the requirements of the specifications.
2. The stock material is identifiable by heat number and mill test report so the Inspector can determine if the material meets the required specification.

Instead of these requirements, the Engineer may take representative stock samples and test them at the Contractor's expense.

C. Identifying Steel

Provide a system of assembly-marking individual pieces and the issuance of cutting instructions to the shop that will maintain identity of the mill test report number.

Before cutting or placing individual pieces of steel in stock for later use, mark the pieces with the following:

- Mill test report number
- Heat number
- Color code, if any

Transfer heat numbers and color codes only in the presence of the Inspector.

Color code steel pieces according to ASTM A 6/A 6M specification identification. Establish and record an individual color code for steels not included in the A 6/A 6M specification.

If steel is subject to fabrication that might erase a painted color code mark before assembly, stamp it with a steel die or attach a tag.

D. General Procedures

1. **Marking Steel.** Mark finished beams or girders with the following:
   - Erection mark or match mark according to the erection diagram on the shop drawings.
   - Weight, if a member weighs more than 3 tons (3 Mg).
2. **Edge Planing.** Plane sheared edges of plates more than 5/8 in. (16 mm) thick to a depth of 1/4 in. (6 mm).
3. **Re-Entrant Cuts.** Fillet re-entrant cuts, notch free, to a radius of at least 3/4 in. (19 mm).
4. **Oxygen Cutting.** Steel may be oxygen-cut if the following is obtained:
   - Smooth surface free of notches and cracks
   - Accurate profile using a mechanical guide

   Ensure that oxygen cutting conforms with AWS D 1.5. Oxygen-cut by hand only where approved.
   After cutting, round the corners of oxygen-cut surfaces to a 1/16 in. (2 mm) radius by grinding.
5. **Cambering.** The camber shown on the plans is that required after completely fabricating the member, including attaching cover plates and shear connectors. Do not use cambering methods that will induce stresses that may impair the service life of the member.
   a. Obtain camber for plate girders by cutting both edges of the web after the shop web splices are complete and have been inspected.
   b. Apply heat no hotter than 1,150 °F (620 °C) to adjust deviations from the camber ordinates (shown on the Shop Drawings) caused by web distortion from either of the following:

      Oxygen cutting
      Weld metal shrinkage
   c. Obtain camber for rolled beams with approved heat-cambering methods.

6. Finishing Bearing Surfaces

Ensure that the surface finish of bearings, base plates, and other bearing surfaces in contact with each other or with concrete meets the ANSI surface roughness requirements, defined in ANSI B 46.1 Part 1, as follows:

Surface	Finish Requirement
Steel slabs	ANSI 2,000 (50 µm)
Heavy plates in contact in shoes to be welded	ANSI 1,000 (25 µm)
Milled ends of compression members and milled or ground ends of stiffeners and fillers	ANSI 500 (12.5 µm)
Bridge rollers and rockers	ANSI 250 (6.3 µm)
Pins and pin holes	ANSI 125 (3.2 µm)
Sliding bearings	ANSI 125 (125 µm)

Finish surfaces that contact metal or masonry as specified below.

a. **Sole and Bearing Plates.** Ensure that sole and bearing plates have full contact when assembled. Straighten warped or deformed plates before machining; then do one of the following to the surfaces of plates contacting masonry:

   1) Machine the surfaces to an ANSI 2,000 (50 µm) surface roughness rating value.

   2) Straighten the surfaces so that the maximum clearance under a straightedge placed across the bearing surface in any direction is 1/16 in. (2 mm)

b. **Cast Pedestals and Shoes.** Machine the surfaces of cast pedestals and shoes that contact metal surfaces.

c. **Bearing Assemblies.** Finish fabricated bearing assemblies according to Subsection 501.3.04.D.6, *Finish Bearing Surfaces*.

   Perform final machining after the assembly is completely fabricated. If the completed assembly must be heat-treated, perform final machining after the heat treatment.

d. **Plates in Contact with Elastomeric Pads.** Ensure that the plates are straight and free of loose mill scale. Do not machine-finish the surface in contact with the elastomeric pad.

e. **Direction of Cut.** Machine the faces of movable surfaces and their opposing contact surfaces so that the finish cut is in the direction of the expected movement, unless using non directional finishing equipment.

f. **Abutting Joints**. In compression members (and tension members when specified on the plans), face the abutting joints and bring them to even bearings. When facing joints is not required, ensure an opening of 1/4 in. (6 mm) or less.

7. Annealing and Stress Relieving

After heat treatment, machine-finish, bore, and straighten the structural members required by the plans to be annealed or normalized. Perform full annealing and normalizing according to ASTM A 919 and the following:

a. During heating and cooling, keep the furnace temperature uniform so the temperature difference between any two points on a member does not exceed 100 °F (40 °C).

b. Record each furnace charge to identify the pieces in the charge and show the temperatures and schedule used.

   The method of recording the treatment operation procedures is subject to the Inspector’s approval.

c. Provide proper instruments, including recording pyrometers, to determine member temperatures in the furnace.

d. When the Contract requires, stress-relieve welded bridge shoes, pedestals, and other similar weldments according to AWS specifications.

8. **Component Fabrication**

a. Beam and Girder Ends

Fabricate the ends of beams and girders to be vertical in the final erected position, unless otherwise shown on the plans.

b. End Connection Angles

Build end connection angles to the exact length shown on the plans, measured between the heels of the connection angles. The allowed tolerance is plus 0 to minus 1/16 in. (plus 0 to minus 2 mm).

Where continuity is required, face end connections. Ensure that the connection angle thickness after facing is no less than 3/8 in. (10 mm) or the amount shown on the plans.

c. Steel Joints

At the shop, shape the plates, angles, or other structural shapes to conform to the section of the concrete deck. Ensure that painting and other fabrication requirements conform to the specifications for these Items.

d. Bent Plates

Ensure that unwelded, cold-bent, load-carrying, rolled steel plates meet the following requirements:

1) The bend lines are at right angles to the rolling direction.

2) The plate will not crack during bending.

Minimum bend radii, measured to the concave face of the metal, for all grades of steel used in this specification, are shown in the following table:

Thickness “T” in Inches (Millimeters)	Minimum Bend Radii
Up to ½ (12)	2 T
Over 1/2 to 1 (12 to 25)	2-1/2 T
Over 1 to 1-1/2 (25 to 38)	3 T
Over 1-1/2 to 2-1/2 (38 to 60)	3-1/2 T
Over 2-1/2 to 4 (60 to 100)	4 T

Low-alloy steel in thicknesses over 1/2 in. (12 mm) may require hot bending for small radii. If a shorter radius is essential, bend plates hot at 1,200 °F (650 °C) or less. Ensure that hot-bent plates have bend lines at right angles to the rolling direction.

3) Round the corners of plates to a radius of 1/16 in. (2 mm) before bending.

e. Stiffeners

Ensure that bearing stiffeners and stiffeners used as supports for concentrated loads have full bearing on the flanges they transmit load to or the flanges they receive load from. Mill or grind the bearing surfaces of stiffeners.

On weldable steel in flange compression areas, the Contractor may weld stiffeners as shown on the plans.

Ensure that stiffeners not located at points of concentrated loads fit tightly enough to keep water out after painting, unless otherwise shown.

f. Pins

Turn pins accurately to the dimensions shown on the Shop Drawings. Ensure that pins are straight, smooth, and flawless. The pins may be forged and annealed or of cold-finished, carbon steel shafting.

Furnish two pilot nuts and two driving nuts for each size of pin, unless otherwise specified.

g. Pin Holes

Bore pin holes in members so they are:

True to the specified diameter

Smooth

Straight

At right angles to the axis of the members

Parallel with each other, unless otherwise required

Produce the final surface with a finishing cut. Bore holes in built-up members after completing bolting or welding.

Ensure that pin hole diameters meet the following requirements:

Pin Diameter	Pin Hole Diameter
5 in. (125 mm) or less	Must not exceed pin diameter by more than 1/50 in. (0.50 mm)
Larger than 5 in. (125 mm)	Must not exceed pin diameter by more than 1/32 in. (0.75 mm)

h. Threads

For structural steel construction, use threads for bolts and pins that conform to the Unified Screw Threads ANSI B1.13 (Metric Screw Threads, ANSI B 1.13M), Class 2A for external threads, and Class 2B for internal threads except pin ends with a diameter of 1 3/8 in (35 mm).

i. Unfinished and Turned Bolts

1) Bolts

Do not use ribbed bolts. Use unfinished bolts or turned bolts that conform to ASTM F 568M Class 4.6. Use bolts with single self-locking nuts or double nuts unless otherwise shown.

Use turned bolts with an ANSI surface roughness rating of 125 (3.2 μm).

2) Washers

Use beveled washers when bearing faces have a slope of more than 1 to 20 with respect to a plane normal to the bolt axis.

3) Heads and Nuts

Use hexagonal heads and nuts with standard dimensions for bolts of nominal size specified or of the next larger size. Provide a washer under the nut.

Use threads with a diameter equal to the body or nominal diameter of the bolt specified. For turned bolts, threads shall be entirely outside of the holes.

j. Anchor Bolts

Use anchor bolts of the size and shape specified on the plans.

9. Coating Machine-Finished Steel Surfaces

Coat the following with rust-inhibiting grease or with other approved corrosion-preventive compounds:

- Opposing surfaces of sliding bearings
- Mating convex and concave surfaces of curved plates and rocker bearing assemblies
- Sliding surfaces opposite self-lubricating bronze surfaces
- Pins and pinholes

Coat other machined surfaces with one coat of the shop primer specified on the plans. Include convex faces of rockers and sole plates at fixed bearings of spans that have line bearings on steel plates.

10. Shop Painting

Perform shop painting according to Section 535, especially Subsection 535.3.05.C, *Paint New Steel Structures*, step 5.

E. Bolt Holes

Produce bolt holes as follows:

1. Full-Size Punched Holes

   The Contractor may use full-size punched holes if these conditions exist:

   - A member is composed of 5 or less separate thicknesses of metal, and
   - The metal thickness of any one part is 3/4 in. (19 mm) or less for structural steel, or 5/ 8 in. (16 mm) or less for high-strength steel.

   Poor hole matching will be cause for rejection. Punch holes as follows:

   a. Punch holes 1/16 in. (2 mm) larger than the nominal diameter of the bolts.
   b. Do not punch full-sized holes on field connections of main members.
   c. Ensure that the die diameter for punched or sub punched holes does not exceed the punch diameter by more than 1/16 in. (2 mm).
   d. Cut holes clean to avoid torn, ragged edges.
   e. Enlarge holes by reaming.

2. Sub punched and Sub drilled Holes

   Sub drill holes 3/16 in. (5 mm) smaller than the nominal diameter of the bolts.

   After assembly, ream the holes if any one of the conditions exists:

   - A member is composed of more than 5 separate thicknesses of metal.
   - The metal thickness of any one main part is greater than 3/4 in. (20 mm) for structural steel or 5/8 in. (16 mm) for high-strength steel.
   - When required according to Subsection 501.3.05.E.1, *Normal Assembly*, step b.

   Instead of sub punching and sub drilling, the Contractor may drill holes from the solid after assembly. However, whether drilling from the solid or sub drilling and sub punching, ensure the following:

   a. Holes are no more than 1/16 in. (2 mm) larger than the nominal diameter of the bolts.
   b. Holes for turned bolts are sub punched or sub drilled.
   c. Holes are carefully reamed after assembly to provide a light-driving fit with the bolt.

3. Accuracy of Punched, Sub punched, and Sub drilled Holes

   Accurately full-size punch, sub punch, or sub drill holes so that after assembly but before reaming, holes meet the following requirements:

   - A cylindrical pin 1/8 in. (3 mm) smaller than the nominal diameter of the punched hole can enter perpendicular to the face of the member in at least 75 percent of the adjacent holes in the same plane without drifting.
   - A pin 3/16 in. (5 mm) smaller than the nominal diameter of the hole can pass through the hole.

   If either of these requirements is not met, the faulty pieces will be rejected.

4. Reamed and Drilled Holes

   Ensure that reamed and full-sized drilled holes are cylindrical, perpendicular to the member, and 1/16 in. (2 mm) larger than the nominal diameter of the bolts. Ream and drill holes as follows:

   a. Direct reamers using mechanical means when practical.
   b. Ream and drill with twist drills.
   c. Remove burrs on outside surfaces. Disassemble parts, if required, to remove burrs caused by drilling or reaming.
   d. For connecting parts that require reamed or drilled holes, do the following:
      1) Assemble the connecting parts.
      2) Hold them securely while reaming or drilling.
      3) Match-mark them before disassembling.

5. Accuracy of Reamed and Drilled Holes

   After drilling and reaming holes, ensure that at least 85 percent of the holes in any group have no offset greater than 1/32 in. (0.75 mm) between adjacent thicknesses of metal. Make sure the remaining holes are not elongated or show an offset greater than 1/16 in. (2 mm) between the adjacent thicknesses of metal.

6. Fitting Up

   Before reaming, drilling, or bolting, ensure that the pieces forming built-up members are:

   - Straight
   - Close-fitting
   - Clean
   - True to the required dimensions
   - Free from twists, bends, open joints, burrs, and other defects resulting from faulty fabrication or workmanship
   - Well-pinned
   - Firmly drawn together

   Before shop bolting material with full-size punched holes:

   a. Ensure that holes are no more than 1/16 in. (2 mm) larger than the nominal diameter of the bolt.

      Holes may be spear-reamed if necessary to clear and clean them for entering bolts.
   b. Carefully adjust end connection angles and similar parts to the correct position and firmly hold them in place until bolted.
   c. Fit up connections securely before placing bolts.
   d. Ream or drill unfair holes (holes that prevent the bolt from entering).

F. High Tensile-Strength Bolt Connections

This section covers the shop and field connections of structural joints using High Tensile-Strength bolts tightened to a specified tension. Use HTS structural bolts that meet the requirements of Subsection 852.2.03, *High Tensile-Strength Bolts*. Furnish the bolts, nuts, and washers according to Subsection 852.2.03.

To seat parts solidly, keep joint surfaces (including those adjacent to the bolt heads, nut, or washers) free of scale (except tight mill scale), dirt, burrs, metal spatters, and other defects. Ensure that joint contact surfaces are free of oil, grease, paint, lacquer, galvanizing, rust, and other matter. Refer to the requirements of Subsection 535.3.05.C, *Paint New Steel Structures* step 5.

Install fasteners with a hardened washer under the nut or bolt head, whichever is the element turned in tightening.

- When the slope of the bolted-part surfaces contacting the bolt head and nut do not exceed 1:20 (with respect to a plane normal to the bolt axis), use a flat washer.

- When the slope of an outer face of the bolted parts exceeds 1:20, use a smooth, beveled washer.
- If necessary, clip washers on one side to a point no closer than 85 percent of the bolt diameter from the center of the washer.

When a joint assembly is complete, ensure that each bolt has a tension 5 to 10 percent above the required minimum value shown in Table A: Required Fastener Tension.

G. High Tensile-Strength Bolt Tightening Methods

Tighten HTS bolts with either the Calibrated Wrench Method or the Turn-of-Nut Method. For both methods, conduct the final rotation of the nut or bolt (whichever is the turned element) from a snug-tight condition according to Table B: Nut Rotation from Snug Tight.

Snug tight is the tightness achieved when the plies of the joint are in firm contact. Obtain this with a few impacts of an impact wrench or with full effort using an ordinary spud wrench. Ensure that the snug tightening procedure produces 10 to 30 percent of the required fastener tension shown in Table A: Required Fastener Tension.

1. Calibrated Wrench Method

   Install bolts in the connection holes with a hardened washer under the turned element and bring the bolts up to snug tight (described above) as follows:

   a. Snug tighten systematically from the most rigid part of the connection to the free edges as follows:
      1) Start the tightening pattern at the center of the pattern near the end of each member being spliced.
      2) Work toward the edges of the splice plate.
   b. After the initial snug tightening, systematically tighten the bolts again as necessary using a similar tightening pattern until all bolts are simultaneously snug tight and the connection is fully compacted.
   c. Following snug tightening, tighten the bolts in the connection using a calibrated wrench (either air impact or manual torque). Systematically tighten from the most rigid part of the joint to its free edges.
   d. After the first pass, systematically tighten the bolts again to ensure that bolts that may have relaxed from tightening adjacent bolts are tightened to the prescribed amount.
   e. Operate impact wrenches until the wrench cuts out at the setting established by calibration.

      If using a manual torque wrench, measure the target torque with the turned element in motion.
   f. During installation in the assembled steel work, verify that the wrench adjustment selected by the calibration does not rotate the nut or bolt head from snug tight more or less than that permitted in Table B: Nut Rotation from Snug Tight.

2. Turn-of-Nut Method

   When bolts are too short to fit in the tension calibrating device, use the Turn-of-Nut Method in the actual work.

   Install bolt connection holes with a hardened washer under the turned element and bring the bolts up to snug tight (described above) as follows:

   a. Snug tighten the bolts using steps a and b of the Calibrated Wrench Method.
   b. Following snug tightening, tighten the bolts in the connection by the applicable amount of rotation specified in Table B: Nut Rotation from Snug Tight.
   c. During the tightening operation, do not rotate the part not turned by the wrench.
   d. Tighten systematically from the most rigid part of the joint to its free edges as follows
      1) Start the tightening pattern at the center of the pattern near the end of each member being spliced.
      2) Work toward the edges of the splice plate.

H. Welded Construction

Ensure that welded construction conforms to the requirements below. Electroslag or electragas welding is prohibited.

1. **Insufficient Welds.** Repair, remove, or replace welds that do not meet the requirements of the specifications using methods permitted by 3.7 of ANSI/AASHTO/AWS D 1.5 specifications. If the weld is unacceptable, the Engineer will reject the entire piece.

   After welding repairs are made, the Engineer will have the repaired areas retested to determine if the repairs meet specification requirements.
2. **Unauthorized Welds.** Obtain the Engineer's approval before making temporary or permanent welds not shown on the plans or permitted by the specifications.

I. Alterations to AASHTO Paragraphs

Ensure that welded construction conforms to the American Welding Society (AWS) *Bridge Welding Code* ANSI/AASHTO/AWS D 1.5 (including revisions) except as modified by these specifications and AASHTO. Exceptions to the ANSI/AASHTO/AWS specifications are noted below.

1. **Paragraph 3.5.2.** Instead of Paragraph 3.5.2, apply the following requirements:
   a. Before cutting ends to length, shop assemble ends of members to be field connected by welding in the laydown position (placed to grade from bearing to bearing).
   b. To align field splices vertically, match-cut adjoining ends while in the laydown position and matchmark the ends at the center point of the web section.
   c. Check rolled shapes with ends to be field welded before beginning fabrication in order to take into consideration allowed mill tolerances on web-center-line-to-flange measurements. Pair shapes to provide the best possible alignment.
2. **Paragraph 3.10.1.** Instead of Paragraph 3.10.1, apply the following requirements:
   a. Remove slag from welds immediately after completing each weld. Do not further clean or paint welds to be encased in concrete.
   b. For welds connecting swaybracing members to steel piling that are to be painted according to Subsection 535.3.05.E, *Paint Steel H-Piling, Metal Shell Piling, and Steel Swaybracing* and Subsection 535.3.05.F, *Apply Special Protective Coatings to Steel Piling, Steel Swaybracing, and Concrete Piling*, remove the slag and do not clean any further.
   c. Clean and paint other welds as specified below.
   d. After removing slag and after completing visual, ultrasonic, or magnetic particle inspection, either blast-clean or scrub welds with water and a stiff brush. Ensure that weld areas are clean and free of spatter, rust, loose scale, oil, and dirt.
   e. Prime welds on the same day they are cleaned, using the prime coat specified on the plans or in the Special Provisions. When using water to clean, ensure that the surface is dry before painting. Clean and prime welds as soon as practical after the weld is accepted and before the weld area rusts.
3. **Paragraph 4.30.1.** Instead of Paragraph 4.30.1, apply the following requirements:

   After welding studs to beams, visually inspect the studs and give a random number of them a light blow with a hammer. Strike the following with a hammer and bend them 15 degrees from the correct installation axis:
   - Studs that do not show a full 360-degree weld fillet.
   - Studs that do not ring when given a light blow with a hammer.
   - Studs that have been repaired by welding.

   In case of a defective or repaired weld, bend the stud 15 degrees in the direction that places the defective portion of the weld in the greatest tension.

   Replace studs that crack (either in the weld, base metal, or the shank) during inspection or subsequent straightening. See paragraph 4.30.4.

   On studs that must be replaced, the Contractor may manually weld the stud with the following fillet welds:

Stud Size	Fillet Weld
3/4 in. (19 mm)	Full 360 degrees–1/4 in. (6 mm)
7/8 in. (22 mm)	Full 360 degrees–5/16 in. (8 mm)
1 in. (25 mm)	Full 360 degrees–5/16 in. (8 mm)

501.3.05 Construction

A. Straightening Material

The Engineer may permit straightening of plates, angles, other shapes, and built-up members if the straightening is minor and can be accomplished in the field. Use only methods that do not injure the metal.

1. **Heat Straightening.** When the Engineer allows it, heat-straighten metal as follows:
   a. Ensure that parts to be heat-straightened are free of stress and external forces. The exception is stresses from the mechanical means used to apply the heat.
   b. Carefully apply a limited amount of localized heat under supervision:
      1) Heat the area to no more than 1150 °F (620 °C) as measured by temperature-indicating crayons, liquids, or bimetal thermometers.
      2) Cool the metal slowly after heating.

         After the metal cools naturally to 600 °F (315 °C), the Contractor may use air-mist spray cooling.
   c. After straightening a bend or knuckle, have the Engineer carefully inspect the metal surface for evidence of fracture and for general acceptability.

B. Erection

Proposed erection methods are subject to the Engineer's review. Even with this review, assume responsibility for providing adequate and safe methods and for carrying out the work according to the plans and specifications. Begin erection only after the Engineer's review.

1. Assemble Parts in the Field

   Before assembly, clean surfaces that will permanently contact each other.

   Assemble parts accurately, following the match marks, according to the plans and the erection diagram shown in the Shop Drawings.

   Do not hammer if it will injure or distort the members.

   Ensure that fitting-up and drifting done during field assembly and connection meet the requirements of Subsection 501.3.04.E.6, *Fitting Up*.
2. Erect Beam and Girder

   Before making field connections (bolting or welding) on continuous beams or girders, adjust splice joints to the correct elevations and slopes and properly align the beams.

   The Contractor may make beam and girder splices on the ground if using the proper blocking to give adjoining sections the correct relative slopes.
3. Place Anchor Bolts and Adjust Nuts

   Unless otherwise shown on the plans, provide formed holes for anchor bolts. Set the bolts using an approved non-shrinking mortar. Place anchor bolts as follows:
   a. After erecting structural steel, drop the bolt into the dry hole to ensure that it fits properly.
   b. Remove the bolt and fill the hole approximately two-thirds full with an approved non-shrinking mortar the consistency of thick paint.
   c. With even pressure or light hammer blows, force the bolt down until:

1) Mortar rises to the top of the hole.

2) The anchor bolt nut and washer rest firmly against the metal flange, plate, shoe, or pedestal.

3) The bolt has the correct projection above the top of the concrete bearing area.

d. Remove excess mortar flushed from the hole down to the concrete bearing area.

e. Clean holes or slots and metal surfaces in order to field paint surfaces properly and to allow moving parts to expand and contract without restraint.

f. Tighten nuts on anchor bolts that pass through beam and girder flanges or through sole plates attached to flanges as follows:

1) At both fixed and expansion ends, tighten nuts and bolts to bear on the washer and then back off one full turn.

2) Draw nuts on other anchor bolts down to a tight fit.

3) Do not burr anchor bolt threads.

g. Adjust the horizontal locations of the anchor bolts relative to the midpoint of slotted holes in bottom beam flanges according to the ambient temperature at bolt placement. This allows the beam and its attached bearing components to expand or contract in the future.

h. Do not grout anchor bolts within a complete unit until beam splicing within the unit is complete.

4. Erect Steel Joints

Erect steel joints so that the surface in the finish grade plane (laterally and longitudinally) is true and free of warping.

Keep joints from moving out of their correct position during concrete placement.

Cut loose temporary connections as soon as possible to avoid restraining expansion and contraction.

Note that openings shown on the plans are based on an erection temperature of 60 °F (15 °C). Make corrections in the opening size for the actual erection temperature, and maintain the required opening.

5. Connect Pins

Furnish pilot and driving nuts at no additional cost to the Department. Drive pins so that members take full bearing. Provide pin nuts and run them up tight. Burr the threads at the face of the nut.

6. Misfits

Correct misfits by reaming, cutting, and chipping during erection.

Immediately report to the Engineer errors that occur in shop fabrication or deformations from handling and transportation that prevent assembling and fitting up parts properly. The Engineer must approve the correction method.

Assume responsibility for misfits, errors in fabrication, and damage. Make corrections or replace parts at no additional cost to the Department.

C. Finishing Bearing Areas

7. Steel on Concrete

Unless otherwise required, level and finish bearing areas with a Type IV—Floated Surface Finish according to Subsection 500.3.05.AB.5, *Type IV—Floated Surface Finish.*

a. Finish so that steel joint members, shoes, and bearing plates have full and uniform bearing.

b. Correct improperly finished areas by approved means.

c. Ensure that shoes and plates are on the correct alignment and elevation.

d. Unless otherwise provided, place shoes and plates on layers of canvas (cotton duck) and red primer that conforms with Subsection 870.2.01.A.1, *No. 1A, Red Primer* as follows:

1) Coat the bearing area surface with red primer.

2) Place three layers of at least 8 oz (227 g) duck and coat each layer's top surface with red primer.

3) Position shoes or plates on the top layer of duck while red primer is still plastic.

4) Instead of red primer—saturated duck, the Contractor may substitute thin pads of an approved type and thickness.

8. Steel on Steel

Prepare bearing areas as follows:

a. Ensure that sole and bearing plates, rockers, and shoes that are designed to bear on one another fit with full bearing.

b. Keep contact areas free of dirt, grit, and other foreign matter.

c. Prepare machined surfaces that have been shop-coated according to Subsection 501.3.04.D.9, *Coating Machine-Finished Steel Surfaces* and that will be exposed after erection as follows:

1) Remove the shop coating.

2) Replace the coating with the same paint system used on structural steel components.

9. Steel on Self-Lubricating Bronze Plates

Prepare machined surfaces that have been shop-coated according to Subsection 501.3.04.D.9, *Coating Machine-Finished Steel Surfaces* and that will be in contact with self-lubricating bronze plates or bushings as follows:

a. Remove the shop coating.

b. Coat the surface with stick lubricant or liquid furnished by the manufacturer of the self-lubricating bronze material.

10. Steel on Elastomeric Pads

Place elastomeric pads on concrete bearing areas that have the Type IV—Floated Surface Finish specified in Subsection 500.3.05. AB.5, *Type IV—Floated Surface Finish*, unless otherwise required.

Ensure that plates that will contact elastomeric pads meet the *no paint* requirements of Subsection 535.3.05.C.5.e, *Plates That Touch Elastomeric Pads*.

D. Field Painting

Field paint according to Section 535 using the paint system required by the plans or Special Provisions. See also Subsections 501.3.05.C.2, *Steel on Steel*, and 501.3.05.C.4, *Steel on Elastomeric Pads*.

E. Assembly

Allow only enough drifting during assembly or field connections to bring the parts into position. Ensure that drifting does not enlarge or distort holes.

Follow these requirements when shop assembling components.

1. Normal Assembly

Do normal shop assembly as follows:

a. Unless otherwise specified, and before reaming, assemble each individual, full-length continuous beam, tower face, bent, rigid frame, or plate girder in the shop.

b. Subpunch or subdrill and ream bolt holes in field connections and splices according to Subsection 501.3.04.E.1, *Full-Size Punched Holes*, and Subsection 501.3.04.E.2, *Subpunched and Subdrilled Holes*, while assembled in the shop.

c. Obtain approval of the assembly, including the camber, alignment, accuracy of holes, and faced joints.

d. On holes for the field connections of the ends of floor beams and stringers, do one of the following while members are assembled:

Subpunch and ream the holes

Ream to a steel template

2. Complete Assembly

   When the Contract requires, make the complete shop assembly of an entire structure or a portion of it, including the floor system.

3. Partial Assembly

   When authorized by the Engineer or Inspector, modify the shop assembly requirements above to permit partial shop assembly as follows:

   a. For plate girders, continuous beams, rigid frames, and columns of bents and towers, assemble at least three abutting sections.

   b. When the plans require that the ends of compression members be faced, assemble these members with faced ends in full bearing.

4. Reaming and Drilling Through Templates

   Ream and drill through templates as follows:

   a. Use steel templates with hardened steel bushings in holes accurately dimensioned from the center lines of the connection (inscribed on the template) and from the finished end of the template.

   b. Use center lines to accurately locate the template from the milled or scribed ends of members.

   c. Use exact duplicate templates to ream matching members or the opposite faces of any one member.

   d. Accurately locate templates for connections on like members so that like members are duplicates and require no match-marking.

   e. Full-size ream or drill field connections through templates after locating the templates by position and angle and bolting the templates firmly in place.

   f. When using templates to ream field connections of web members of a bent, tower, or girder, do the following:

      1) Face or scribe at least one end of each web member normal to the long axis of the member.

      2) Accurately set the templates at both ends from the faced or scribed end.

5. Match-Marking

   According to the erection diagram, match-mark connecting parts assembled in the shop to ream holes in field connections.

501.3.06 Quality Acceptance

A. Testing and Inspection

1. Heat Number Testing

   The Department will sample and test each heat number that structural steel is furnished from to fabricate main members.

   To facilitate this testing, ship one piece from each heat of main member structural steel to the fabrication site. Provide pieces long enough to take a properly oriented, representative, 4 x 12 in (100 x 300 mm) sample. This may require that the extra length pieces be 4 or 12 in. (100 or 300 mm) longer, depending on testing orientation requirements.

2. Fastener Assembly Testing

   Upon receiving HTS fastener assemblies (bolts, nuts, and washers), notify the Inspection Services Branch of the Office of Materials and Research. The branch will verify that the Contractor has the documentation required by Subsection 852.2.03, *High Tensile-Strength Bolts* and sample the assemblies as necessary.

3. Bolted Construction Inspection

   The Inspector will check the following before or during the bolting operation. Provide the Inspector easy access to the areas of the member to be inspected.

The Inspector will:

a. Verify that bolt tension calibrators have been calibrated within the last year. Ensure that the manual torque wrenches have been calibrated at least daily for each diameter, length, and grade as shown in this specification.

b. Ensure that bolts are routinely installed to the proper tensions. After inspection, no further evidence of proper bolt tension is necessary.

If installation tension verification is necessary subsequent to installation and tightening of bolts, notify the Inspection Services of the Office of Materials and Research.

c. Monitor the surface condition and storage of bolts, nuts, and washers. See Subsection 501.2.01.A, *Fasteners*, for storage requirements.

d. Ensure that each bolting crew member understands the procedure for snug-tightening the joint and can demonstrate this knowledge by tightening a fastener in a bolt-tension calibrator.

e. Witness the installation method verification procedure and ensure that the same conditions exist during the job-site tightening.

f. Witness fastener installation to ensure proper tightening. This monitoring will verify that plies of connected material are drawn together and that the procedure for snug tightening is followed.

g. Witness the final tightening procedure and mark at least two bolts in each connection to verify that further tightening (from the snug tight position) produces the rotation specified in Table B: Nut Rotation from Snug Tight.

4. Material Application and Traceability Verification

In addition to the requirements specified in Subsection 501.3.04.C, *Identifying Steel*, the fabricator shall demonstrate by written procedures and by actual practice a material application and traceability method for the main stress-carrying elements of a shipping piece. The method must be visible at least through the fit-up operation.

The traceability method shall verify proper material application as it relates to the following:

- Material specification designation
- Heat number
- Material test reports for special requirements

5. Mill and Shop Inspection

Give two weeks' notice to the Department's State Materials and Research Engineer (the Materials Engineer) before beginning mill or shop work so that inspection arrangements can be made. Inspection at the mill or shop is intended to facilitate work and avoid errors and does not relieve the Contractor of the responsibility for imperfect material or work quality.

Do not roll or fabricate material until:

- You inform the Materials Engineer where the orders have been placed.
- The inspection is arranged or waived.

Furnish the facilities necessary for the inspection of materials and work quality in the mill and shop. Allow Inspectors free access to the necessary mill and shop locations, and cooperate with the Inspector during inspection.

Shop inspection is required for steel and other metal materials being fabricated.

Inspectors will do the following:

a. Determine if steel members, member components, or other fabricated steel components meet the plans and specifications.

b. Identify the steel by color code and correlate its heat numbers obtained from certified mill test reports

NOTE: Do not cut steel or apply prime paint until the Inspector completes this step.

c. Check fabrication, especially the grade of steel, dimensions, welding, and bolting

d. Perform necessary non-destructive testing to determine conformance with the specifications and plans.

e. Reject materials or work that does not meet the specifications.

NOTE: Even if the Inspector accepts materials or members, they can be rejected later if found defective. Promptly replace or repair rejected material or members at no additional cost to the Department.

B. Quality of Work and Finish

Provide quality work and finish on shop work. Ensure that shearing, flame cutting, and chipping are neat and accurate. Neatly finish all parts of the work.

C. Welded Construction

6. Inspection

An Inspector will be assigned to the fabrication shop for as much time as the State Materials and Research Engineer deems necessary. The State's Inspector or authorized representative will inspect fabrication phases that include, but are not limited to, the following:

- Certification and transfer of heat numbers and grade steel
- Dimensions and assembly
- Inspection and testing of shop welds
- Non-destructive testing
- Painting
- Random sampling
- Stamp of shop inspection

7. Quality Control

Assume the following quality control responsibilities for non-fracture critical and fracture critical members and their components:

a. Perform 100-percent nondestructive radiographic or ultrasonic testing of full penetration welds before offering the welds to the State for quality assurance inspection.

b. Perform magnetic particle testing of fillet welds according to ANSI/AASHTO/AWS D 1.5.

8. Qualification

Qualify shop weld procedures and welders according to ANSI/AASHTO/AWS D 1.5. The Engineer may accept tests conducted by other states as evidence of qualification. In the absence of approved shop weld procedures, welding operator and welder qualifications, qualify with the State Materials and Research Engineer as follows:

a. In the presence of the Engineer's representative, prepare test plates according to ANSI/AASHTO/AWS D 1.5.

b. Requalify according to ANSI/AASHTO/AWS D 1.5 or whenever the Engineer requires. A new welding procedure qualification is not needed at the start of each new Project.

9. Testing

Furnish labor and equipment to do the following:

- Position welds for magnetic particle testing
- Help transport ultrasonic equipment
- Provide the Inspector easy access to testing areas

The Inspector's access to work in the shop and field is top priority.

The Department of Transportation, in its routine quality assurance inspection, will ultrasonic or magnetic-particle test approximately 25 percent of the welds.

If testing indicates faulty work, the Inspector will immediately notify the Contractor of the necessary corrective work. Ensure that welders are available to repair faulty work as soon as practical.

a. **Non-destructive Testing.** If weld cracking occurs, non-destructive testing for Final Acceptance of fillet and groove welds may be delayed to:

   Within 24 hours after welding has been completed for material 2 in. (50 mm) or less

   Within 48 hours after welding has been completed for material over 2 in. (50 mm).

   The fabricator may use, at its expense, nondestructive testing methods other than those specified to examine weld passes or completed welds. Refer to ANSI/AASHTO/AWS D 1.5.

b. **Ultrasonic Testing.** Unless otherwise specified on the plans or in Special Provisions, test butt welds in main members by the ultrasonic method.

   In addition to the testing requirements of the plans, specification, and Special Provisions, the Engineer may require ultrasonic testing if the quality of the work warrants it.

10. Walkways for Field Testing

When field testing, provide a continuous walkway between the center-most line of stringers from one of the approach fills to the farthest row of splices as follows:

a. Provide crosswalks connecting with the center line walkway at each butt-welded splice or bolted connection on each row of stringers.
b. Rest working platforms on the top side of the bottom flange with supporting braces fitting flush against the web.
c. Provide at least 18 in. (450 mm) of clearance on each side of the welded splice or bolted connection. Ensure that the top of the working platform is no more than 3 in. (75 mm) above the top side of the bottom flange.
d. Construct walkways and working platforms of sound materials. If constructing with wood, use wood free of excessive knots or knots that could cause an unsafe condition.
e. Construct walkways at least 20 in. (500 mm) wide and long enough to permit each end to rest on a fixed part or member of the bridge.
f. Ensure that walkways have a vertical support at least every 10 ft. (3 m).
g. Construct working platforms at least 36 in. (900 mm) wide and long enough to permit each end to rest on a fixed part or member of the bridge.
h. When a deck already exists from the end bent out to the splices, do not construct a separate walkway unless the deck reinforcement steel has been put in place.
i. Do not allow deck forms to be placed within 18 in. (450 mm) of splices until the welds or bolted connections have been inspected and accepted.

11. Tolerances

For built-up members, the requirements of paragraph 3.5.1.7 of ANSI/AASHTO/AWS D 1.5, as modified, apply except at ends to be field connected by welding. The combined warpage and tilt tolerances shall be one-half that specified.

For rolled shapes, apply mill practice tolerances (ASTM A 6/A 6M) except at ends to be field connected by welding. The combined warpage and tilt tolerances shall be one-half that specified.

Use the above tolerances unless there are deviations that are additive when measured at the toe. In this case, ensure that the maximum offset between adjoining flanges does not exceed 1/4 in. (6 mm).

501.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

501.4 Measurement

Structural steel will be measured either per pound (kilogram) or per Lump Sum.

- **Per pound (kilogram) basis.** The quantity of structural steel to be measured for payment will be the net weight of metal in the completed and accepted structure.

  A unit weight of 490 lbs./ft.^{3} (7850 kg/m3) will be used to calculate the net weight of steel. The weights of rolled shapes or plates will be computed based on their nominal weight per foot (meter) as listed in standard handbooks such as the AISC Manual of Steel Construction.

- **Lump sum basis.** When the plans specify a Lump Sum basis, this work will be measured as an accepted Lump Sum quantity, complete in place. Tabulated quantities are shown on the plans as a service, but they do not relieve the Contractor of conforming to plan details. If the plan details and tabulated quantities differ, the plan details will govern. The Contractor shall determine the actual quantities required before submitting a bid.

501.4.01 Limits

A. Qualification

Assume the cost of qualification tests and test sample preparation required under these specifications. This cost is considered incidental to The Work.

B. Testing

Ultrasonic or magnetic-particle testing by the Department of Transportation under its quality assurance inspection rate of approximately 25 percent of welds will be performed at no cost to the Contractor.

The Contractor shall assume the cost of additional ultrasonic or magnetic-particle testing above the 25 percent rate to determine the extent of weld defects and to check corrected work. The rate for this extra testing will be $90 per hour for the Inspector, equipment, travel, and subsistence.

If the Contractor is equipped with satisfactory ultrasonic or magnetic-particle inspection equipment, the Contractor may test the Work corrected in the shop at no additional expense to the Department, but the Engineer will interpret the ultrasonic and magnetic-particle inspection.

501.5 Payment

This work will be paid for at the Contract Price per pound (kilogram) of structural steel or per Lump Sum, each complete in place. The Contract Price for structural steel includes the costs of labor and equipment and the direct or incidental costs of furnishing easy access for inspection and testing.

Payment will be made under:

Item No. 501	Structural steel, Bridge No._____	Per lump sum
Item No. 501	Structural steel	Per lb (kg)
Item No. 501	Structural steel-swaybracing	Per lb (kg)

501.5.01 Adjustments

A. Payment Conditions

The cost of steel joints and metal bearing assemblies used in structures with no structural steel Pay Item shall be included in the Contract Price for superstructure concrete, unless otherwise shown on the plans.

When authorized changes are made, the Lump Sum payment will be adjusted on a negotiated basis.

On projects with multiple bridges, payments will be applied on an individual bridge basis.

Upon satisfactory completion of the erecting, bolting, and welding of structural steel for the bridge, 95 percent of the Contract Price, either per Lump Sum Basis or per pound (kilogram) basis, will be included for payment on the next statement.

Steel spans are considered satisfactorily erected when they are placed in their final positions on the substructure, properly spaced, and anchored down. Bolting is considered satisfactorily complete when defective welds are repaired and found satisfactory by additional inspection.

Upon satisfactory completion of field painting, the remaining 5 percent of the Contract Price will be included for payment on the next statement.

Material allowance payments of structural steel will be determined and paid for in accordance with the requirements of Section 109.

Section 520—Piling

Replace Section 520 with the following:

520.1 General Description

This work consists of placing completed piling in structures. The work includes incidentals and additional work except for the following:

- Prestressed concrete cylinder piling (see Project Special Provisions)
- Piling for ground-mounted roadside signs (see Section 636)

Although square, prestressed-concrete piles are a Pay Item under Section 520, have them manufactured, finished, cured, marked, handled, stored at the plant, and shipped from the plant according to Section 865.

The requirements in this Specification are minimal. Comply with the requirements and assume the responsibility for taking additional precautions to complete the work successfully.

520.1.01 Definitions

Plan Driving Objective (PDO): Statement on the Plans specifying the minimum requirements during pile driving. The PDO may require a driving resistance (tonnage [kilonewtons] by formula), a minimum tip elevation, or a combination of these.

Minimum Tip Elevation: Elevation the pile tip cannot stop above. When composite prestressed concrete piling is used, this term will refer to the protruded tip of the Steel H-Pile Section.

Long Pile: A pile more than 50 ft. (15 m) in length.

520.1.02 Related References

A. Standard Specifications

Section 101—Definitions and Terms

Section 104—Scope of Work

Section 109—Measurement and Payment

Section 500—Concrete Structures

Section 501—Steel Structures

Section 547—Pile Encasement

Section 636—Highway Signs

Section 855—Steel Pile

Section 865—Manufacture of Prestressed Concrete Bridge Members

B. Referenced Documents

ASTM D 1143

QPL 37

520.1.03 Submittals

A. Template Plan for Positioning Piling

Before driving piling, submit a plan for ensuring piling stability and position, including templates, to the Engineer. Do not drive piling until the plan is approved.

B. Plans for Loading Test Methods

Submit the plans for loading test methods to the Engineer for approval before beginning the work.

Ensure that the test method is logical and can be rationally analyzed by a commonly accepted structural design theory.

C. Loading Test Equipment

Submit the list of equipment for conducting loading tests to the Engineer for approval before beginning the work.

If the testing apparatus is a hydraulic jack, furnish 5 copies of the calibration certification to the Engineer for the equipment, prepared by the manufacturer, an authorized representative, or an approved testing laboratory. Consult the Engineer to find out which laboratories are approved.

520.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Preservative Treatment of Timber Products	863
Timber Piles	861.2.01
Prestressed Concrete Piles Bridge Members	865
Welded and Seamless Steel Piles	855.2.01
Fluted Steel Shell Piles	855.2.02
Steel H-Piles	855.2.03
Steel Bolts, Nuts, and Washers	852.2.01
Aluminum Alloy Sheet and Plate	850.2.01
Metal Caps	862.2.01.A.5

Refer to Subsection 855, “Steel Pile” for Specifications on cast steel-H pile points. For a list of sources, see QPL 37.

Use the following piling types where shown on the Plans:

- Timber piling
- Prestressed concrete piling
- Metal shell piling
- Steel H-piling

Use other piling types when the Plans and Special Provisions require it.

520.2.01 Delivery, Storage, and Handling

A. Timber Piling

Handle timber piling carefully using only non-metallic slings. Do not drop or damage the piling.

Store timber piles on skids above the supporting surface. Keep hardware covered.

B. Pre-stressed Concrete Piling

Handle prestressed concrete piling carefully to prevent fracture by impact or by excessive bending stress either in storage, during transportation, or when being transferred to the leads. Do not place other materials on the piling during storage or transport.

1. Transporting Prestressed Concrete Piling

   Transport prestressed concrete piling using the approved limits of support spacing for the various sizes and lengths of piling. These limits are shown on Standard Plans or on other drawings and are available to the Engineer from the Department.

2. Loading and Unloading Prestressed Concrete Piling

   Load and unload piles using the embedded pick-up points placed during manufacture.

3. Storing Prestressed Concrete Piling

   Store piles as follows:

   - Store piling in single layers directly on the ground only when there is uniform, level bearing for the full pile length.
   - To store piles in tiers, support the piling using blocks of uniform thicknesses placed immediately adjacent to the embedded pick-up points and in line vertically.
   - Store piling in groups of the same lengths.

4. Placing Piles in the Leads or in Position

   When picking up piles from storage and placing them in the leads or in position, use only the single pick-up point, marked with “SP” or a line painted on the pile at the plant, unless noted on the Plans or otherwise directed by the Engineer.

5. Driving Piles

   Do not subject prestressed concrete piling to excessive tensile stresses from combining a particular hammer with the soil conditions. Excessive stress may occur, for example, in these situations:

   - When encountering hard driving resistance at the point of a long pile

   When such situations damage pile, make changes to provide undamaged piling in place. If piles are damaged, the Engineer may require the following:

   a. Reduce the energy delivered to the piling by reducing the stroke, changing the cushioning, or using a lighter ram.
   b. Maintain equivalent energy but use a heavier or lighter ram with a different stroke.
   c. Use a smaller hammer for the easier, initial driving.
   d. Drill pilot holes, jet, or spud. When these driving aids are required or permitted, see Subsection 520.3.05.B, *Drill Pilot Holes* and Subsection 520.3.05.G, *Jet and Spud.*

C. Metal Shell Piling

Do not deform or dent metal shell piling during handling and storage. Place shells to be stored for a prolonged period on enough skids to prevent ground contact and deflection. Keep the shells fully drained.

D. Steel H-Piling

Do not deform or bend flanges on steel H-piling during handling and storage. Place steel H-piling to be stored for a prolonged period on enough skids to prevent ground contact and deflection. Keep the piling fully drained.

520.3 Construction Requirements

520.3.01 Personnel

Furnish enough labor and work to install the complete loading test, including a temporary shelter over the area if the Engineer requires it.

520.3.02 Equipment

A. Hydraulic Jack for Loading Tests

If the hydraulic jack used to apply the loading test changes behavior during use, return the jack to the manufacturer, an authorized representative, or a testing laboratory approved by the Engineer for recalibration.

B. Driving Head

Use a structural steel driving head recommended by the manufacturer as suitable for the type and size of pile being driven. The driving head shall:

- Hold the pile in the proper driving position
- Be constructed to prevent pile damage
- Be constructed to transmit the hammer energy along the pile axis
- Fit loosely enough around the pile head so that the pile can rotate slightly without binding

C. Cushion or Shock Blocks

Replace cushion blocks as necessary to prevent pile damage. Inspect cushions periodically to ensure that they prevent pile damage.

1. Hammer Cushions

   Use cushions or shock blocks above the driving head to avoid damaging the pile. Replace used hammer cushions reduced to half their original thickness with new cushions.

   Use hammer cushions of a man-made material only such as micarta or aluminum. Do not use materials such as plywood, hardwood, wire rope, and asbestos.

2. Pile Cushions

   For prestressed concrete piling up to 24 in (600 mm), provide a suitable pile cushion block for the top of the pile. Use a cushion made of material that does not compress so far that the cushioning effect is lost.

   For prestressed concrete piling, 30 in (750 mm) and 36 in (900 mm) square, use an approved solid hardwood pile cushion block at least 6 in (150 mm) thick or an equivalent in the base of the hammer to cushion the hammer ram blow on the pile or follower.

3. Follower Cushions

   When a follower is permitted or required, use an approved, square-shaped laminated cushion block between the follower and the top of the pile.

   Use a cushion block for a follower that is:

   - At least 6 in. (150 mm) thick
   - Made of 1 in. (25 mm) hardwood boards (preferably green) of uniform thicknesses
   - Cut to fit the pile head

   Subsection 520.3.02.F, *Followers*, defines a follower within the scope of these specifications.

D. Hammers

Regardless of the requirements for hammers in these Specifications, the PDO governs in selecting the hammer. The exception for this is the tabulations for prestressed concrete piling shown in the Energy Rating Table in Subsection 520.3.02.D.1.b. Except for timber piling, drive piling with power hammers of an approved make and model (steam or diesel) that are single-acting (open end diesel) or double-acting (enclosed ram diesel).

When desired, use gravity (drop) hammers to drive timber piling and, within the conditions in Subsection 520.3.02.D.2, *Gravity Hammers*, steel H-piling and metal shell piling.

Hammer types and restrictions are as follows:

1. Power Hammers

   Maintain power hammers to obtain their potential stroke length and number of blows per minute. Driving resistance values are invalid when these requirements are not met.

If driving resistance values are invalid, stop the driving operations and correct the problem. Do not begin driving until the problem is resolved.

a. Power Hammer Types

Power hammer types include:

- **Steam Hammers.** Use steam or compressed air from boilers or air compressors to power steam hammers.

  Use boilers and air compressors with an accurate pressure gauge and capacities and hose sizes at least equal to those specified by the hammer manufacturers.
- **Open-End Diesel Hammers.** Use open-end diesel hammers that allow measurement of the ram stroke length above the top of the hammer.
- **Enclosed-Ram Diesel Hammers.** Use enclosed-ram diesel hammers with a bounce chamber gauge and charts that will evaluate the equivalent energy being produced under any driving condition.

b. Power Hammer Restrictions

Follow these power hammer restrictions:

- **Timber Piling.** Drive timber piling using a power hammer with a maximum energy rating of 22,400 ft.lb. (30 400 N·m).
- **Steel Piling.** Drive steel H-piling and metal shell piling using a power hammer with an energy per blow of at least 1 ft.lb. (1.4 N·m) but not less than 9,000 ft.lb. (12 200 N·m) for each pound (kilogram) of driven weight.
- **Prestressed Concrete Piling.** Except as specified in the following Energy Rating Table, drive prestressed concrete piling using a power hammer with an energy per blow of at least 1 ft.lb. (1.4 N·m) for each pound (kilogram) of pile weight, but not less than 15,000 ft.lb. (20 300 N·m).

Driving conditions may require hammers with more energy than the minimum required on the Energy Rating Table. However, the Department will not require hammers that have more than the minimum energy rating, regardless of pile length, unless the Plans or Special Provisions specify otherwise.

Energy Rating Table (English)			
Manufacturer’s Energy Ratings on Hammers for Prestressed Concrete Piling			
Pile Size (in.)	Weight Lb./Ft.	Minimum Energy Rating Ft.·Lbs. , Ft·Tons	
		Ft. ▪ Lbs.	Ft. ▪ Tons
14 solid	204	22,400	11.2
16 solid	267	22,400	11.2
18 solid	338	32,000	16.0
20 solid	417	32,000	16.0
24 voided	482	32,000	16.0
30 voided	709	39,800	19.9
36 voided	923	50,000	25.0

Energy Rating Table (metric)		
Manufacturer’s Energy Ratings on Hammers for Prestressed Concrete Piling		
Pile Size (mm)	Weight kg/m	Minimum Energy Rating N·m
350	304	30,400
400	397	30,400
450	503	30,400
500	621	30,400
600	717	30,400
750	1055	54,000
900	1374	67,800

2. Gravity Hammers

   When using a gravity hammer, regulate the drop height to avoid damaging the pile. Do not allow the drop height to exceed 10 ft. (3 m) for timber piling and 12 ft. (3.7 m) for steel piling.

   Ensure that the hammer is marked with its weight to the nearest 50 lbs. (25 kg). Upon the Engineer’s request, furnish a certified scale weight of the hammer.

   Follow these gravity hammer restrictions:

   a. **Timber Piling.** Drive timber piling using a gravity hammer that weighs at least 2,000 lbs. (900 kg) but no more than 3,500 lbs. (1500 kg).

      However, ensure that the hammer has enough weight to obtain the PDO with a maximum fall of 10 ft. (3 m).

   b. **Steel Piling.** If desired, substitute a gravity hammer for a power hammer when the quantity of a steel piling type shown on the Bridge Plans Summary of Quantities does not exceed 800 linear ft (245 linear meters), including test pile lengths if any, for that pile type for an individual bridge.

      When using a gravity hammer within the scope of the linear foot (meter) condition, ensure that it has enough weight to obtain the PDO with a maximum fall of 12 ft. (3.7 m). The maximum allowable hammer weight is 5,000 lbs. (2300 kg).

c. **Pre-stressed Concrete Piling.** Do not use gravity hammers to drive prestressed concrete piling.

E. Leads

Equip pile driving rigs with leads that allow the hammer to move freely and support piling during driving. Use leads that meet the following requirements:

- The vertical axis of the leads and hammer coincide with the vertical axis of the pile.
- The leads are long and rigid enough to hold the pile in accurate alignment while it is being driven.

However, ensure that the driving rig can slightly adjust the lead position to compensate for minor changes in direction while driving.

When the pile is supported by the material being penetrated or by approved templates, use hammer leads only.

Driving in deep water may require special platform-type templates to ensure piling stability and position (see Subsection 520.1.03.A, *Template Plan for Positioning Piling*). Use templates with enough area to accommodate all persons necessary to perform and inspect the work.

The Engineer may require templates in other necessary locations to ensure piling stability and position.

F. Followers

Do not use inserts of similar type piling placed between the hammer and a pile to keep the hammer above water level or other levels.

Within the scope of these Specifications, a follower is part of the driving mechanism used to drive larger-sized prestressed concrete piling.

Position the follower between the pile head and the hammer driving base to evenly distribute the driving energy across the concrete area of voided-type piling.

Always use followers when driving 36 in. (900 mm) prestressed concrete piling. The Department allows followers when driving 30 in. (750 mm) prestressed concrete piling.

G. Spuds

Use spuds heavy enough to penetrate through strata or a stratum of firm or hard material to reach the necessary depth.

Control the alignment for battered spudding using templates that maintain the batter. Unless otherwise permitted, use templates to control vertical spudding.

Mark the distance from the top of the spud clearly at 2 ft. (600 mm) intervals along the length of the stem.

Use either round or square spud tips for pile driving that meet the following requirements:

- At least as large as the pile to be driven at the spudding location
- If round, no more than approximately 2 in. (50 mm) larger than the diameter or diagonal dimension of the pile
- If square, no more than approximately 2 in. (50 mm) larger than the lateral dimension or diameter of the pile

H. Jetting Equipment

Provide enough pumping capacity, using at least two jets, to produce a volume and pressure that will freely erode the material next to the pile and the material 6 in. (150 mm) below the pile tip.

I. Loading Test Equipment

Furnish the necessary material, tools, equipment (including a constant tension wire with a weight and sheave or a weight and round pin), and incidentals to properly install the complete loading test and a temporary shelter over the area if the Engineer requires it.

520.3.03 Preparation

A. Remove Obstacles

Unless otherwise permitted, remove or cut out portions of obstacles that interfere with attaining the PDO. This will be measured and paid for as described in Subsection 520.4.01.A, *Removing Obstacles*.

B. Form the Embankment at Bridge Ends

Before driving piling at bridge ends and unless otherwise shown on the plans, form the embankment as follows:

1. Make the embankment at bridge ends full depth to the subgrade template except for the stage construction providing a bench for the end bent.
2. Thoroughly compact the embankment as provided in the specifications.
3. When the Plans or Special Provisions require a waiting period, delay the construction of all or portions of the bridge as required.

The minimum acceptable length of completed full-depth embankment is specified in Subsection 101.11, *Bridge*.

520.3.04 Fabrication

General Provisions 101 through 150.

520.3.05 Construction

A. Determine the Pile Length

Use full-length piling when possible, but always use full-length timber piling. Use piling long enough to reach the PDO.

Except for test piles shown on the Plans, pile lengths are based on the lengths assumed to remain in the completed structure.

Provide fresh headings and the additional length necessary to suit the method of operation at no additional expense to the Department. Pile lengths or quantities shown on the Plans are for estimating purposes only.

The Engineer's "Length List" will be available only after the test piles that logically cover the listed bents have been driven and evaluated and required load tests have been performed. The written "Length List" itemizes the number, type, size, and length of pile required per bent.

1. Steel H-Piling or Metal Shell Piling Lengths

   Determine and furnish the required lengths of piling in place to reach the PDO, regardless of whether the Plans require test piles or show estimated lengths.

   To determine these lengths of piling in place, either drive test piles, make borings, or make other investigations at no additional expense to the Department.

2. Timber Piling Lengths

   Have the Department determine the lengths of this piling. Furnish the piling either according to the Plan listing or according to the Engineer's "Length List," as directed.

   Lengths for timber piling up to 40 ft. (12 m) will be given in 1 ft. (300 mm) increments.

   Lengths for timber piling over 40 ft. (12 m) will be given in 2 ft. (600 mm) increments.

3. Prestressed Concrete Piling Lengths

   Have the Department determine the lengths of this piling. Furnish the piling according to the Plan listing or the Engineer's "Length List," as directed.

   Lengths for prestressed concrete piling 18 in. (450 mm) square or smaller will be given in 2-1/ 2 ft. (750 mm) increments.

   a. **Additional Lengths for Prestressed Concrete Piling.** If a prestressed concrete pile, including test pile, is driven below cutoff elevation before reaching the PDO, the Engineer will determine the net additional length required and add this extension length to the written "Length List."

b. **Composite Prestressed Concrete Piling Lengths.** The composite pile length of composite prestressed concrete piling (with steel H-section tips partially embedded in and partially protruding from the concrete), is the end-to-end length of the concrete.

The total length of the steel H-section and its embedded and protruding tips is as shown on the plans. The steel sections are incidental to the work.

B. Drill Pilot Holes

When pilot holes are required, drill them to the diameter and approximate depth specified on the plans.

Backfill voids and holes with sand or other suitable granular material, or other material as indicated on the plans. This backfill is an incidental part of the work.

The following are not considered pilot holes:

- Holes created by spudding (punching)
- Holes dug to drive piling that is too long to fit leads
- Holes dug to replace a template (if permitted)

Where pilot holes are required in granular material and the material cannot be sealed off using "mudding" drilling methods, drill the pilot hole as follows:

1. Place a casing pipe with a large enough diameter around the boring device.
2. Hold the casing in position until the pilot hole is completed and the pile driving progresses deep enough into the hard material to keep loose material out of the pilot hole.

Drilling pilot holes using casing is incidental to the work.

C. Test Piling

The plans will normally require test piles only with timber and prestressed concrete piling, including composite piling. However, the Department may require steel H or metal shell test piles.

When the plans show the design load of a pile as well as a PDO, the design load is shown only for information purposes if a loading test is required.

Ensure that the piling to be loaded is of the size and type and at the locations specified on the plans or designated by the Engineer.

The Engineer may revise the quantity or location of the Department's test piles.

The Department may designate locations on the plans where the Engineer will record pile driving data during driving operations. Such piles are designated as "Driving Data Piles."

Follow these requirements when driving:

- Ensure that the cross-sectional dimensions of test piles are the same as the piles that will be part of the completed structure.
- Test piles are generally longer than piles that remain in the completed structure. Regardless of the PDO, drive test piles to their full length, where possible, for exploratory purposes.
- Drive test piles of the length, type, and size designated on the plans in the locations the Engineer specifies.
- When using timber test piles, peel the piles and drive them next to the piles that will be part of the completed structure. If desired, machine-peel timber test piles and leave them untreated.
- Drive other types of test piles so that they become part of the completed structure.
- Ensure that test piles furnished and driven in permanent locations meet the requirements in Subsection 520.3.05.D.1 or 520.3.05.D.2 as appropriate, and Subsection 520.3.05.A.1. Drive test piles to determine required lengths in the Engineer's presence.
- Cooperate with the Engineer to obtain the required data on "Driving Data Piles" as an incidental part of the work. "Driving Data Piles" do not need to be driven before other piling.

D. Evaluate Bearing Capacity

Determine the bearing capacity of piling by determining driving resistance, performing loading tests, or doing a combination of these.

Determine driving resistance for all piling driven regardless of PDO requirements.

1. Determine Driving Resistance for projects designed using Allowable Stress Design (ASD)

   Drive a pile in one continuous operation and determine the driving resistance without delays. However, in soft material the Contractor may, at the Engineer's discretion, determine the driving resistance after delaying driving operations.

   Determine the driving resistance of the piling using the appropriate formula for the hammer type. These resistance formulas apply only when:

   - The hammer has a free fall.
   - The head of the pile is not broomed, crushed, spalled, or excessively crimped.
   - The penetration rate is reasonably uniform.

   Determining driving resistance by formula is not a Pay Item. Provide the facilities for determining driving resistance by formula as an incidental part of the work.

Driving Resistance Formulas (English)		
Hammer Type	**Formula Number**	**Formula (DR =)**
Gravity hammer	1	$\frac{2WH}{S + 0.7}$
Single-acting steam (or air) hammer; open-end diesel hammer	2	$\frac{2WH}{S + 0.2}$
Double-acting, enclosed-ram diesel hammer	3	$\frac{2E}{S + 0.2}$
Double-acting steam (or air) hammer	4	$\frac{2(W + Ap)H}{S + 0.2}$
NOTE: Do not use the manufacturer's bearing chart unless it agrees with the applicable formula above.		

Driving Resistance Formulas (metric)		
Hammer Type	**Formula Number**	**Formula (DR =)**
Gravity hammer	1	$\frac{0.167WH}{S + 17.8}$
Single-acting steam (or air) hammer; open-end diesel hammer	2	$\frac{0.167WH}{S + 5.08}$
Double-acting, enclosed-ram diesel hammer	3	$\frac{0.15E}{S + 5.08}$
Double-acting steam (or air) hammer	4	$\frac{0.166(W + A)Hp}{S + 5.08}$
NOTE: Do not use the manufacturer's bearing chart unless it agrees with the applicable above formula.		

The abbreviations in the driving resistance formulas are defined as follows:

Driving Resistance Formula Abbreviations	
Abbreviation	**Meaning**
DR	Driving resistance in tons (kilonewtons).
W	Weight of the striking part of the hammer in tons (newtons).
H	Height of fall in feet (meters) for gravity, steam, and air hammers. When using Formula 1, the maximum height is 10 ft. (3 m) for timber piling and 12 ft. (3.7 m) for steel H or metal shell piling.
	Observed average height of fall in feet (meters) for open-end diesel hammers. Record "H" as the average penetration in inches (millimeters) per blow being determined. When rating open-end diesel hammers to comply with energy requirements, use the height of fall as 8 ft (2.4 m).
E	Average equivalent energy in foot-tons (newton-meters) for enclosed-ram diesel hammers. Measure "E" as the average penetration in inches (millimeters) per blow being determined using a gauge attached to the hammer.
A	Area of piston in square inches (meters) for double-acting steam or air hammers.
p	Pressure at the hammer in tons per in.^{2} (pascals) for double-acting steam or air hammers.
S	Average penetration in inches (millimeters) per blow for the last 5 to 10 blows for a gravity hammer and the last 10 to 20 blows for a power hammer.

2. Determine Driving Resistance for projects designed using Load and Resistance Factor Design (LRFD)

   Drive piles in one continuous operation after driving resistance has been determined and associated report has been approved by the Geotechnical Bureau. Determine the driving resistance of the piling based on the method specified in the plans, which will be one of the following methods (a – c):

   a. Complete a dynamic pile testing in accordance with Special Provision Section 523. The pile bearing will be determined by computing the penetration per blow with less than ¼-inch (6-mm) rebound averaged through 12 inches (305 mm) each of penetration. When it is considered necessary by the Engineer, the average penetration per blow may be determined by averaging the penetration per blow through the last 10 to 20 blows of the hammer. In soft material the driving resistance may be determined, at the Engineer's discretion, after delaying driving operations and performing pile re-strikes.

   b. Perform a loading test in accordance with Sub-Section 520.3.05.D.3.

   c. Use FHWA-modified Gates Formula as provided below (Shall not be used when driving pile to hard rock):

$R_{ndr} = 1.75\,(E_d)^{0.5}\log_{10}(10N_b) - 100$	(kips)	U.S units
$R_{ndr} = 7\,(E_d)^{0.5}\log_{10}(10N_b) - 550$	(kN)	S.I. units

Where:

R_{ndr} = nominal pile driving resistance measured during pile driving

E_d = developed hammer energy. This is the kinetic energy in the ram at impact for a given blow. If ram velocity is not measured, it may be assumed equal to the potential energy of the ram at the height of the stroke, taken as the ram weight times the actual stroke (ft.-lb. for U.S units, kN-m for S.I. units)

N_b = Number of hammer blows for 1.0 inch of pile permanent set (blows/in)

These resistance formulas apply only when:

- The hammer has a free fall.
- The head of the pile is not broomed, crushed, spalled, or excessively crimped.
- The penetration rate is reasonably uniform.

Determining driving resistance by formula is not a Pay Item. Provide the facilities for determining driving resistance by formula as an incidental part of the work.

Once the driving resistance has been determined by one of the methods noted above, do not continue to drive piles if the Engineer determines that the piles have reached practical refusal. Practical refusal is defined as 20 blows per inch with the hammer operating at the highest setting or setting determined by the Engineer and less than ¼-in. (6-mm) rebound per blow. The Engineer will generally make this determination within 2 in. (51 mm) of driving. However, the Engineer will not approve the continuation of driving at practical refusal for more than 12 in. (305 mm). When the required pile penetration cannot be achieved by driving without exceeding practical refusal, use other penetration aids such as jetting, spudding, predrilling or other methods approved by the Engineer.

Use the Wave Equation Analysis for Piles (WEAP) program to evaluate the suitability of the proposed driving system chosen from the methods noted above (including the hammer, follower, capblock and pile cushions) as well as to estimate the driving resistance to achieve the pile bearing requirements and to evaluate pile driving stresses. Use the WEAP program to show that the hammer is capable of driving to a driving resistance equal 130 percent (1.3 times) the driving resistance shown in the plans without overstressing the piling in compression or tension and without reaching practical refusal.

Perform the WEAP analysis with personnel who are experienced in this type work and have performed this analysis on a minimum of 15 projects. Provide a list of the qualifications and experience of the personnel to perform the WEAP analysis for this project.

The Engineer may modify the scour resistance shown in the plans if the dynamic pile test is used to determine the actual soil resistance through the scour zone. Also, the Engineer may make modifications in scour resistance when the Contractor proposes drilling and/or jetting to reduce the soil resistance in the scour zone.

A minimum of two weeks prior to beginning any pile driving operations, submit to the Geotechnical Bureau for evaluation and approval the following information on all of the proposed pile driving system(s) to be used on the Project including but not limited to:

i. Items on Pile Driving Equipment Data Sheet
ii. Other information on the driving system required by the Engineer
iii. A WEAP program output indicating the approximate depth or elevation where the pile will achieve the bearing required
iv. Valid Driving Criteria.

Valid driving criteria is defined as having the required hammer having a hammer set greater than 3 blows per inch and less than 10 blows per inch at the driving resistance for that pile.

If WEAP analyses show that the hammer(s) will overstress the pile, modify the driving system or method of operation as required to prevent overstressing the pile. Resubmit the modified pile driving system information and WEAP program output to the Geotechnical Bureau for re-evaluation. Do not begin pile driving operations until the Geotechnical Bureau has approved the qualifications of the personnel, the WEAP program output, and the pile driving system(s).

Approval of the pile driving system(s) is also based on satisfactory field trials with dynamic pile testing. Obtain approval from the Geotechnical Bureau for the pile driving system(s) based on satisfactory field performance.

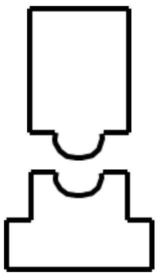
If piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided that the hammer is properly sized and cushioned, will not damage the pile, and will develop the required resistance.

For penetration of weak soils by concrete piles, use thick cushions and/or reduced stroke to control tension stresses during driving.

Pile Driving Data Form

Contract ID:
PI Number:
County

Structure Name:
Structure No.:
Pile Driving Contractor:



Hammer

Manufacturer: ____________ Model No. _______________
Hammer Type: ___________ Serial No. _______________
Manufacturers Maximum Rated Energy: _____________(ft-k)
Stroke at Maximum Rated Energy: ___________________(ft)

Range in Operating Energy: __________ to __________(ft-k)
Range in Operating Stroke: ___________ to ____________(ft)
Ram Weight: __________________________________ (kips)
Modifications: ______________________________________

Striker Plate

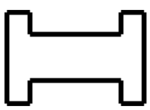
Weight: ____________(kips) Diameter: _____________(in)
Thickness: ____________(in)

Hammer Cushion

Material 1
Name: __________________
Area: _______________(in^2)
Thickness/Plate: _______(in)
No. of Plates: _____________

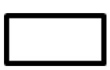
Material 2
Name: __________________
Area: (in^2)
Thickness/Plate:________(in)
No. of Plates: _____________

Total Thickness of Hammer Cushion: ________________(in)



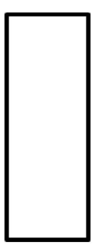
Helmet

Weight including inserts: _________________________(kips)



Pile Cushion

Material: ____
Area: _______________(in^2) Thickness/Sheet: _______(in)
No. of Sheets: ____________
Total Thickness of Pile Cushion: ____________________(in)



Pile

Pile Type: ____
Wall Thickness: ________(in) Taper: __________________
Cross Sectional Area: ___(in^2) Weight/Meter: ____________
Ordered Length: _________________________________(ft)
Driving Resistance: ______________________________(kips)
Description of Splice: ________________________________
Driving Shoe/Closure Plate Description: __________________

Submitted By: ____________________________________ Date: ___________________

3. Perform Loading Test

Unless otherwise specified on the Plans, use a test method that conforms to ASTM D 1143, modified for quick load tests.

Use loading apparatus capable of the lesser value of the following:

- For concrete piles, 400 percent of the design load or 500 tons (4450 kilonewtons)
- For steel piles, 400 percent of the design load or 90 percent of the yield strength

The Engineer may increase or decrease the number of loading tests.

Furnish and read the instrumentation necessary to determine the pile settlement under load.

A loaded pile is unsatisfactory when the total settlement under Maximum Applied Load as defined by the Office of Materials and Testing Geotechnical Bureau exceeds 1 in. (25 mm) or the permanent settlement exceeds 1/4 in. (6 mm) using the standard loading procedure in ASTM D1143 Section 5.

The laboratory will determine the maximum safe design load, or the failure load of original loading materials based on the results of the loading test.

The Engineer may require the following piles to be driven further:

- Unsatisfactory piles as defined in the paragraphs above
- Piles without enough maximum safety design or failure loads as determined by the Office of Materials

Perform the loading test as follows:

a. Test load piling as required on the Plans, or as directed by the Engineer.

b. Furnish and drive the piling to be test loaded.

c. Furnish and drive necessary anchor piling.

   When the Engineer permits, use piling that will remain in the completed structure after load testing as anchor piles when desired.

d. Apply the test loads in equal increments of 10 to 15 percent of the design load.

e. Apply the loads at constant 2-1/2-minute time intervals throughout the test.

f. After the test is complete, remove the temporary materials. These temporary materials remain the Contractor’s property.

g. Remove or cut off the piling that will not remain in the completed structure.

   Cut off the piling at least 1 ft. (300 mm) below the bottom of the footing or the ground line, whichever applies.

h. In deep water, have the Engineer direct how much pile to remove.

E. Drive Piling

Drive piling to the PDO shown on the Plans. When the PDO involves only a driving resistance requirement, the Engineer will determine the depth to drive piling. If there is no Plan PDO, drive the piling as directed by the Engineer.

If the Engineer determines that driving results and loading test results require modification, drive the piling to a PDO modified by the Department.

Drive piling as follows:

1. When using pilot holes, drive the piling enough to fix the point firmly and reach the PDO.
2. Drive piling so that it conforms closely with the position and line shown on the plans.
3. Drive piling of a given type, including test piles, with the same type and size of hammer.
4. Use vibratory or other pile driving methods only when permitted by Special Provisions Plan Notes or directed by the Engineer.
5. Do not damage piling during driving. Pile damage includes:
   - Crushed, spalled, or cracked concrete
   - Split, splintered, or broomed wood
   - Broken piling

- Shell collapse
- Steel deformation

6. Do not force piling into the proper position.
7. When driving a prestressed concrete pile, ensure that the pile point is well-seated with reasonable soil resistance before using full driving energy.
8. Determine the driving resistance when driving the pile using the appropriate Driving Resistance Formula.

F. Excavate and Redrive

Do not drive foundation and end bent piling until excavation is nearly complete.

If driving a test pile to the side (one that will not become part of the structure) have it begin penetration at approximately the same ground elevation as if it were driven within the structure.

Redrive piles that are raised or moved while driving adjacent piling.

G. Jet and Spud

Jetting and, unless otherwise noted in the Contract, spudding are considered incidental to the Work.

Unless otherwise permitted by the Engineer, do not jetting or spudding operations lower than 3 ft. (900 mm) above the estimated final elevation of the pile tip, or lower than 3 ft. (900 mm) above the specified Minimum Tip Elevation to obtain minimum penetration.

When jetting or spudding to drive a prestressed concrete pile, ensure that the pile point is well seated with reasonable soil resistance at the point before using full driving energy.

1. Jetting

   When the Engineer permits, use jetting to properly position a pile. Additional driving may be required to determine the final driving resistance when piles are positioned by jetting.

   Should additional driving require additional length, the additional expense involved is considered incidental to the Work.

   Jetting may be required with any hammer or piling type (including test piling) and at any site. However, jet only when directed or permitted by the Engineer and as follows:

   a. Do not use jets where the Engineer determines that the jets may endanger the stability of embankments or other improvements.
   b. Perform trial jetting to determine whether to jet using one or two jets. Have the Engineer approve the trial run.
   c. Suspend the pile driving that requires jetting until the jetting is accomplished as directed by the Engineer.
   d. Jet either ahead of the actual pile driving or simultaneously with it as the Engineer determines from the results of trials.

      Control and dispose of water and solids that run off from the jetting.
   e. Maintain parallel drainage to railroad tracks.
   f. Do not simultaneously drive and jet a prestressed concrete pile unless there is reasonable soil resistance at the pile point.
   g. If using jets and hammers simultaneously as required or permitted by the Engineer, withdraw the jets before reaching the PDO and continue driving to fix the point of the pile firmly and reach the PDO.
   h. After jetting an area completely, recheck the driving resistance of questionable piles.

2. Spudding

   If the plans or Engineer require spudding, do it to facilitate driving.

   The Engineer may require advance jetting exploration before deciding whether or not spudding is necessary to penetrate firm or hard material.

H. Cut Off, Splice, and Extend Piling

Cut off pilings at the required elevation. Splice piling driven below this elevation and extend it according to the Pile Splice Details. Ensure that the minimum splice spacing is at least 10 ft. (3 m).

Lengths of cutoff of any piling, including test piles, remain the property of the Contractor. Dispose of cutoff lengths outside the highway right-of-way according to Subsection 104.07, *Final Cleaning Up*. If desired, use undamaged pieces of steel H and metal shell cutoff for splice plates, extensions, and reinforcement for steel H-tips.

1. Cut Off Prestressed Concrete Piling

   Cut prestressed concrete piling using pneumatic tools, saws, or other approved methods as follows. Do not use explosives.

   When the Engineer considers it necessary, use an approved collar when cutting.

   a. Cut back the required amount of concrete at the end of the pile to be extended, leaving the prestressed strand exposed.
   b. Make the final cut at right angles to the pile axis.
   c. When cutting, avoid spalling or damaging the pile below the cutoff elevation.
   d. If the pile is damaged, replace the pile or repair the damage by cutting back to the extent determined by the Engineer. Replace or repair piles at no expense to the Department.

2. Extend Prestressed Concrete Piling

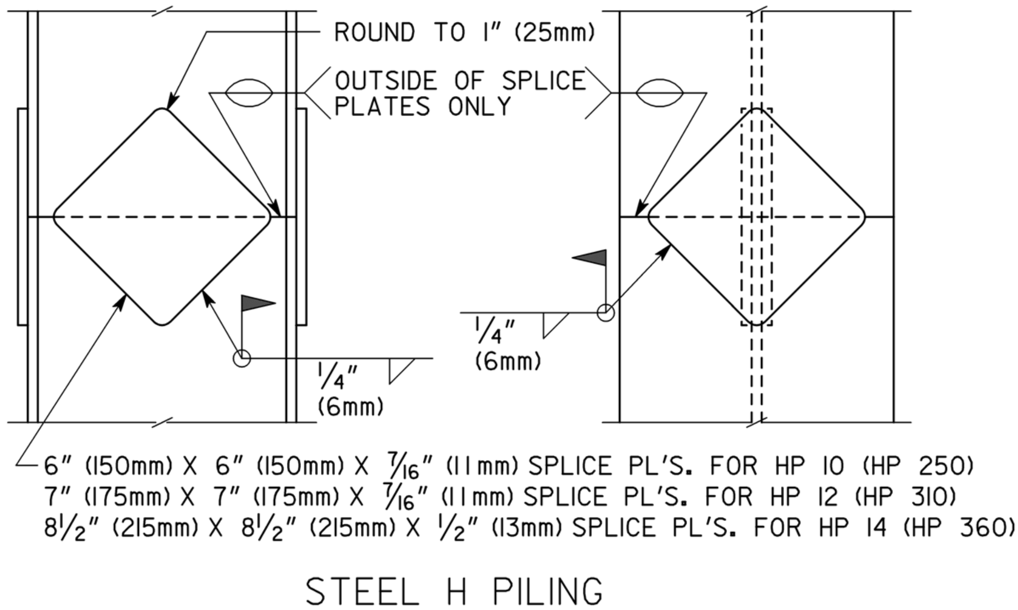
   Driven extensions of prestressed concrete piling shall consist of Class AAA concrete. Undriven extensions shall consist of Class A concrete.

   Extend prestressed concrete piling as follows:

   a. Build, place, and brace the form work for the extension carefully to obtain true alignment and prevent leaks at the construction joint.
   b. Just before placing the new concrete, thoroughly wet the cut area and cover it with a thin coating of cement paste.
   c. When driving the extension, chamfer the top 1 in. (25 mm) at right angles to the extension axis.
   d. Remove the forms and cure and finish the concrete according to Subsection 865.2.01.B.10, *Concrete Curing* and Subsection 500.3.05.Z, *Cure Concrete*.
   e. When extending prestressed concrete piling, comply with the required details when additional driving is or is not necessary after making the extension.

      When additional driving is necessary, ensure that the extension reaches its 28-day compressive strength and has been water-cured for 5 curing days before resuming driving. The delay is considered incidental to the work.

•


ROUND TO 1" (25mm)
OUTSIDE OF SPLICE PLATES ONLY
1/4" (6mm)
1/4" (6mm)
6" (150mm) X 6" (150mm) X 7/16" (11mm) SPLICE PL'S. FOR HP 10 (HP 250)
7" (175mm) X 7" (175mm) X 7/16" (11mm) SPLICE PL'S. FOR HP 12 (HP 310)
8 1/2" (215mm) X 8 1/2" (215mm) X 1/2" (13mm) SPLICE PL'S. FOR HP 14 (HP 360)
STEEL H PILING

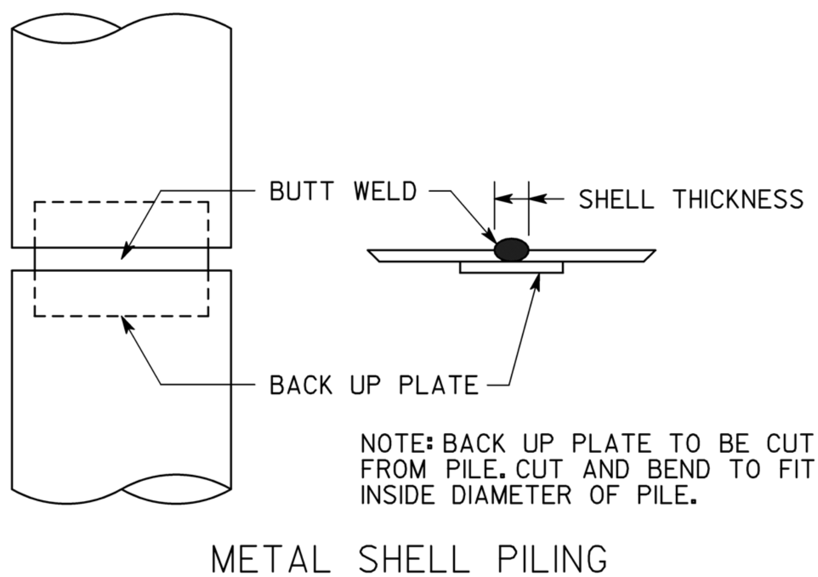

BUTT WELD
SHELL THICKNESS
BACK UP PLATE
NOTE: BACK UP PLATE TO BE CUT FROM PILE. CUT AND BEND TO FIT INSIDE DIAMETER OF PILE.
METAL SHELL PILING

FIGURE 1

3. Splice and Extend Steel H-Piling and Metal Shell Piling

   Splice and extend steel H-piling or metal shell piling before, during, or after driving according to the Pile Splice Details [Figure 1]. Ensure that the sections have identical cross sections.

   Instead of using the splice details for H-piles shown in the Pile Splice Details (Figure 1], when desired, use approved H-pile splicers as follows:

   a. Ensure that H-pile splicers are the proper size recommended by the manufacturer for the pile to be spliced.
   b. With the splicer in position and before making the splice, ensure that at least 90 percent of the mating ends of the piling to be spliced touch.
   c. Connect the splicer and the piling by welding according to a procedure approved by the Department.

4. Cut Off and Splice Timber Piling

   Accurately cut off piling to be capped with timber or precast concrete to obtain true bearing on every pile without using shims.

   Replace or repair piles inaccurately cut off at no additional expense to the Department. Replace or repair to the Engineer's satisfaction.

   Do not splice timber piling without the Engineer's permission.

I. Weld Steel Piling Splices and Swaybracing Attachments

Weld steel piling splices and swaybracing attachments according to Section 501.3.06.C.

Weld only in the Engineer's presence. Use a welder with current Department certification for welds involved.

J. Repair and Treat Timber Piling

Repair and treat timber piling as follows:

1. Field treat cuts and abrasions in treated timber piling with either of these heated treatments:
   - Two applications of a mixture of 60 percent creosote oil and 40 percent roofing pitch
   - Two thorough brush coats of creosote oil followed by a covering of roofing pitch

   Allow each coat to dry before applying the next.
2. Before placing bolts, field treat holes made after treating with hot creosote oil.
3. Plug unused holes with treated plugs after the field treatment.
4. When the approved use of temporary forms or braces causes nail or spike holes in treated piling, fill the holes using either of these methods:
   - Drive galvanized or aluminum nails or spikes flush with the surface.
   - Plug the holes with treated plugs after the field treatment.
5. Field treat treated piling heads used in permanent structures that will not be encased in concrete footings or caps after cutoff:
   a. Treat the sawed surfaces with either of these heated treatments:
      - Three applications of a mixture of 60 percent creosote oil and 40 percent roofing pitch
      - Three thorough brush coats of creosote oil followed by a covering of roofing pitch.
      - Allow each coat to dry before applying the next.
   b. Cover each pile head with a minimum 28-gauge (0.015 in [0.38 mm] thick) metal.
      - The metal may be aluminum or galvanized steel. However, aluminum is preferred.
      - Trim the metal neatly.
      - Bend the metal down around the pile and fasten it to the side using large-headed aluminum or galvanized roofing nails.

K. Bolt Timber Bracing

Bolt permanent timber bracing at its intersections with piles using standard steel bolts and nuts and cast or malleable iron ogee washers. Refer to Subsection 520.2 *Materials*

1. Place an ogee washer under the bolt head and under the nut.
2. Ensure that the diameters of the bolt and the drilled hole are each 3/4 in (19 mm).
3. After adjusting the nuts, burr the bolt threads.

L. Use Prestressed Concrete Piling

Piles cracked in transportation, handling, or storage may be rejected by the Engineer as defective piles if the cracking indicates structural damage.

Piles with cracks that are not structurally damaging that will not be used in sea water or alkali soils may be accepted by the Engineer if the cracks close and are not visible when the pile is in the leads.

When using prestressed concrete piling, comply with the following:

- Do not drive prestressed concrete piles until they reach a minimum strength of 5,000 psi (35 MPa) and a minimum age of 5 days.
- Form vent holes for voided-type piles in one face of each pile at approximately 5 ft. (1.5 m) on the centers. Ensure that these holes remain open permanently.
- After completing the driving, cut back and point over cable loops used as embedded pick-up points that remain above the ground or water line.

M. Use Metal Shell Piling

Metal shell piling consists of steel shells filled with Class A concrete after they are driven in place and cut off.

Ensure that the shell's minimum wall thickness is 1/4 in. (6 mm) unless otherwise shown on the Plans. However, furnish shells thick and rigid enough that they can be driven to the PDO without crimping, buckling, or distorting.

The Contractor may use either of the following:

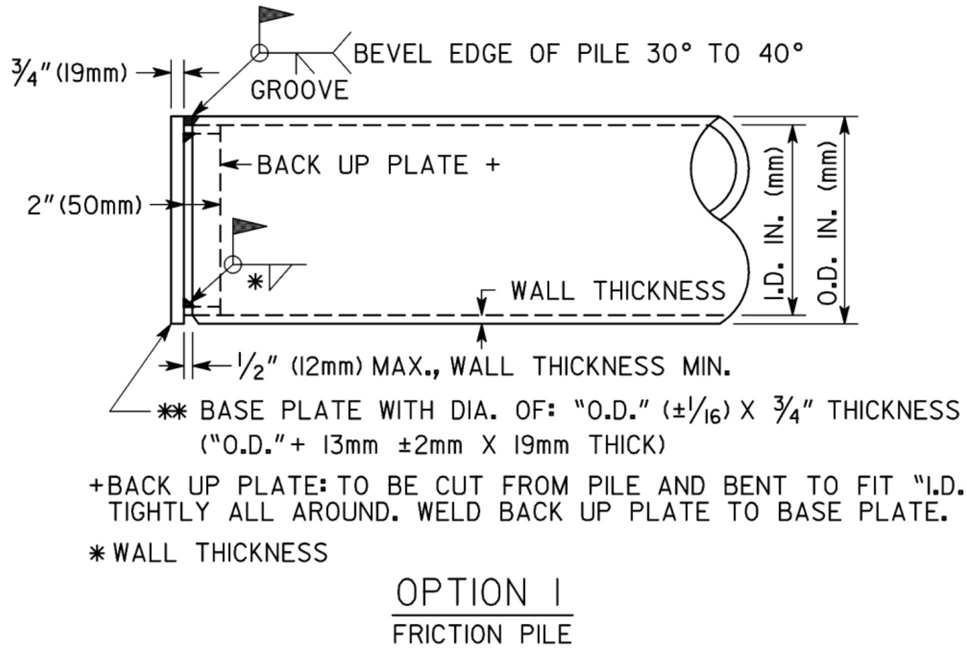
- Shells of constant section
- Shells that meet the requirements of Subsection 855.2.02, *Fluted Steel Shell Pile*

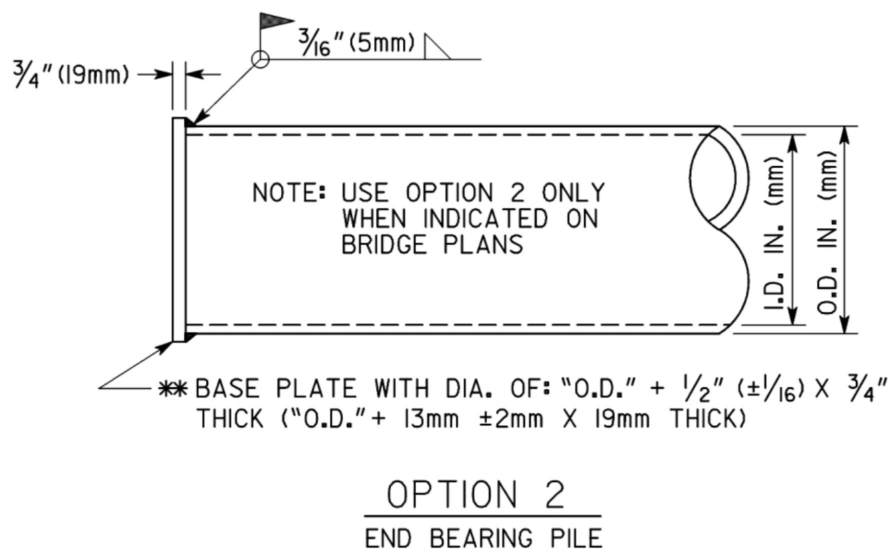
Use metal shell piling as follows:

1. Drive metal shell piling closed-ended.
2. Unless the Plans specify another detail, construct the end closure according to Option 1 of the Closure Plate Detail [Figure 2] so that the closure plate does not project beyond the outside diameter of the pile.
3. After driving, keep the tops of shells covered until the concrete is placed.
4. Ensure that driven shells are clean and free of water immediately before placing concrete. Use a suitable light to inspect the entire length of the shell in place.
5. Before placing concrete, examine the shells for collapse or diameter reduction.

   Shells that are broken or are collapsed enough that bearing capacity is materially decreased will be rejected as defective piles.

   Fill rejected shells that cannot be removed with Class A concrete at no expense to the Department.
6. When reinforcement steel is required, rigidly assemble and lower it into the shell so that its position is correct during concrete placement.





** BASE PLATE: NO MILL TEST REPORT REQUIRED. PLATES WILL BE ACCEPTED ON THE BASIS OF VISUAL INSPECTION

FIGURE 2

7. Ensure that there are no loose reinforcement steel bars.
8. Do not place concrete in the shells until completing driving within a 30 ft. (9 m) radius or until driving shells in any one bent or footing.

   If this is not possible, stop the driving within the radius limit until the concrete in the last shell filled reaches a minimum strength of 2,000 psi (14 MPa).

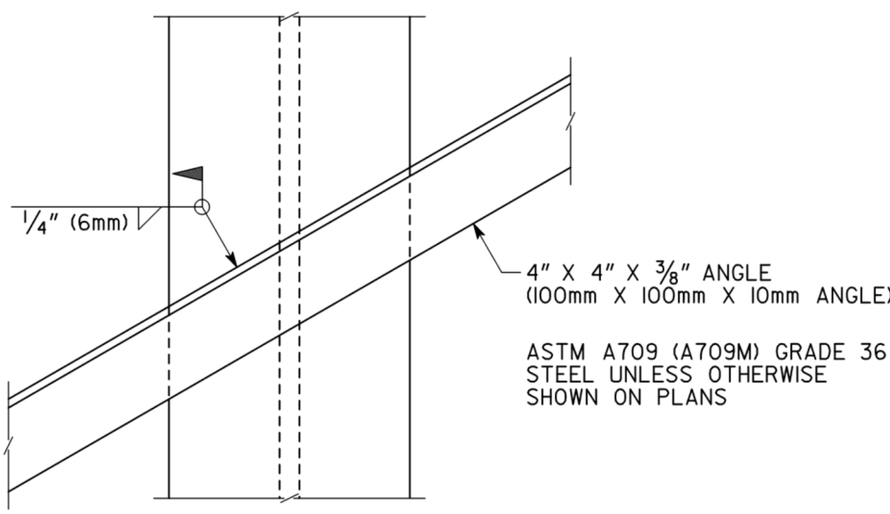
   The Engineer may adjust the 30 ft. (9 m) limit according to the prevailing vibration conditions.
9. Place concrete in the shells continuously from tip to butt. Where shells contain reinforcement steel, use tremies to pour the concrete.
10. For shells in trestle bents, mechanically vibrate the concrete starting approximately 10 ft. (3 m) below the ground and working up.
11. For shells in footings, mechanically vibrate the concrete for approximately 25 ft. (7.5 m) downward from the top of the shell pile.
12. Pour footings and trestle bent caps at least two hours after filling the last shell in the footing or trestle bent with concrete.

N. Use Steel H-Piling

Wherever the Plans require HP 14 in. by 73 lb. (360 mm by 108 kg) steel H-piling, the Contractor may substitute HP 13 in. by 73 lb. (330 mm by 109 kg) steel H-piling and, as appropriate, 13 in. (330 mm) pile tip reinforcement for bearing pile in footings. Do not make this substitution for pile bents. Do not change the Contract Bid Price to make the substitution.

Do not cut or trim steel H-piling to fit into an improperly sized steel driving head. Instead, replace the head with one that conforms to the requirements of Subsection 520.3.02.B, *Driving Head*.

Place swaybracing members as shown on the Plans or as required by the Engineer and weld it according to the Swaybracing Attachment Detail [Figure 3].



SWAYBRACE ATTACHMENT DETAIL

FIGURE 3

If steel H-piles are not driven in the position and to the alignment required, the Engineer may require fills and shims between the bracing and the pile flanges as an incidental part of the work.

O. Coat and Paint Piling

Apply a special protective coating as described below to steel H-Piling, metal shell piling, steel swaybracing, and when specified, PSC piling. Clean and paint the piling according to Subsections 535.3.03.A, *Clean New Steel Structures*, and Subsection 535.3.05.E, *Paint Steel H-Piling, Metal Shell Piling, and Steel Swaybracing*.

1. Coating Requirements for End-Bent Piling

   Clean end-bent piling and coat it with a System IV paint for 2 ft. (600 mm) below the bottom of the cap.

   As an alternate to coating, pour a concrete collar 2 ft. (600 mm) deep with a 3 in. (75 mm) cover around the pile.

2. Coating Requirements for Structures Crossing Streams

   Coat pilings as follows:

   a. **Piles Not Encased.** For piles within the stream and within 10 ft. (3 m) of the top of the stream bank, extend the coating required in Subsection 520.3.05.O.1, *Coating Requirements for End-Bent Piling* for 5 ft. (1.5 m) below the stream beds.

      Give piles a protective coating 5 ft. (1.5 m) below ground line for bents more than 10 ft. (3 m) outside each stream bank.

   b. **Piles Encased.** For piles that will be encased according to Section 547, extend the System IV paint 12 in. (300 mm) below the top of the encasement.

3. Coating Requirements for Grade Separation Structures

   For grade separation structures, extend coatings for intermediate bent piling to 5 ft. (1.5 m) below the finished ground line.

520.3.06 Quality Acceptance

A. Reaching the PDO

The Engineer is solely responsible for determining whether the PDO has been reached satisfactorily.

B. Driving Corrections

Correct driving deviations that exceed 3 in. (75 mm) from either the position or the line shown on the plans as directed by the Engineer.

Do not allow the pile heave from driving nearby piling to exceed 1/4 in. (6 mm) without retapping.

C. Correcting Rejected Piles

Rejected piles are:

- Unable to meet material certification
- Damaged by internal defects or by improper driving
- Driven out of proper location as described in Subsection 520.3.06.B, *Driving Corrections*.
- Incorrectly driven below the elevation fixed by the plans or the Engineer
- Excessively crimped in driving (steel piling)

If cracks develop in a prestressed concrete pile that do not classify the pile as defective, seal the cracks with an approved epoxy crack sealer at no expense to the Department. Place the sealer as directed by the Engineer.

If a pile is driven excessively out of position or below cutoff elevation through no fault of the Contractor, correct it using the method designated by the Engineer at the Department’s expense.

Correct rejected piling at no expense to the Department using one or more of the following methods approved for the pile:

1. Extract the pile and replace it with a new one.
2. Drive a second pile next to the defective pile.
3. Cut off the pile to obtain a fresh heading, splice it, and extend the pile according to Subsection 520.3.05.H, *Cut Off, Splice, and Extend Piling*.

4. Extend the footing or cap concrete to embed the pile properly and change the bar reinforcement steel as required.
5. Delay the Work pending a design analysis (performed by the Contractor with a Department review) and make the corrections specified by the Engineer. The delay is considered incidental to the Work.

520.3.07 Contractor Warranty and Maintenance

A. Unused Piling (Prestressed Concrete or Timber)

Undriven and undamaged whole lengths of piling ordered by the Engineer will become the property of the Department.

Assemble and neatly stack the lengths as directed by the Engineer at a convenient location for loading on Department vehicles.

Guard the lengths against damage or loss for 10 days after notifying the Engineer in writing that the lengths are ready for loading. The 10-day period begins when the Engineer receives the notice.

520.4 Measurement

The items included in this work will be measured for payment as described in Subsection 520.4.01, *Limits*.

520.4.01 Limits

A. Removing Obstacles

When the obstacle removed (see Subsection 520.3.03.A, *Remove Obstacles*) consists of the structure being replaced, and the Department has previously paid for removing the structure, remove or cut the obstacle at no cost to the Department.

When the obstacle consists of another object below the original ground and its removal or cutting is necessary, the removal or cutting is measured as Extra Work if it is not covered by another Pay Item.

Cutting by spudding is not measured for payment.

B. Order Lengths

The Department will not recognize, accept, or pay any claim for adjusting the Contract Unit Prices because of underruns or overruns of estimated lengths or quantities of piling.

C. Test Piling

Accepted test piles required by the Plans or the Engineer are measured per each and paid for at the Contract Unit Price.

Accepted piles furnished and driven as test piles at the Contractor’s option to determine order lengths are measured and paid for the same as for other piling in place of that type used in the completed structure.

Piling measured and paid for as test piles is not included in other measurement for payment.

There is no additional measurement for payment for “Driving Data Piles.”

D. Steel H-Piling and Metal Shell Piling

These piling types are measured in linear feet (meters) of piling in place remaining in the completed work and will be paid for at the respective Contract Price. Measurement does not include piling measured as test piling.

Payment is full compensation for furnishing, driving, jetting, spudding, lining, filling with concrete, disposing of cutoffs, and painting, including special protective coatings.

Pile encasement will be paid for by the linear foot (meter) according to Section 547.5.

Steel swaybracing of steel H-piling will be measured and paid for under Subsection 501.4, *Measurement* and Subsection 501.5, *Payment*.

E. Prestressed Concrete Piling and Timber Piling

These piling types are measured in linear feet (meters) of piling in place (plus an allowance for cutoff lengths noted in Subsection 520.4.01.F, *Cutoffs*) and paid for at the Contract Price. Measurement does not include piling measured as test piling.

Pay lengths will be based on the Engineer's pile order length.

Payment is full compensation for furnishing, driving, jetting, spudding, lining, disposing of cutoffs, and placing special protective coatings on prestressed concrete piling, if required.

For timber piling, this payment is also full compensation for the costs of furnishing, placing, and removing temporary bracing necessary to hold the piles in alignment.

The pay quantity includes prestressed concrete piling extensions (see Subsection 520.4.01.G.2, *Extensions*).

F. Cutoffs

No separate payment will be made for cutting off pile or for using the cutoff lengths of steel H or metal shell piling.

However, cutoff undamaged pieces of steel H or metal shell piling used to make other piles or used as extensions will be paid for as piling in place, described in Subsection 520.4.01.D, *Steel H-Piling and Metal Shell Piling*, Subsection 520.4.01.G, *Splices and Extensions*, and Subsection 520.4.01.G.2, *Extensions*.

G. Splices and Extensions

All extensions and splices are measured and paid for the same way, whether or not the pile is a test pile.

Splicing and extending timber piling, if allowed, will be measured and paid for as Extra Work according to Subsection 109.05, *Extra Work*.

1. Splices

   For any pile including test piles, each splice per steel H or metal shell pile provided for in the Splice Tabulations will be included in the pay quantities and paid for as a Specification allowance of piling in place in the amounts of 4 linear ft. (1.2 m) for steel H-pile and 2 linear ft. (600 mm) for metal shell pile.

   When the original length of a Department test pile is increased by the Engineer after being driven, each splice required as ordered and accepted is measured for payment in the amount provided above. Other steel pile splices, including others made on test piles, will be performed at the Contractor's expense.

   For prestressed concrete piling, each splice ordered and accepted (except those required because of Contractor negligence) will be measured and paid for as a Specification allowance of 5 linear ft. (1.5 m) of piling. This payment compensates for the costs of making the actual splice within the limits of the cut-back portion. Include uncompensated costs in the overall bid submitted.

Splice Tabulations	
Steel H or Metal Shell Piling	
In Place Length	Maximum Pay Splices (If Made)
60 ft. (18 m) or less	None
Above 60 ft. (18 m) through 90 ft. (27 m)	1
Above 90 ft. (27 m) through 120 ft. (36 m)	2
Above 120 ft. (36 m) and up	3

   Splices will be paid for only when performed.

2. Extensions

   The extension of a prestressed concrete pile, including test piles, will be the net length ordered by the Engineer measured from the original pile head to the extended head. This extension is measured as piling.

The actual splice within the cutback portion is measured separately as specified in Subsection 520.4.01.G.1, *Splices*.

Extensions required because of the Contractor's negligence are not measured for payment.

The Engineer will determine the length of extensions for the Department's steel H or metal shell test piling. These extensions will be paid for as piling in place according to Subsection 520.4.01.D, *Steel H-Piling and Metal Shell Piling*.

H. Alternate to Extending Test Piling

Instead of extending a prestressed concrete test pile that requires additional driving to reach the PDO (as provided in Subsection 520.4.01.G.2, *Extensions*.), the Engineer may give the Contractor the option of abandoning the pile as a test pile as far as measurement and payment are concerned.

If the Contractor chooses this option, the Engineer will allow the Contractor to drive a substituted, longer pile of the required length as the test pile at another location selected by the Engineer.

The Engineer will determine the net additional length required. This additional length will be paid for as piling with no splice allowance.

Complete the abandoned test pile, which is measured the same as non-test piles.

The Engineer will not allow the option if the driving data obtained is sufficient or if a loading test is needed instead of further driving.

I. Loading Tests

The number of loading tests completed and accepted will be measured and paid for per each at the Contract Price.

Any loading test or additional stage of loading abandoned because of Contractor fault will not be measured.

J. Cast Steel H-Pile Points

Cast steel H-Pile points of the type and size designated on the Plans are measured per each.

K. Pilot Holes

Pilot holes drilled and accepted as a Contract Item are measured per linear foot (meter) from the natural ground (intermediate trestle bents) or from the bottom of concrete, whichever applies. Pilot holes will be paid for at the Contract Price.

Pilot holes not required by the Plans but made at the request of the Engineer will be measured and paid for as Extra Work according to Subsection 109.05, *Extra Work*.

L. Composite Prestressed Concrete Piling

No separate payment will be made for furnishing and driving steel H-pile sections partially embedded in and partially protruding from prestressed concrete piling, including test piles.

M. Unused Prestressed Concrete or Timber Piling

Unused prestressed concrete or timber piling will be paid for at invoiced cost, including transportation plus 10 percent.

520.5 Payment

This work will be measured and paid for at the Contract Prices, complete in place.

Payment is full compensation for all costs of complying with these Specifications, including incidentals and additional work.

Payment will be made under:

Item No. 520	Piling in place, (type), (size)	Per linear foot (meter)
Item No. 520	Piling, (type), (size*)	Per linear foot (meter)
Item No. 520	Test pile, (type), (size*)	Per each
Item No. 520	Loading test, (type), (size*)	Per each
Item No. 520	Pilot holes	Per linear foot (meter)
Item No. 520	H-pile points (type), (size)	Per each
Item No. 520	Cast steel H-pile points (type), (size)	Per each
*For timber piling, size will be omitted.		

520.5.01 Adjustments

A. Test Piles

No deduction will be made when a required test pile underruns in length with the Engineer's consent.

When a required test pile overruns in length with the Engineer's consent, see Subsection 520.4.01.G.1, *Splices*.

B. Cutoff Allowances

Cutoff allowances exclude test piling.

Cutoff allowances will be made for each excess linear foot (meter) removed to achieve the cutoff elevation as follows:

- For timber piling, the cutoff allowance is 50 percent of the Contract Price.
- For prestressed concrete piling, the cutoff allowance is 75 percent of the Contract Price.

C. Loading Tests

If the loaded pile does not carry the load satisfactorily after the load is placed and it is necessary to redrive and reload the pile, this reload constitutes an additional stage of loading but not an additional loading test.

Each additional stage of loading made and accepted on any single pile as specified will be measured and paid for as 50 percent of a loading test.

Section 530—Waterproofing Fabrics

Replace Section 530 with the following:

530.1 General Description

This work consists of waterproofing concrete and other masonry surfaces by preparing and applying a composite waterproofing membrane at locations shown on the plans.

530.1.01 Definitions

General Provisions 101 through 150.

530.1.02 Related References

A. Standard Specifications

Section 500—Concrete Structures

B. Referenced Documents

General Provisions 101 through 150.

530.1.03 Submittals

General Provisions 101 through 150.

530.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Waterproofing Membrane Material	888.2.03
Mortar	834.2.03

For a list of waterproofing membrane sources, see QPL 22.

530.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

530.3 Construction Requirements

530.3.01 Personnel

General Provisions 101 through 150.

530.3.02 Equipment

General Provisions 101 through 150.

530.3.03 Preparation

A. Prepare the Concrete

Prime the concrete and apply the membrane only under the following conditions:

- Air and concrete temperatures are above 40 °F (4 °C).
- All surfaces are thoroughly dry.
- Concrete is at least 7 days old.

Prepare the concrete as follows:

1. Fill all hole cracks and depressions in the concrete surface flush with mortar composed of one part Portland cement and two parts approved sand and cure according to Subsection 500.3.05.Z, “Cure Concrete.”

   The Contractor may use approved, commercially produced, fast setting, no sag grouts to expedite the work.
2. Chip or grind smooth all high spots, sharp points, and edges.
3. Thoroughly clean and dry the concrete surface.

B. Prime the Concrete

Prime all areas that will receive membrane and allow the areas to cure according to the manufacturer’s recommendations or as directed by the Engineer.

Areas not covered with membrane in 24 hours must be reprimed.

530.3.04 Fabrication

General Provisions 101 through 150.

530.3.05 Construction

A. Seal Openings and Structure Edges

At openings for drains and pipes and at the edges of structures, construct a seal to prevent water from passing between the waterproofing and the surface that it overlays.

Apply a manufacturer-recommended edge seal to any area of the membrane permanently exposed to sunlight.

B. Waterproof Joints

Joints require a double thickness of waterproofing membrane over properly sealed expansion, construction, or control joints.

Pre-strip the joint with a 12 in. (300 mm) wide membrane before applying the main waterproofing. The surface of this pre-strip does not need priming.

C. Seal Seams

Edge and end seams must overlap at least 4 in. (100 mm) on all applications.

D. Apply Membrane

Apply the membrane as follows:

Rub the entire membrane firmly and completely as soon as possible to minimize bubbles caused by air outgassing or water vapor from the concrete.

Slit all fish mouths, overlap the flaps and repair with a patch pressed or rolled to make the seal. Seal the edges with mastic.

Patch misaligned or inadequately lapped seams with the membrane.

E. Protect Membrane

When necessary, use a manufacturer-approved protection system to protect waterproofing membranes from damage caused by backfill material or other construction activities.

F. Repair Membrane

As soon as possible, patch all tears and inadequately lapped seams with waterproofing membrane.

Slit fish mouths and repair with a patch extending 8 in (200 mm) in all directions from the slit and seal the edges of the patch with mastic.

530.3.06 Quality Acceptance

General Provisions 101 through 150.

530.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

530.4 Measurement

This work will be measured for payment in square yards (meters) of accepted waterproofing.

530.4.01 Limits

General Provisions 101 through 150.

530.5 Payment

This work will be paid for at the Contract Price per square yard (meter) for waterproofing complete in place.

Payment will be made under:

Item No. 530	Waterproofing	Per square yard (meter)

530.5.01 Adjustments

General Provisions 101 through 150.

Section 541—Detour Bridges

Replace Section 541 with the following:

541.1 General Description

This work consists of constructing, maintaining, and removing detour bridges.

Construct detour bridges the width and length required on the plans. (The bridge width is the clear distance between curbs or hub guards.) Construct the bridges at the locations required on the plans and provide the necessary end walls or bulkheads as part of the Work.

541.1.01 Definitions

General Provisions 101 through 150.

541.1.02 Related References

A. Standard Specifications

Section 104—Scope of Work

Section 105—Control of Work

Section 540—Removal of Existing Bridge

B. Referenced Documents

AASHTO Standard Specifications for Highway Bridges

541.1.03 Submittals

A. Bridge Design Considerations

Unless otherwise shown, design detour bridges for an AASHTO HS-20 live load capacity. This capacity is based on the working stresses allowed for the materials used and for the design criteria of the AASHTO Standard Specifications for Highway Bridges.

The Contractor may omit lane loadings from design considerations. Load factor design is allowed.

B. Bridge Drawings

Submit to the Engineer a proposed layout, shop drawings, and calculations for each detour bridge for review and approval. Submission should be made electronically in a portable document format (pdf) and include an index. Format all drawings to fit 11 in. x 17 in. (279 mm x 432 mm) paper. Present calculations to fit 8.5 in. x 11 in. (216 mm x 297 mm) paper. The submission shall be prepared and stamped by the Design Engineer who shall be registered as a Professional Engineer in the State of Georgia. Do not begin work until drawings have been approved.

541.2 Materials

Use materials approved by the Department. Material restrictions are as follows:

- Do not use timber in the superstructure.
- Do not use structurally unsound materials of any type.

Piling may be timber. Tight bark does not need to be removed from timber piles.

541.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

541.3 Construction Requirements

541.3.01 Personnel

General Provisions 101 through 150.

541.3.02 Equipment

General Provisions 101 through 150.

541.3.03 Preparation

General Provisions 101 through 150.

541.3.04 Fabrication

General Provisions 101 through 150.

541.3.05 Construction

A. Construct the Detour Bridge

Construct the detour bridge according to drawings approved by the Engineer.

B. Construct Safety Features

Construct either of the following safety features at both ends of the detour bridge:

1. Guard rail

   Construct according to the Construction Details shown in the plans.
2. Precast median barrier according to current Temporary Concrete Barrier Standards.

   When the precast median barrier option is selected, construct the barrier as follows:
   a. Place the precast median barrier on both sides and both ends of the detour bridge unless otherwise directed by the Engineer.
   b. Ensure that the barrier extends at least 40 ft. (12 m) from the bridge ends unless the plans show otherwise.

C. Remove the Detour Bridge

After the permanent construction is open to traffic, remove the detour bridge according to Section 540.

Material salvaged from the detour bridge remains the property of the Contractor. Consider the salvage value when compiling the bid.

541.3.06 Quality Acceptance

General Provisions 101 through 150.

541.3.07 Contractor Warranty and Maintenance

A. Maintain the Detour Bridge

Except as otherwise provided in Subsection 104.05.D, *Detours Outside Right-of-Way*, maintain the detour bridge so it can safely carry the design loading at all times. Furnish labor and material to maintain the bridge.

If the Engineer determines that the detour bridge endangers public safety, promptly repair the bridge. If the bridge is not repaired immediately, the Engineer will proceed according to Subsection 105.15, *Failure to Maintain Roadway or Structures*.

541.4 Measurement

This work will not be measured separately for payment.

541.4.01 Limits

General Provisions 101 through 150.

541.5 Payment

This work will be paid for at the Contract Price per detour bridge complete in place, maintained, and removed.

Payment will be made under:

Item No. 541	Detour bridge (requires width, length, and sta. no.)	Per lump sum

541.5.01 Adjustments

After the detour bridge is completed, the Engineer will include 80 percent of the Contract Price for the detour bridge in the next statement.

After the detour bridge is satisfactorily removed, the Engineer will include the remaining 20 percent in the next statement.

Section 550—Storm Drain Pipe, Pipe-Arch Culverts, and Side Drain Pipe

Replace Section 550 with the following:

550.1 General Description

This work includes furnishing and installing the following:

- Storm drain pipe
- Side drain pipe
- Pipe-arch culverts
- Elliptical pipe
- Flared end sections
- Safety end sections
- Tapered pipe inlets

Install structures according to the Specifications and the details shown on the Plans, or as directed by the Engineer.

550.1.01 Definitions

Side Drain – All driveway pipes (commercial, non-commercial, residential, utility, farm, logging, and mining).

Storm Drain Pipe –All pipe used in the highway drainage system that receives surface water through inlets and conveys the water through conduits to a pipe outlet

Thermoplastic Pipe – High Density Polyethylene (HDPE), Polypropylene (PP) and Polyvinyl Chloride (PVC).

General Provisions 101 through 150.

550.1.02 Related References

A. Standard Specifications

Section 161—Control of Soil Erosion and Sedimentation

Section 205—Roadway Excavation

Section 207—Excavation and Backfill for Minor Structures

Section 208—Embankments

Section 645—Repair of Galvanized Coatings

Section 812—Backfill Materials

Section 815—Graded Aggregate

Section 834—Masonry Materials

Section 840—Corrugated Aluminum Alloy Pipe

Section 841—Iron Pipe

Section 843—Concrete Pipe

Section 844—Steel Pipe

Section 845—Thermoplastic Pipe

Section 847—Miscellaneous Pipe

Section 848—Pipe Appurtenances

B. Referenced Documents

General Provisions 101 through 150.

GDOT Manual on Drainage Design for Highways

Ga. Std. 1030D

Ga. Std. 1030P

GDT 136

ASTM C 1479

ASTM D 2321

550.1.03 Submittals

General Provisions 101 through 150.

550.2 Materials

Ensure materials meet the requirements of the following Specifications:

Material	Section
Backfill Materials	207
Graded Aggregate	815
Reinforced Concrete Pipe	843.2.01
Nonreinforced Concrete Pipe	843.2.02
Mortar And Grout	834.2.03
Bituminous Plastic Cement	848.2.05
Rubber Type Gasket Joints (Concrete Pipe)	848.2.01
Preformed Plastic Gaskets	848.2.06
Corrugated Steel Pipe	844.2.01
Bituminous Coated Corrugated Steel Pipe	844.2.02
Corrugated Aluminum Alloy Pipe	840.2.01
Bituminous Coated Corrugated Aluminum Pipe	840.2.03
Aluminized Type 2 Corrugated Steel Pipe	844.2.06
Ductile Iron Pipe, Fittings and Joints	841
Precoated, Galvanized Steel Culvert Pipe	844.2.05
Smooth Lined Corrugated High Density (HDPE) Polyethylene Culvert Pipe	845.2.01
Polyvinyl Chloride (PVC) Profile Wall Drain Pipe	845.2.02
Polyvinyl Chloride (PVC) Corrugated Smooth Interior Drain Pipe	845.2.03
Smooth Lined Corrugated Polypropylene (PP) Pipe	845.2.05
Miscellaneous Pipe	847

Use any of the following types of pipe:

Rigid Pipe Types

- Reinforced concrete
- Nonreinforced concrete
- Ductile Iron

Flexible Pipe Types

- Corrugated steel or Aluminum
- Smooth-lined corrugated high density polyethylene (HDPE)
- Polyvinyl Chloride (PVC) Profile Wall Drain Pipe
- Polyvinyl Chloride (PVC) Corrugated Smooth Interior Drain Pipe
- Precoated, Galvanized Steel Culvert Pipe (Polymer)
- Smooth Lined Corrugated Polypropylene (PP) Pipe

Use the type of pipe designated on the Plans, or acceptable alternate types when applicable. For a listing of acceptable alternate pipe types see the GDOT Approved Material Selections List in Chapter **7–** Storm Drain Design of the Department's Manual on Drainage Design for Highways. This document summarizes general applications for pipe.

For concrete, corrugated steel and aluminum pipes see Ga. Std. 1030D for minimum thicknesses, minimum cover, maximum fill, allowable pipe diameters and trench construction detail.

For thermoplastic pipes see Ga. Std. 1030P for minimum cover, maximum fill, allowable pipe diameters and trench construction details.

A. Thermoplastic Pipe Project Restrictions

Thermoplastic pipe is restricted to the following project conditions:

1. Storm Drain
   a. Travel Bearing: ADT less than 15,000
   b. Non-Travel Bearing: Non-Interstate
2. Side Drain
   a. Allowed on all projects

550.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

550.3 Construction Requirements

550.3.01 Personnel

General Provisions 101 through 150.

550.3.02 Equipment

General Provisions 101 through 150.

550.3.03 Preparation and Backfill

Before installing pipe, shape the foundation material as shown on the Plans.

Prepare structure excavations, foundation and backfill according to Section 207. Except, use the following foundation and backfill material requirements for thermoplastic pipe installations:

1. For storm drain applications (cross and longitudinal) use graded aggregate material meeting Section 815.
   a. 20 ft. (6.1 m) maximum fill height for High Density (HDPE) Polyethylene Culvert Pipe.
   b. 25 ft. (7.6 m) maximum fill height for Polyvinyl Chloride (PVC) and Polypropylene (PP) Pipe.

2. For side drain applications (driveway) use backfill material based on fill height.
   a. Fill heights up to 10 ft (3 m), use normal backfill material meeting the following soil classes per Subsection 810.2.01.
      - High Density (HDPE) Polyethylene Culvert Pipe use Class II B2 soil or better.
      - Polyvinyl Chloride (PVC) and Polypropylene (PP) Pipe use Class II B3 soil or better.
      - If the required soil Class is not available use graded aggregate material meeting Section 815.
   b. Fill heights above 10 ft. (3 m), use graded aggregate material meeting Section 815.
3. Other structures and pipes shall be at least 2 ft (600 mm) from installed pipe.

550.3.04 Fabrication

General Provisions 101 through 150.

550.3.05 Construction

A. Drainage

Provide necessary temporary drainage. Periodically remove any debris or silt constricting the pipe flow to maintain drainage throughout the life of the Contract.

B. Damage

Protect the structure by providing sufficient depth and width of compacted backfill before allowing construction traffic over a culvert. Repair damage or displacement from traffic or erosion occurring after installing and backfilling at no additional cost to the Department.

C. Installation

Check vertical and horizontal alignment of the pipe culvert or pipe barrel by sighting along the crown, invert and sides of the pipe, and by checking for sagging, faulting and invert heaving. Repair any issues involving incorrect horizontal and/or vertical alignment before backfilling pipe.

1. Concrete Pipe

   Install Concrete Pipe according to ASTM C 1479 and as per plans. Lay sections in a prepared trench with the socket ends pointing upstream. Join section using rubber gasket installed according to Subsection 848.2.01 and the manufacturer's recommendations.
2. Ductile Iron Pipe

   Lay pipe sections in a prepared trench, with bells pointing upstream. Construct joints according to Subsection 841.2.02.A.
3. Corrugated Metal

   Lay pipe sections in a prepared trench, with outside laps of circumferential joints pointing upstream and longitudinal joints at the sides. Join the sections with coupling bands, fastened by two or more bolts. Before backfilling the structure:
   a. Repair areas of damaged coatings and exposed base metal according to applicable AASHTO Standard Specification specified in Section 844.
4. Thermoplastic Pipe

   Install smooth-lined corrugated HDPE, PVC, and smooth-lined polypropylene pipe according to ASTM D 2321 and as per plans using backfill requirements in Subsection 550.3.03. Use fitting and couplings that comply with the joint performance criteria of AASHTO Standard Specifications for Highway Bridges, Division II. Ensure all joints are "silt tight" as stated in the AASHTO bridge specifications.
5. Specials (Wyes, Tees, and Bends)

   Install wyes, tees, and bends as shown on the Plans or as directed.
6. Tapered Pipe Inlets

   Locate and install tapered pipe inlet end sections as shown on the Plans or as directed.

7. Elongation

   Elongate metal pipe as shown on the Plans. Order the elongation of the vertical axis of the pipe to be done in the shop.

   Ensure the manufacturer ships metal pipe with wire ties in the pipe ends. Remove wire-ties immediately after completing the fill.

8. Flared End Sections

   Use flared end sections on the inlet, outlet, or on both ends of storm drain pipe, according to Plan details.

550.3.06 Quality Acceptance

The Engineer will visually inspect all pipe for alignment, deflection, cracking, joint separation, sagging, or other exterior damage.

The Department may elect to conduct Quality Assurance verifications of any pipe inspections. These verifications will be performed by Department personnel.

The Department will require video inspection on projects that have more than 500 linear feet of storm drain pipe and on routes with an AADT greater than 3,000 vehicles. Conduct video inspection in accordance with the requirements of this Specification and GDT 136 on 20% of all storm drain pipe and 10% of all side drain pipe installations. The Engineer will randomly select installations to be tested.

Unless the Engineer directs otherwise, schedule the video inspections for the selected locations no sooner than 30 days after completing pipe installations to be tested.

A. Post Installation Inspection

Before post installation inspection, dewater installed pipe (if necessary) and provide the Engineer with a post installation inspection schedule. Notify the Engineer at least seven days in advance of beginning inspection. Perform post installation inspections after compacted backfill has reached a depth of 8 feet or after completion of the pipe installation and final cover, which includes the embankment and all non-asphalt bases and/or subgrades. Notify the Engineer if distresses or locations of improper installation are discovered. When camera testing shows distresses or improper installation in the installed pipe, the Engineer may require additional sections to be tested or may require corrective action.

Video and laser profiling and measurement technology must be certified by the company performing the work to meet the requirements of GDT 136. Inspection contractor personnel completing remote inspections shall be NASSCO – PACP Certified Technicians. Testing performed by a company failing to meet these requirements will result in non-payment of the pipeline video inspection and non-certification of the pipe tested.

For video recorded, laser profiled pipe indicating deflection is in excess of Specification requirements, the Contractor may elect to further test the pipe with the use of a mandrel. Ensure mandrel meets requirements of GDT 136 and the Engineer has approved before use.

Mandrel or manual post installation inspection allowed for pipe diameters greater than 48 inches.

B. Requirements for Rigid Pipe – Concrete

1. Joints**:** Note differential movement, cracks, spalling, improper gasket placement, movement or settlement of pipe sections, and leakage in the inspection report. Repair or replace pipe sections to the satisfaction of the Engineer where joint separation is greater than 1 inch (25 mm). Repair or replace pipe sections where soil migration through the joint is occurring.
2. Longitudinal and Transverse Cracks: Cracks with a width less than 0.01 inch (0.25 mm) are considered hairline and minor and only need to be noted in the inspection report, no corrective action is necessary. When cracks exceed the cracking and installation thresholds indicated in the Rigid Pipe Remediation Table in Section 550.5.01.B, regardless of position in the wall of the pipe, measure the width, length, and locations of the cracks and diameter of the pipe, both horizontally and vertically, use remediation methods in accordance with recommendations of the pipe manufacturer and submit to the Engineer for review and approval an evaluation utilizing a Professional Engineer registered in the State of Georgia that takes into

consideration structural integrity, environmental conditions, and the design service life of the pipe. Based on the evaluation, the Department may allow the pipe to remain in place if the cracking is remediated according to an approved remediation plan submitted in writing to the Engineer. Provide 10 business days for the Department to review the evaluation. When the pipe shows cracking 0.01 inch (0.25 mm) or greater and extending for a length of 12 inches (300mm), remediate or replace as directed by the Engineer. When the camera/video cracking results are called into question, the Department may require manual inspection measurements.

C. Requirements for Flexible Pipe – Thermoplastic, Corrugated Metal

1. Joints: Remediate pipe showing evidence of crushing at the joints. Note differential movement, improper joint sealing, movement or settlement of pipe sections, and leakage in the inspection report. Remediate joint separation of greater than 1 inch (25 mm) per manufacturer’s recommendation. Repair or replace pipe sections where soil migration through the joint is occurring.
2. Cracks: Remediate cracks or splits in the interior wall of the pipe. Use remediation methods in accordance with recommendations of the pipe manufacturer and accepted and authorized by the Engineer.
3. Buckling, bulging, and racking: Note in the inspection report flat spots or dents at the crown, sides or flowline of the pipe due to racking. Note areas of wall buckling and bulging in the inspection report. The Engineer will determine if corrective action is necessary.
4. Deflection: If flexible pipes exceed the deflection and installation thresholds indicated in the Flexible Pipe Deduction Table in Section 550.5.01.C, provide the Department with an evaluation of each location conducted by a Professional Engineer registered in the State of Georgia addressing the severity of the deflection, structural integrity, environmental conditions, and design service life. Based on the evaluation, the Department may allow the pipe to remain in place at a reduced unit price as shown in the Flexible Pipe Deduction Table. Provide 10 business days for the Department to review the evaluation. When the pipe shows deflection 10 percent or greater, remove and replace. When the laser deflection results are problematic, the Department may require mandrel or manual testing.
5. Coating on Corrugated Metal: Note areas of the pipe where the original coating has been scratched, scoured or peeled.

550.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

550.4 Measurement

A. Excavation and Backfill

Foundation backfill materials Types I, II and III are measured according to Subsection 207.4, *Measurement.*

Normal backfill is not measured separately.

No measurement will be made for graded aggregate used for structural backfill of thermoplastic pipe.

B. Flat Bottom and Circular Pipe (All Types)

The overall length of pipe installed, excluding tapered inlets, is measured in linear feet (meters), along the central axis of the diameter of the pipe. Wyes, tees, and bends are included in this measurement.

C. Pipe-Arches

The overall length of pipe-arch installed is measured in linear feet (meters), along the bottom center line of the pipe.

D. Multiple Installations

In multiple installations, each single line of culvert structure is measured separately.

E. Tapered Pipe Inlets

Tapered pipe inlet sections are measured as a unit; do not include them in the overall length of the pipe.

F. Flared-End Sections

Flared-end sections are measured separately by the unit and not included in the overall pipe length.

G. Smooth-Flow Pipe

Smooth-flow pipe is measured by the linear foot (meter) along the pipe invert.

H. Elliptical Pipe

Elliptical pipe is measured in linear feet (meters) along the bottom center line of the pipe.

I. Video Inspection

Video Inspection is measured by the linear feet of quantity of pipe inspected. When inspection above the quantity specified in the Contract is performed due to the possibility of additional distresses or non-compliance noted by the Department and the pipe is found to be in compliance, the Department will measure this quantity as Extra Work as per Specification 104.04. However, if additional distresses are found, the additional linear feet of video inspection will not be measured for payment.

J. Deduction for Pipe Deflection

Quantity of deflected pipe will be determined using the pipe inspection summarization report in accordance with GDT 136. Deductions and possible replacement of pipe will be made for pipe sections that do not meet the requirements of this specification in accordance with the table in sub-section 550.5.01. The section length is determined by the length of the pipe between joints where the failure occurred.

550.4.01 Limits

Excavation and normal backfill are not measured for payment.

550.5 Payment

A. Backfill

Foundation backfill material Type II and III will be paid for according to Section 207.

Foundation backfill material Type I will be paid for according to Section 205 or Section 206.

Graded aggregate used for structural backfill of thermoplastic pipe will not be paid for separately, payment will be included in the overall price bid for pipe.

B. Pipe Installations

Pipe installations complete in place and accepted will be paid for at the Contract Price for each item.

This payment is full compensation for excavating, furnishing, and hauling materials; installing, cutting pipe where necessary; repairing or replacing damaged sections; making necessary connections; strutting, elongating, providing temporary drainage; joining an extension to an existing structure where required; and removing, disposing of, or using excavated material as directed by the Engineer.

1. Smooth Flow Pipe

   The quantity of each diameter and steel thickness of smooth flow pipe as measured will be paid for at the Contract Unit Price per linear foot (meter) bid for the various sizes. Payment is full compensation for furnishing labor, materials, tools, O-ring mechanical joints, equipment, and incidentals to complete this Item, including removing and disposing excavation material.

2. Flared-End Sections

   Flared-end sections, measured as specified above, will be paid for at the Contract Unit Price for each section of the specified size.

Payment will also include sawing, removing, and replacing existing pavement removed to install a new drainage structure.

Payment for this item is made as follows:

One hundred percent of the Contract Price bid per linear foot (meter) is paid when the pipe is installed per the specifications including the required material documentation. The Contract Price is paid before post installation inspection.

C. Video Inspection

Include the cost of Video Inspection in the bid submitted for this pay item. Video Inspection will be paid for up to the maximum number of linear feet included in the contract. Testing performed by a company failing to meet the requirements of GDT 136 will result in non-payment of the pipeline video inspection and non-certification of the pipe tested. Failure to perform the video inspection may result in a deduction of payment for pipe installed until video inspection is complete.

D. Temporary Drainage

Temporary Drainage items will be paid for at 75% of contract price for each item when installed. The final 25% will be paid when the temporary drainage item is removed or filled with flowable fill as specified in the plans.

Payments will be made under:

Item No. 550	Storm drain pipe___ in (mm), Class ___	Per linear foot (meter)
Item No. 550	Side drain pipe___ in (mm), H=___	Per linear foot (meter)
Item No. 550	Pipe arch (span) ____in (mm) x (rise) ___in(mm)	Per linear foot (meter)
Item No. 550	Tapered pipe inlet ___ in (mm),	Per each
Item No. 550	Flared-end section ___ in (mm),	Per each
Item No. 550	Elliptical pipe___ in (mm) wide x ___ in (mm) high	Per linear foot (meter)
Item No. 550	Video Inspection	Per linear foot (meter)
Item No. 550	Storm drain pipe___ in (mm), Class ___, Temporary	Per linear foot (meter)
Item No. 550	Side drain pipe ___ in (mm), H= ___, Temporary	Per linear foot (meter)
Item No. 550	Flared-end section ___ in (mm), Temporary	Per each

550.5.01 Adjustments

A. Excavation

Excavation will not be paid for separately, but the other provisions of Section 205 and Section 208 shall govern.

B. Rigid Pipe

RIGID PIPE REMEDIATION TABLE	
Crack Width (inches)	Payment
Greater than or equal to 0.01 (0.25mm) and extend 12 in. (300 mm) but less than or equal to 0.1 in. (2.5 mm)	Remediate - 100% of the Unit Bid Price (1)
Greater than 0.1 in. (2.5 mm)	Remediate or Replace (1)

(1) Provide in writing a method for repairing the observed cracking. Do not begin work until the method has been approved.

C. Flexible Pipe

FLEXIBLE PIPE DEDUCTION TABLE	
Amount of Deflection (%)	Payment
0.0 to 5.0	100% of the Unit Bid Price
5.1 to 7.5	75% of the Unit Bid Price (1)
7.6 to 9.9	50% of the Unit Bid Price (1)
10 or greater	Remove and Replace

(1) Provide Structural Analysis for Flexible Pipe. Based on the structural analysis, the pipe may be allowed to remain in place at the reduced price.

Section 561—Renovating Existing Pipe

Replace Section 561 with the following:

561.1 General Description

This work includes furnishing and inserting helically corrugated metal pipe, smooth-lined corrugated polyethylene pipe, high density polyethylene profile wall pipe, centrifugal cast concrete, cure in place pipe (CIPP), and high density polyethylene solid wall pipe or a polyvinyl chloride pipe inside an existing pipe and pressure grouting the space between the two pipes.

561.1.01 Definitions

General Provisions 101 through 150.

561.1.02 Related References

A. Standard Specifications

Section 801—Fine Aggregate

Section 830—Portland Cement

Section 831—Admixtures

Section 844—Steel Pipe

Section 845—Smooth Lined Corrugated Polyethylene (PE) Culvert Pipe

Section 880—Water

Section 882—Lime

Section 883—Mineral Filler

B. Referenced Documents

GDT 84

561.1.03 Submittals

General Provisions 101 through 150.

561.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Corrugated Steel Pipe (Helically Corrugated)	844.2.01*
Smooth-Lined Corrugated Polyethylene (PE) Culvert Pipe	845
Portland Cement, Types I or II	830
Mineral Filler (Limestone Dust)	883
Fly Ash, Type A	831
Water	880
Fine Aggregate, Size No. 20	801.2.02
Agricultural Lime	882.2.02**
*Use Georgia Standard 1030D to determine the metal thickness of the insert pipe.	
**For this Work, use agricultural lime that has 90 percent minimum passing the No. 30 (600 µm) sieve and 30 percent minimum passing the No. 200 (75 µm) sieve.	

A. High Density Polyethylene (HDPE) Profile Wall Pipe

Use pipe liner that consists of a HDPE profile wall pipe that conforms to the requirements of ASTM F 894. Polyethylene material shall have polyethylene pipe liners material designation of PE 3408 and shall have a material cell classification per ASTM D 3350 of 334433C or higher.

Join HDPE profile wall pipe liner by thermal fusion (extrusion welding) per manufacturer specifications or provide a positive mechanical joint that meets the requirements of ASTM D 3212. The joint shall be able to be pulled or pushed into the host pipe without joint separation.

B. High Density Polyethylene (HDPE) Solid Wall Pipe

Pipe liner shall consist of a HDPE solid wall pipe that conforms to the requirements of ASTM F 714 with an SDR of 32.5. Polyethylene material shall have polyethylene pipe liners material designation of PE 3408 and shall have a material cell classification per ASTM D 3350 of 345464C.

Join HDPE solid wall pipe liner by butt fusion per ASTM F 2620 and the manufacturer specifications or provide a positive mechanical joint that meets the requirements of ASTM D 3212. The joint shall be able to be pulled or pushed into the host pipe without joint separation.

C. Polyvinyl Chloride (PVC) Pipe

Pipe liner shall consist of PVC corrugated pipe with a smooth interior that conforms to the requirements of ASTM F 949. PVC pipe shall have a minimum pipe stiffness of 46 psi (317 kPa) when tested according to ASTM D 2412. Use pipe made of PVC compound with a cell classification per ASTM D 1784 of 1245B.

Join the PVC pipe liner with a PVC coupling that uses elastomeric sealing gaskets. The assembled joint shall meet the performance requirements of ASTM D 3212. The joint shall be able to be pulled or pushed into the host pipe without joint separation. Ensure that elastomeric seals meet the requirements of ASTM F 477.

D. Centrifugal Cast Concrete (Spin Cast)

The lining rehabilitation system shall be designed for and consist of spray applying and/or centrifugally spin-casting an engineered cementitious fine aggregate composite concrete lining material designed specifically for structural pipe rehabilitation. Application to the inside of an existing structure shall conform to the requirements of ASTM F-

2414 and F-2551. Lining systems must be designed to adhere to culvert and storm sewer piping constructed from a variety of materials including, but not limited to; concrete, brick, and corrugated metal pipe (with either a galvanic, bituminous, aluminized, or plastic coating). Mortar materials must convey its uniqueness from an ordinary mortar mix containing sand, fine sand, cement, and water to provide a maximum possible crack width of 0.0625-inches (1.5875 mm) with a minimum factor of safety of 2.0. The Contractor shall submit liner thickness calculations to the Project Engineer 14 days prior to work commencing for review. The wall thickness design shall be based upon the compressive and bending strength performance parameters of the liner material. The design loading shall be the sum of the cover depth dead load, appropriate highway truck loading taking into account the soil type and the type of pavement. The minimum liner thickness at no point shall be less than 0.5-inch (12.7 mm) measured from the peaks of the wall surface for smooth wall pipe and the crests of the corrugations for corrugated pipe walls. Where the fabrication of the wall section utilizes nuts and bolts or rivets, the required minimum thickness must also insure that the projections of these fasteners will be covered at least 0.5-inch (12.7 mm) with lining material. These calculations will be performed by a registered professional engineer.

The completed liner shall be smooth and free from honeycomb and areas of segregation. Contractor shall employ an independent third party ACI certified testing agency to conduct and report compressive strength testing of the concrete utilized in the rehabilitation. At a minimum this shall include compressive strength (ASTM C39 or C-109) Min 8,000 psi (55158 kPa) at 28 days tests.

The net inside diameter of the reconstructed lined pipe shall maintain the lined pipe's final capacity as close as possible to its original capacity.

E. Cure in Place Pipe (CIPP)

Pipe liner shall consist of a solid wall pipe rehabilitation using a glass fiber reinforced felt tube and resin system, cured by Ultraviolet light system (UV) designed to requirements of ASTM F-1216 or ASTM F-1743. At a minimum, the pipe lining shall meet ASTM D790 physical properties.

The net inside diameter of the reconstructed lined pipe shall maintain the lined pipe's final capacity as close as possible to its original capacity.

F. Grout Mixtures

Mix water with the dry ingredients to produce a grout with an efflux time from the flow cone of at least 16 seconds and no more than 22 seconds when tested according to GDT 84.

Add cement, cement and limestone dust, or cement and fine aggregate to the batch proportions to produce the required consistency.

Table of Grout Mixtures					
Mix Proportions, Percent by Weight of Dry Materials					
Dry Materials	Grout Types				
	1	2	3	4	5
Cement	25	25	25	25	100
Limestone dust		25	75	50	
Fly ash	25			25	
Fine aggregate	50	50			

561.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

561.3 Construction Requirements

561.3.01 Personnel

General Provisions 101 through 150.

561.3.02 Equipment

A. Batching

Use weight hoppers and scales for each dry material or calibrated volumetric batch hopper. Calibrate volumetric batch hoppers in increments equivalent to one 94 lb. (42.6 kg) bag of cement.

B. Mixing

Use a watertight batch-type mixer capable of blending the various materials into a homogenous mixture.

C. Grout Pumping

Use a positive-displacement, piston-type pump or a screw-type worm pump equipped with the following:

- Discharge line with a positive cut-off valve at the nozzle end and a by-pass return line to recirculate the grout back into a holding tank or mixer
- A nozzle or device at the end of the discharge line that will remain secure in the 1 in. (25 mm) grout pipe and free of leaks

D. Pulling

Provide equipment capable of pulling the new helically corrugated metal pipe.

E. Spin Casting

The necessary equipment and application methods to apply the liner materials shall be only as approved by the material Manufacturer. Material shall be mixed in accordance with Manufacturer's specifications to proper consistency, then the materials shall be pumped through a material plaster hose for delivery to the appropriate and / or selected application device.

- The mortar delivery hose shall be coupled to a high speed rotating applicator device.
- The rotating casting applicator shall then be positioned within the center, or positioned higher inside the pipe, as required by the diameter the pipe.
- The spin cast nozzle must be capable of bidirectional operation.

F. Cure in Place Pipe (CIPP)

The necessary equipment and application methods to apply the liner materials shall be only as approved by the material Manufacturer. When inserting the curing equipment in the liner, care should be taken to not damage the inner film material. Approved UV light systems shall have the ability to record specific parameters during the curing process to ensure the liner is properly cured. The recording parameters will include:

- Project name
- Line section
- Date and time
- Curing speed
- Light source working & wattage
- Inner air pressure
- Inner temperatures
- Length of liner

561.3.03 Preparation

General Provisions 101 through 150.

561.3.04 Fabrication

General Provisions 101 through 150.

561.3.05 Construction

A. Grout Mixtures

Use the Table of Grout Mixtures in Subsection 561.2.F, *Grout Mixtures*.

B. Installation

Install pipe liner according to the manufacturer's guidelines and as specified in the plans, with the following requirements:

1. Clean and inspect the existing pipe before pulling or pushing the new pipe through.
2. Use a nose cone on all on all pipe liners. The nose cone shall have enough strength to withstand pulling or pushing of the new pipe liner. Weld or bolt the nose cone to the end of the liner. Use a nose cone that includes a ring for attaching the pulling cable.
3. After pulling or pushing the new pipe through the old one, plug the space between the pipes at both ends with concrete or mortar. Insert a 1 in. (25 mm) grout pipe with threaded ends on the outside into the tops of the plugs at both ends of the pipes, and screw on a threaded cap.
4. After the pipe plugs have been in place long enough to develop strength to withstand pressure grouting, remove the grout pipe caps. Connect the grout pump to the downstream grout pipe and pump grout into the void until it flows freely from the upstream grout pipe.
5. After pumping is complete, replace the grout pipe caps.

C. Spin Cast Installation

Install pipe liner according to the manufacturer's guidelines and as specified in the plans, with the following requirements:

1. All internal debris should be removed from the original pipeline. Gravity pipes should be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment.
2. All loose or defective concrete, brick, or grout shall be removed to provide an even surface prior to application of the lining material.
3. The Contractor will perform a pre-installation video inspection that meets NASSCO PACP requirements and verify that pipe and or manhole is clean and conditions are suitable for installation of the liner.
4. The floor and interior walls of the pipe shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge and all debris or material that may be attached to the wall or bottom of the pipe.
5. Active leaks must be sealed prior to application of the lining material. The use of quick-setting mortars or chemical grouts are approved methods for stoppage of active leaks. All products employed in the stoppage of active leaks should be preapproved by the Department QPL-27 and used in accordance with Manufacture's recommendations.
6. The Contractor shall accurately field measure and size each individual manhole and individual pipe section.
7. The Contractor shall provide flow maintenance around the section or sections of pipe designated for rehabilitation.
8. The Contractor shall mix material to Manufacture's recommended water cement ratio. Precision metering of water in a continuous mixing chamber is required to maintain the strict water to material ratio.
9. The mixing operations must be performed in a manner to control dust to a minimum into the surrounding environment.
10. Pumps must be equipped with multiple sensors that stop the pump if material either runs out or is overflowing.

11. Back-up spin casting units and spin cast nozzles should be onsite at all times during the lining process to address any application issues that arise, to include nozzles failures and achieving required thickness or finish of the liner surface.
12. Beginning at one end of the pipe, controlled multiple passes shall then be made until the specified minimum finished thickness is attained as per Manufacturer's recommended rate of application. Lining material must be applied in multiple passes no more than 0.5-inch (12.7 mm) per single pass to accumulate to minimum lining thickness.
13. The lining material shall be applied to a damp surface, with no flowing water.
14. Follow Manufacturer's recommended cure schedule of the liner based on ambient temperature.

D. CIPP Installation

1. Gliding Foil – A continuous heavy gauge (10mil) plastic sheet shall be pulled into place the entire length of host pipe, covering 1/3 – 1 /2 the diameter of lower portion of the host pipe, protecting liner during the pull in process.
2. Liner Installation – Liner shall be securely attached to winch and pulled into place taking care not to exceed pulling forces as stated in Manufacturer's installation protocol.
3. Liner Inflation – Liner shall be inflated per Manufactures inflation process. Once inflated to working pressures the liner shall fit tightly against the host pipe.
4. Pre-Curing Inspection – Once working inflation pressures are reached the liner shall be inspected by integrated CCTV on light assembly checking for proper fit and expansion of the liner.
5. Curing Speeds – Initial curing speeds will start off at a sufficient speed to ensure the first 15 feet (4.572 meter) of liner is cured properly, ramping up to working speed to properly cure the remainder of liner per Manufacturer's protocol. The same process will be adhered to during the last 15 feet (4.572 meter) of liner.
6. Integrated camera – The integrated CCTV camera on the light assembly will inspect post curing operations, fit of liner and any problems that may occur during the curing process.

561.3.06 Quality Acceptance

General Provisions 101 through 150.

561.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

561.4 Measurement

Renovating existing pipe is measured by the linear foot (meter) of the specified diameter of new pipe installed.

561.4.01 Limits

General Provisions 101 through 150.

561.5 Payment

Renovating existing pipe will be paid for at the Contract Unit Price bid per each diameter of existing pipe. This payment will be full compensation for completing all work described in this Section, including cleaning and restoring damaged areas.

Payment will be made under:

Item No. 561	Renovating existing pipe____ in. (mm) diameter	Per linear foot (meter)

561.5.01 Adjustments

General Provisions 101 through 150.

Section 613—Docks

Replace Section 613 with the following:

613.1 General Description

This work includes constructing docks according to plan details and locations, maintaining the docks, and/ or removing the docks as specified by the Engineer.

613.1.01 Definitions

General Provisions 101 through 150.

613.1.02 Related References

A. Standard Specifications

Section 860 - Lumber and Timber

Section 863 - Preservative Treatment of Timber Products

B. Referenced Documents

General Provisions 101 through 150.

613.1.03 Submittals

When the Proposal includes constructing docks, submit to the Engineer for approval three prints or a reproducible drawing showing the proposed construction details for each dock.

The Engineer will check the design and request changes to ensure the design conforms with the specifications and the intended purpose.

After making the required changes, resubmit the drawings to the Engineer for final approval. Do not begin work on the dock until the drawings receive the Engineer's final approval.

613.2 Materials

Ensure that dock timber (except timber used for handrails) is treated in accordance with AWPA U Standards according to Section 863.

Use piles of a wood species that will withstand driving and will support the load required by the Engineer.

Nails and hardware shall be galvanized. Materials used to construct these expendable items will not be pre-inspected, sampled, or tested.

Replace, repair, or strengthen defective, worn, deteriorated, corroded, or unsatisfactory material according to Subsection 613.3.07.A, *Dock Maintenance*.

613.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

613.3 Construction Requirements

613.3.01 Personnel

General Provisions 101 through 150.

613.3.02 Equipment

General Provisions 101 through 150.

613.3.03 Preparation

General Provisions 101 through 150.

613.3.04 Fabrication

General Provisions 101 through 150.

613.3.05 Construction

Ensure that the dock is suitable for its intended purpose. Select construction methods approved by the Engineer.

Drive piling deep enough to provide a safe dock under weather and construction conditions peculiar to the project area.

613.3.06 Quality Acceptance

General Provisions 101 through 150.

613.3.07 Contractor Warranty and Maintenance

A. Dock Maintenance

Maintain the docks to the satisfaction of the Engineer. Follow these guidelines:

1. Immediately replace, repair, or strengthen defective, unduly worn, corroded, deteriorated, or otherwise unsatisfactory material at the Engineer's request.

   NOTE: If repairs are not made promptly, the Engineer may make the repairs and have the costs deducted from the monies due the Contractor.

2. If the dock will not be removed as part of the Work, maintain it as directed by the Engineer to keep it in serviceable condition for future use before moving off the Project or relinquishing it to a subsequent Contractor.
3. When the dock was constructed for use on a previous project or Contract, assume responsibility for the dock and promptly restore and maintain it in a safe and satisfactory condition as directed by the Engineer. Maintain the dock for the duration of the Contract as directed by the Engineer.

B. Dock Removal

When the dock is no longer needed the Engineer will direct in writing to remove it. The salvaged material becomes the Contractor's property.

613.4 Measurement

This work is not measured separately for payment.

613.4.01 Limits

General Provisions 101 through 150.

613.5 Payment

This item will be paid for according to the Plans, Proposal, and the following:

A. Construct, Maintain, and Remove Dock

After the dock is constructed satisfactorily, 50 percent of the Lump Sum price bid will be included in the next monthly statement.

If the dock maintenance is satisfactory, monthly increments of 35 percent of the Lump Sum price bid will be paid based on the percent complete of the Contract. When the dock is no longer required and has been removed, the remaining 15 percent of the Lump Sum price bid will be included in the next monthly statement.

Each dock, complete in place and accepted, suitably maintained until no longer needed, and satisfactorily removed, will be paid for at the Lump Sum price bid, which is full compensation for the Item.

B. Construct and Maintain Dock

After the dock is constructed satisfactorily, 60 percent of the Lump Sum price bid will be paid. If the dock maintenance remains satisfactory, the remaining 40 percent of the Lump Sum price bid will be paid in monthly increments based on the percent complete of the Contract.

C. Maintain and Remove Dock

When the dock was constructed for use on a previous Project or Contract as defined in Subsection 613.3.07.A.3, the Contractor who satisfactorily maintains and removes the dock will be paid 50 percent of the Lump Sum price bid in monthly increments based on the percent complete of the Contract.

When the dock is removed, the remaining 50 percent of the Lump Sum price bid will be paid on the next monthly statement.

D. Maintain Docks

When the Contractor assumes satisfactory maintenance of the dock as provided in Subsection 613.3.07.A, the Lump Sum price bid will be paid in monthly increments based on the percent complete of the Contract.

Payment will be made under:

Item No. 613	Construct, maintain, and remove dock No.____	Per lump sum
Item No. 613	Construct and maintain dock No._____	Per lump sum
Item No. 613	Maintain and remove dock No._____	Per lump sum
Item No. 613	Maintain dock No._____	Per lump sum

613.5.01 Adjustments

General Provisions 101 through 150.

Section 617—Permanent Anchored Walls

Replace Section 617 with the following:

617.1 General Description

This work includes furnishing materials, labor, tools, equipment, and other incidental items to design, detail, and construct an anchored wall. This specification applies to any Contractor-proposed alternate design of Department-furnished plans.

617.1.01 Definitions

Anchor—Synonymous with the terms tie-back or tie-down.

The term Anchored Wall includes the following items:

- Anchors
- Soldier piles
- Lagging
- Facing
- Drainage

617.1.02 Related References

A. Standard Specifications

Section 500—Concrete Structures

Section 511—Reinforcement Steel

Section 853—Reinforcement and Tensioning Steel

B. Referenced Documents

General Provisions 101 through 150.

617.1.03 Submittals

A. Proof of Ability

Submit the following proof of ability (or ability of the Subcontractor) when requested by the Department to design or construct anchored walls:

- Evidence of successfully completing at least 5 Projects similar in concept and scope to the proposed wall.
- Resumes of foremen, anchor testing personnel, and drilling operators to be employed on this Project. Show the type, length, and number of ground anchors each has installed or tested within the past 5 years.
- Evidence of experience in anchor testing. Persons performing anchor testing must prove experience by performing sample tests supervised by the Engineer.

The Department is the sole judge of the qualifications of the foreman, drilling operator, and testing personnel. Do not begin wall construction until the Engineer has approved proof of ability.

B. Design Criteria for Alternate Design

If the Department receives more than 2 submittals of the plans and calculations for review, the Contractor will be assessed $60 per hour of engineering time for reviews in excess of the 2 submittals.

C. Construction Drawings and Design Notes

If a Contractor-proposed alternate anchored wall is a part of the low bid, submit construction drawings and design notes within 28 days of the date of award of the Contract. The Design Engineer shall prepare and stamp the submission.

Include design notes and reproducible drawings in the submission concerning the following:

- Details, dimensions, and schedules of reinforcing steel, including dowels or studs for attaching the facing to the tied back wall
- Details of the anchors and soldier piling, including spacing and size of piles and spacing and angle of anchor installation
- Detailed plans for anchor proof and performance testing that show loading and measuring devices used and procedures followed

D. Wall Final Plans and Calculations

Submit final wall plans and calculations to the Department for review and approval before beginning construction on the wall the time required for plan and calculation preparation and review will be charged to the allowable Contract time. The Department has 30 days for plan and calculation review per Item after receiving the structure calculations and drawings.

New submittals from the Contractor showing corrections from the Department’s review or changes to ease construction or to correct field errors have a 30-day review. The Department is the sole judge of information adequacy.

The Department’s review and acceptance of the final plans and construction methods does not relieve the Contractor from successfully completing the work. Time extensions are not granted for Contractor delays from untimely submissions and insufficient information.

E. Admixture Literature

Before using an admixture, submit to the Engineer the manufacturer’s literature. Indicate the admixture type and the manufacturer’s recommendations for mixing the admixtures with grout.

F. Structural Steel

Submit to the Engineer the mill test reports for each heat or lot of prestressing material used to fabricate tendons.

617.2 Materials

A. Concrete

Use concrete that conforms to Section 500.

B. Reinforcing Steel

Use reinforcing steel that conforms to Section 511.

C. Structural Steel

Use structural steel as follows:

1. Use prestressing bars made of continuously threaded full-length steel that conforms to ASTM Designation A 722, Type II. Do not use couplers.

   Ensure material requirements, coating application, and epoxy coating sampling and testing conform to Section 514.
2. Use full-length prestressing strands and wires according to Section 853.

D. Cement Grout

Produce cement grout using Portland cement that conforms to AASHTO M 85, Type I, II, or III, and potable water. Use cement that is fresh and free of lumps and hydration.

Follow these restrictions if using admixtures:

1. Do not use admixtures with chemicals that may harm the prestressing steel or cement.
2. Do not use expansive additives that cause air bubbles in the grout.
3. If approved by the Engineer, use admixtures that will impart low water content, flowability, and minimum bleeding in the cement grout.

E. Plastic

For corrosion protection, use polypropylene plastic that conforms to designation grade II 26500D as per ASTM D-2146. Ensure that the environmental stress crack resistance of the material prevents failures at 1,000 hours when tested by ASTM D-1693.

F. Corrosion Inhibitor

Use corrosion inhibitor (grease) that conforms to the following test requirements:

- Drop point 300 °F (149 °C) minimum by ASTM D-566
- Flash point 300 °F (149 °C) minimum by ASTM D-92
- Water content 0.1 percent maximum by ASTM D-95
- Rust grade 7 or better after 720 hours, aggressive conditions: rust grade 7 or better after 1,000 hours by ASTM B-117 and ASTM D-610

Water-soluble ions must follow these requirements:

1. Oil separation—0.5 percent by weight maximum at 160 °F (71 °C) by FIMS791B, Method 321.2
2. Soak test—5 percent salt fog at 100 °F (38 °C) 5 mils (0.13 mm) (Q panel type S). (Immerse panels in 50 percent salt solution and expose to 5 percent salt fog—no emulsification after 720 hours—by ASTM B-117 modified.)

Chlorides	10 ppm max by ASTM B-512
Nitrates	10 ppm max by ASTM D-992
Sulfates	10 ppm max by APHA427D

617.2.01 Delivery, Storage, and Handling

A. Protection Systems

Protect prestressed rock and soil anchors against corrosion by properly storing, fabricating, and handling the tendon components before inserting them into the borehole.

Avoid prolonged exposure of the tendon components to the elements and avoid mechanical or physical damage that reduces or impairs the component's ability to resist adverse conditions during service.

Tendon components will be rejected for heavy corrosion or pitting, but not for a light coating of rust.

Use the protection systems as follows:

1. Prestressing Steel

   Protect the entire length of prestressing steel from the anchor plate to the end of the tendon from corrosion.

   a. Encase the prestressing steel in a corrugated plastic tube.
   b. Use cement grout to fill the voids between the tube and the prestressing steel and the tube and the soil. Fill the cement grout between the soil and the tube to at least 1/2 in. (13 mm) thick and extend the entire length of the tendon.
   c. Provide centralizers spaced a maximum of 5 ft. (1.5 m) center-to-center throughout the bond length. Do not use wood or material harmful to the tendon steel or corrugated plastic tubing as centralizers.
   d. Provide a smooth piece of plastic sheath to encapsulate the entire free length. Do not splice the sheath. Ensure that the sheath is at least 0.05 in. (1.27 mm) thick.

e. Place a grease film, compounded to lubricate and inhibit corrosion, between the sheath and the prestressing steel in the entire free length. Ensure that the plastic sheath is seamless, hot melt extruded polypropylene shrunk tightly onto the grease.

   Ensure that the sheath has a coefficient of friction with the steel of less than 0.05 and a wall thickness of at least 0.05 in. (1.27 mm).

f. Ensure that the sheath exerts a positive pressure on the grease. Ensure that the grease film is at least 0.01 in. (0.25 mm) thick. Minimize the void space between the sheath and the steel by filling visible void spaces with grease and sealing the bottom to keep the grout out.

2. Area Underneath Anchorage

   Protect the area immediately behind the stressing anchorage.

   a. Weld a pipe sleeve to the bearing plate and seal the pipe sleeve to the anchor sheath at the other end of the sleeve.
   b. Clean the pipe sleeve to remove dirt, rust, or other harmful material before inserting the tendon into the pipe sleeve.
   c. If a seal is not provided at the lower end of the pipe sleeve, during installation and grouting fill the lower end of the pipe sleeve with grout.

      Keep the pipe sleeve free of harmful material until the upper portion of the pipe sleeve and anchor head is filled with grout.
   d. After stressing the anchors, fill the void inside the sleeve and anchor head with anti-bleed expansion grout.

3. Anchorage

   Encase the anchorage system head at each lift into a corrosion protective system before proceeding to the next lift. Install the protective system for each lift within 30 days after installing the anchors for that lift.

   Ensure that the anchorage system has a cover of at least 3 in. (75 mm) once the wall face is placed.

617.3 Construction Requirements

617.3.01 Personnel

A. Contractor Qualifications

The Contractor and Subcontractor shall be experienced in designing or constructing permanently anchored walls. Provide at least one Registered Professional Engineer licensed to perform work in the State of Georgia and a supervising Engineer for the Project with at least 5 years of experience in constructing permanently anchored walls.

Furnish verification of these qualifications to the Engineer before beginning operations.

B. Design Engineer

The Design Engineer shall:

- Be registered as a Professional Engineer in the State of Georgia
- Have considerable knowledge and experience designing and constructing anchored walls
- Be available at any time during the Contract to discuss the design of the walls with the Department

C. Registered Professional Engineer

Retain the services of a second registered Professional Engineer licensed to perform work in the state of Georgia and prequalified by the Department. The Engineer shall operate independently from the Professional Engineer of Subsection 617.3.01.A, *Contractor Qualifications*.

This Engineer will independently check the design calculations and Plan details for the permanent anchored walls before submitting them to the Department for review.

617.3.02 Equipment

A. Anchorage and Hardware

Use anchorage and hardware suitable for the type of anchor tendon used. Ensure that anchorage and hardware are capable of the following:

- Developing 95 percent of the guaranteed specified minimum ultimate tensile strength of the tendon, when tested in the unbonded state and without failure of the tendon
- Holding a load of prestressing steel that produces a stress of at least 95 percent of the guaranteed specified minimum ultimate tensile strength of the prestressing steel, without exceeding the anticipated set and without causing anchorage or prestressing steel failure
- Lifting-off, detensioning, or retensioning a tendon before secondary grouting to fill voids at the top of the pipe sleeve

B. Anchor Nut and Plate for Bars

Use anchor nuts and plates for bars that have complementary spherical shapes at the contact areas.

617.3.03 Preparation

Before beginning the work, survey the condition of the adjoining properties. Keep records and photograph settlement or cracking of adjacent structures that may become the subject of possible damage claims. Deliver the report to the Department before beginning work at the site.

Obtain a Foundation Investigation Report from the Geotechnical Engineering Bureau of the Department to assist in evaluating existing conditions for design and construction.

617.3.04 Fabrication

A. Tendons

Fabricate the tendons according to the approved details.

1. Keep the tendons free of dirt, rust, or other harmful substances.
2. Use a plastic sheath that is a single piece without splices.
3. Install the sheath at the fabrication shop, not in the field.
4. Before installation, handle and store the tendons so as to avoid corrosion and physical damage.

   Tendons will be rejected for damage such as abrasions, cuts, nicks, welds, weld splatters, or heavy corrosion and pitting.

   Replace the tendons at the Contractor’s expense for material replacements or time delays.
5. Repair damaged coatings in the field at the Engineer’s approval.

617.3.05 Construction

A. Design Criteria for Alternate Design

The design criteria for a proposed alternate or design include:

1. Design rock anchors and soil anchors according to this specification.
2. Assume responsibility for lagging. Design the lagging with sound engineering principles.
3. Use reinforced concrete facing according to the latest AASHTO Standard Specifications for Highway Bridges, including interims.

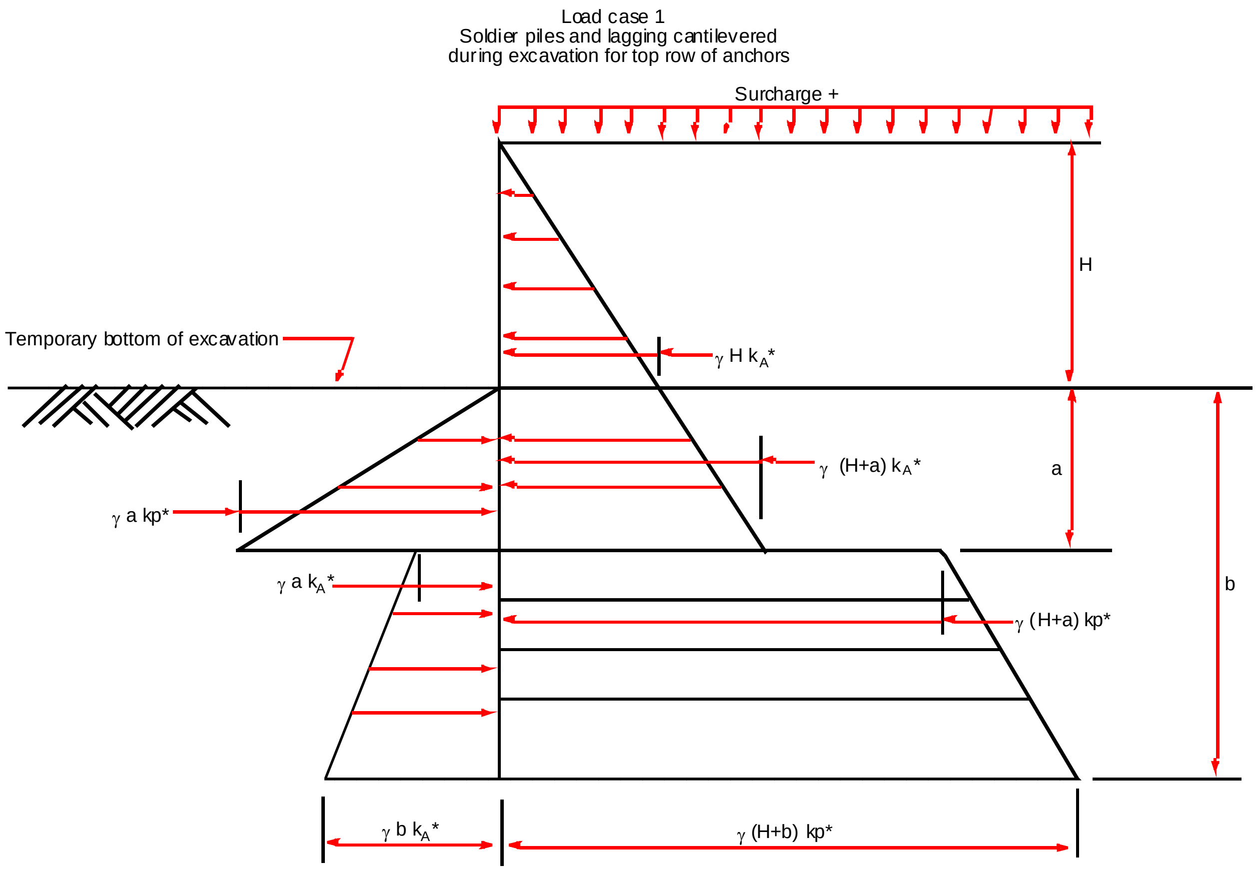
   Ensure that the facing structural thickness is at least 12 in. (300 mm). Perform architectural facing treatment as shown on the Department drawings.
4. Ensure that the concrete strength for a proposed alternate is at least 3,000 psi (20 MPa) 28-day strength. Extend the facing 2 ft. (600 mm) below the gutterline or, if applicable, the ground line adjacent to the wall unless otherwise indicated on the plans.
5. Design soldier piles for shear, bending, and axial stresses according to the latest AASHTO design criteria.

Use steel or concrete soldier piles with a steel yield strength at least 36,000 psi (248 MPa). Ensure that the concrete has a 28-day strength of at least 3,000 psi (20 MPa).

6. Design and install permanent drainage systems behind the wall. Connect drainage systems to the nearest drop inlet using pipe or free drainage through traffic barriers or other obstructions.

   Ensure that holes through traffic barriers or facing are no higher than 3 in. (75 mm) above the gutterline or ground line.

7. Have the wall design account for live load, dead load, and wind load from traffic barriers, lights, overhead signs, or other appendage on top or adjacent to the wall. Figure 1, Figure 2, and Figure 3 indicate loading conditions for soldier piles, lagging, and anchors at critical stages of construction.



\+ Design pressure diagram shall include the effect of surcharge loading

* NOTE: The above diagrams apply for cohesionless soils. For cohesive soils the effect of cohesion may be considered. Where lagging is in place, active earth pressure acts over the entire wall surface. Below lagging, active earth pressure acts only on the soldier pile width and passive earth pressure is generated as follows:

A) In sands and saprolitic soils (with blow counts of 10 or greater) passive pressure is generated over 3 times the soldier pile width.

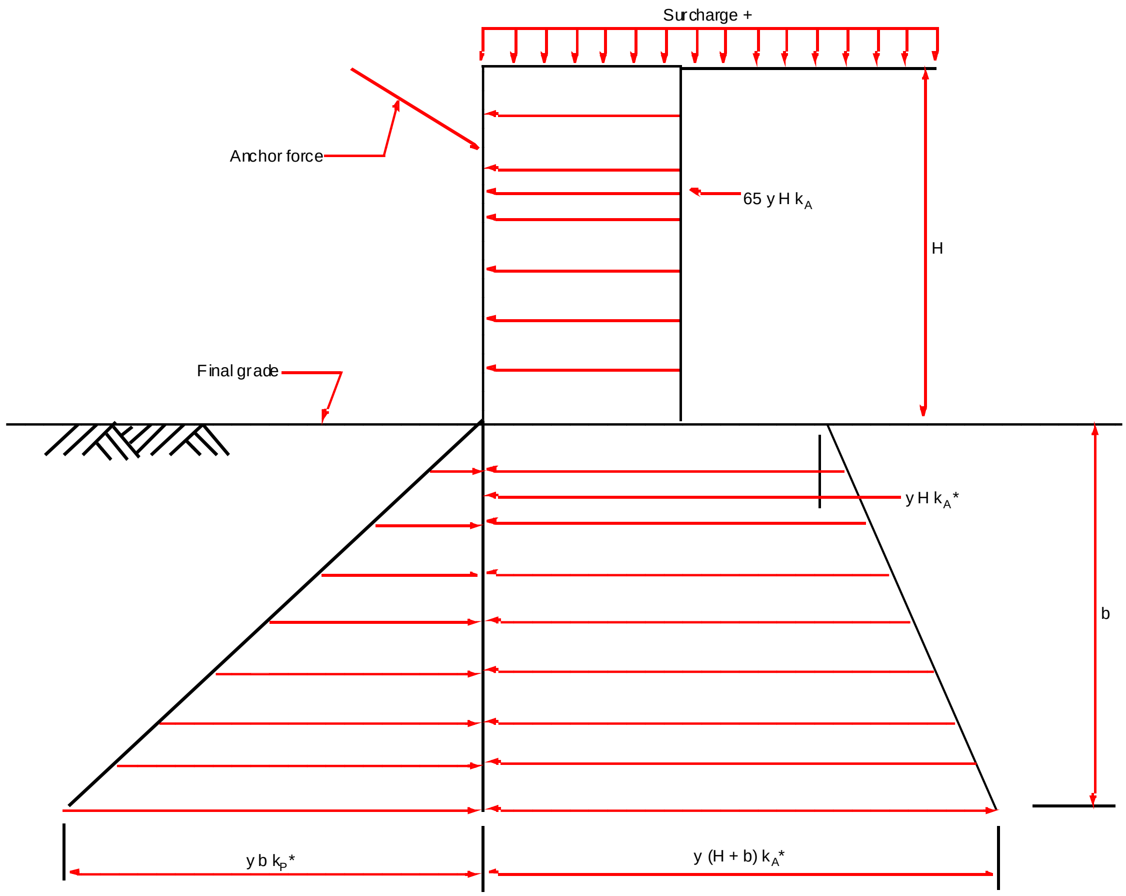
B) In clays, non-saprolitic silts, and saprolitic soils (with blow counts of 10 or less) passive pressure is generated over the width of the soldier pile.

Vertical component of anchor force must be resisted by embedded length of soldier piles below assumed excavation.

γ is the soil unit weight in pounds per cubic foot.

FIGURE 1

Load Case II
Intermediate Excavations for Subsequent Anchor Installations



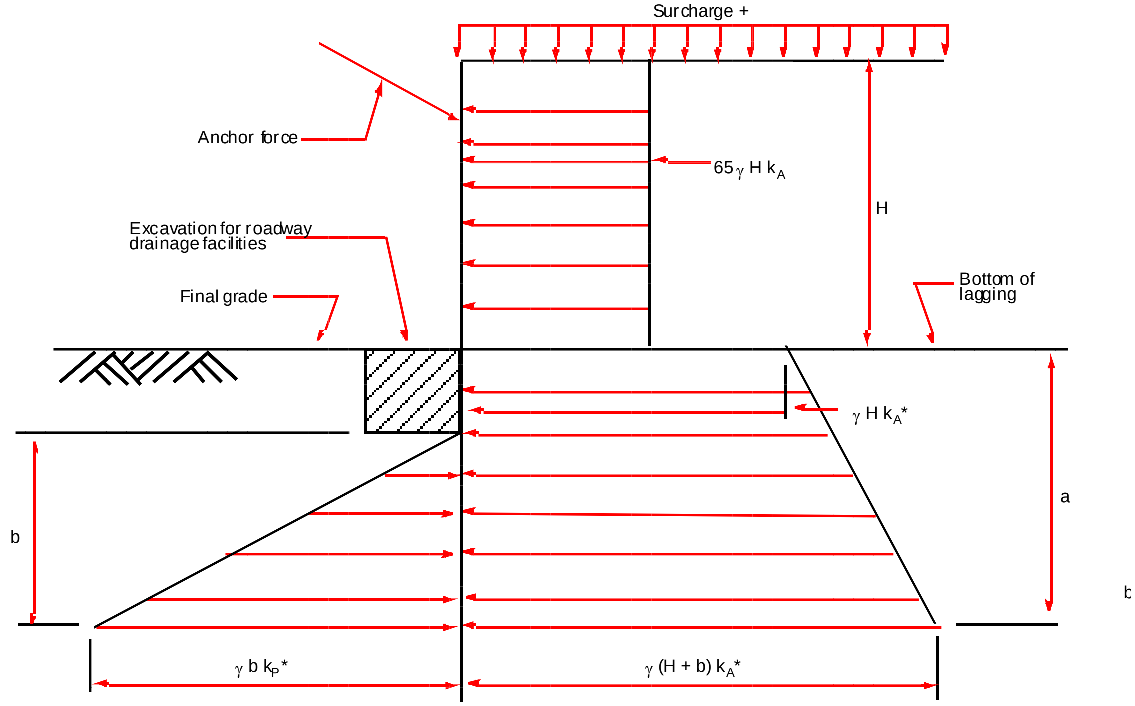
* See “NOTE” Figure 1.
\+ Design pressure diagram shall include the effect of surcharge loading.

K_A = Coefficient of active earth pressure
K_P = Coefficient of passive earth pressure
α = Soil density

FIGURE 2

Load Case II

Final Constructed Condition Assuming Excavation for Drainage Facilities in front of Wall



* See "NOTE" Figure 1.
\+ Design pressure diagram shall include the effect of surcharge loading.

K_A = Coefficient of active earth pressure
K_P = Coefficient of passive earth pressure
γ = Soil density

FIGURE 3

8. Ensure that the wall is compatible with horizontal and vertical criteria indicated on the Department plans.

9. Include the following on the design criteria for rock anchors:

- **a.** Determine the tendon size to ensure that the anchor design load is no greater than 53 percent of the guaranteed ultimate tensile strength of the tendon.
- **b.** Ensure that the free stressing length is no less than 15 ft. (4.5 m).
- **c.** Estimate the bond length using the following equation:

  Lb = P/(3.1416) (d) (tw)

  where

  Lb= Bond length (not less than 10 ft. [3 m])

  P= Design load for the anchor

  d= Diameter of the drill hole

  tw= Bond stress in the interface between the rock and grout

  When determining the bond stress, consider the critical nature of the anchor application, rock property variations, and installation procedures.

10. Include the following in the design criteria for soil anchors:
    a. Analyze the anchor structure system to ensure a well-anchored structure.
    b. Analyze the overall earth mass stability and the assumed failure plane to ensure that the anchor bond length is started at least 5 ft. (1.5 m) beyond the failure plane. Consider the following in the analysis:

- Type of foundation, nearness, and susceptibility to movement of adjacent buildings (see Figure 4).
- Interaction of anchor groups when the anchor center-to-center spacing is less than or equal to 6 times the bulb diameter

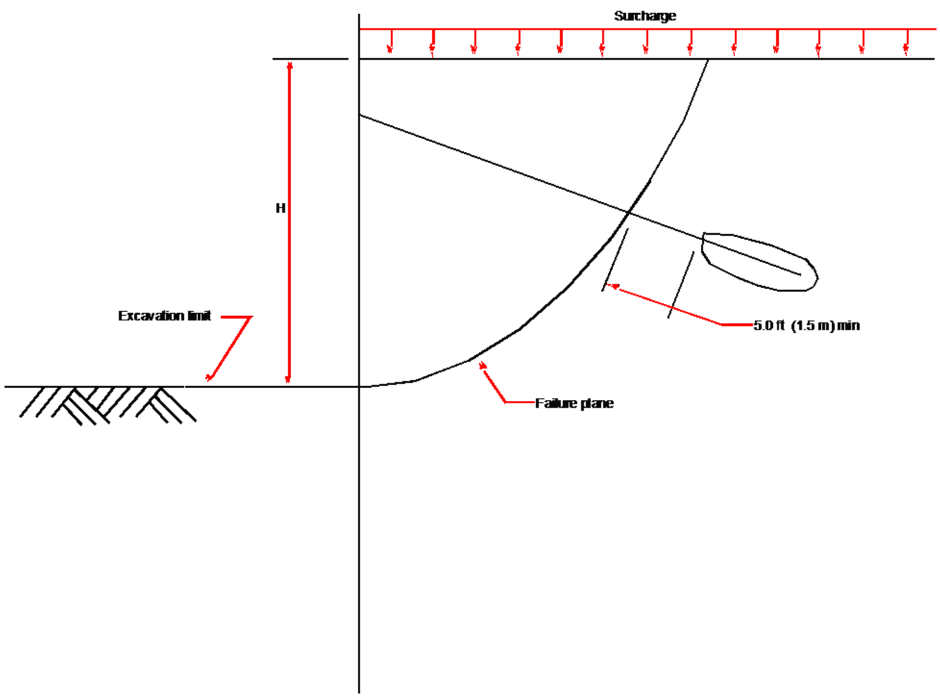


FIGURE 4

    c. Determine the tendon size so that the anchor design load does not exceed 53 percent of the guaranteed ultimate tensile strength of the tendon.
    d. Ensure that the free stressing length is at least 15 ft. (4.5 m).
    e. Use the existing theoretical and empirical methods only to predict anchor capacity for preliminary design estimates. Verify the final anchor capacity by field testing each anchor.

11. Retain a second registered Professional Engineer to operate independently from the Design Engineer Professional Engineer of Subsection 617.3.01.B.

    Have this Engineer independently check the design calculations and Plan details of the permanent anchored walls before submitting them to the Department for review.

B. Ground Movements and Load Transfer Instruments

The Department may install devices to monitor ground movements and load transfers during and after construction. The Department will schedule installation to minimize interference with the Contractor's operations. Cooperate with the instrumentation installers. Anticipate delays of two to four hours per instrumented anchor.

Although the Instrumentation Specialist maintains the instruments, assume responsibility for damage to the instruments, connections, or readouts from operations. Replace and install damaged equipment at the Department's approval and at the Contractor's expense.

C. Rock Anchors

1. When required on the Plan or by the Engineer, use a prestressed rock anchor made of high-strength steel tendon fitted with a stressing anchorage at one end and a way to transfer force to the grout and rock on the other end.
2. Insert the rock anchor tendon into a prepared hole of suitable length and diameter, fixed to the rock, and stressed to a specified force. The basic components of a prestressed rock anchor are as listed below:
   a. Prestressing steel may be single or multiple wires, strands, or bars. The rock anchor length is composed of these two parts:
      - Bond length (socket)—the portion of the anchor that transmits the force to the surrounding rock
      - Free length (stressing length)—the portion of the anchor free to elongate elastically during stressing

   b. The stressing anchorage is the device that permits the stressing and anchoring of the prestressing steel under load.

   c. The fixed anchorage is a mechanism opposite the stressing anchorage on the tendon that transfers the induced force to the surrounding grout or rock. Deformed bars and strand tendons do not have fixed anchorages since the anchor load is transferred to the grout by bond.

   d. Provide grout, vent pipes, and miscellaneous appurtenances to inject the anchor grout. Pump grout through the drill casing or rods.

D. Rock Anchor Installation

Install the rock anchors as follows:

1. Before installation, visit the site to observe existing conditions that may affect the work or design, if applicable, and to review the geotechnical data available for the project.
2. Drive or drill the holes for the anchors by core drilling, rotary drilling, auger drilling, or percussion drilling. If using water in the drilling operation, dispose of the water to minimize wall erosion.

   Repair water erosion damage to the site at no cost to the Department.
3. If the hole will not stand open, install casing to maintain a clean and open hole. Ensure that the hole diameter is at least 3 in (75 mm) if no pressure grouting is used.

   Pressure grouting is grouting with a pressure greater than 60 psi (415 kPa).
4. Ensure that the drill bit diameter is not less than 1/8 in. (3 mm) smaller than the specified hole diameter.
5. Start anchor holes within an angle tolerance of 1 to 3 degrees from the inclination specified on the approved design Plans. Do not allow holes to deviate from a straight line by more than 1 to 2 in. (25 to 50 mm) in 10 ft. (3 m).

   Do not allow holes to extend outside the Right-of-Way limits. Thoroughly clean holes of rock dust, rock chips, grease, or other material before inserting the tendon.
6. Install the tendon in the casing or in a hole drilled for the anchor. Ensure that the tendon's corrosion protection is not damaged during handling or installation.

7. Install the tendon in the bond length, to achieve at least 0.5 in. (13 mm) of grout cover.

   Degrease the bond length of strands or wires before installing by using Acetone, MEK, or MIBK. Do not leave residue on the tendon. Use other substances only after the Department's approval. Include the costs of cleaning tendons in the price bid for Contract Items.

8. If using multi-element tendons without a fixed anchorage at the lower end, adequately space the tendon elements to achieve proper grout coverage.

NOTE: Do not use anchors to ground electric equipment and do not subject anchor tendons to sharp bends.

9. Provide centralizers spaced a maximum of 5 ft. (1.5 m) center to center throughout the bond length. Do not use wood spacers or other material harmful to the tendon steel or sheathing.

10. Inject the grout at the lowest point of the anchor and place over the entire anchor length.

    a. Ensure that the grouting equipment can continuously mix and produce lump-free grout.

       Equip the grout pump nozzle with a grout pressure gauge capable of measuring pressure of at least 150 psi, (10 kPa) or twice the actual pressure used.

    b. Base the material proportions used in the grout on grout tests made before beginning the grouting. Or, select the proportions based on prior documented experience with similar materials and equipment under comparable field conditions.

    c. Use the minimum water content necessary for proper placement and do not exceed a water-cement ratio of 0.45. Do not leave grout in the mixer longer than 45 minutes.

       Only fill voids at the top of the free length with grout after final lock-off.

11. After grouting, do not disturb the tendon until the grout has reached a cube strength of 3,500 psi (25 MPa). Keep the mouth of the hole clean after grouting. Record the following data in a Project field book during the grouting operation:

    - Type of mixer
    - Water-cement ratio
    - Type of additives
    - Grout pressure
    - Type cement
    - Test sample strengths (before stressing)
    - Volume of grout placed in bond and free lengths

12. If using pressure grouting, choose whether to perform a water tightness test. However, if injecting grout with a pressure of 60 psi (415 kPa) or less, always perform a water tightness test.

    Perform the test as follows:

    a. Fill the entire hole in the rock with water and subject it to a pressure of 5 psi (35 kPa) in excess of the hydrostatic head as measured at the top of the hole.

    b. If after 10 minutes the leakage rate from the hole exceeds 0.001 gal per inch diameter per foot of depth per minute (12 mL per 25 mm diameter per meter of depth per minute), consolidate grout, re-drill, and retest the hole. If the second water tightness test fails, repeat the entire process.

    c. During the tests, observe holes adjacent to the hole being tested for water tightness to detect and seal inter-hole connections.

    d. If finding artesian or flowing water in the drilled hole, maintain the pressure on the consolidation grout until the grout has initially set.

E. Cutting of Tendon Protrusions

After the Engineer accepts an anchor, the portion of the anchored tendon protruding over the anchor may be cut if it is not required for use in retesting. Cut the tendon according to the tendon manufacturer's recommendations as approved by the Engineer. Do not damage the tendon anchor.

F. Redesign

If the anchors fail during performance tests or proof tests, modify the design or construction tests and procedures. The design is subject to Department review. These modifications may include:

- Reducing the anchor design load by increasing the number of anchors
- Increasing the grout pressure
- Requiring post-grouting or increasing the bond length

Modify the design or construction procedures, install the redesigned anchors in the wall, and test as previously defined at no cost to the Department.

Anchors that fail the performance or proof tests may be incorporated in the wall. Propose a reduced design load and retest as noted above. The Department will determine acceptance of such anchors.

G. Soil Anchors

A prestressed soil anchor is a high-strength steel tendon fitted with a stressing anchor at one end and an anchor device that transfers force to the soil on the other end. These anchors are used in clay, silt, sand, or gravel and are inserted in a prepared hole that is drilled or driven into the ground.

The following are the two soil anchors considered for use:

- Friction type—rely on friction between the drilled borehole walls
- Anchor grout—rely on an enlarged pressure-grouted bulb or an underreamed bulb to provide resistance to pull-out

Test the soil anchors after placing the anchor grout and after the curing period. The basic components of the soil anchor are identical to the rock anchor as described previously.

For installation, see Subsection 617.3.05.D, *Rock Anchor Installation*, except water tightness tests are not required.

Test and stress soil anchors according to 617.3.06.A , *Anchor Testing and Stressing* except that 15% of the anchors remaining after the initial testing shall be performance tested.

H. Cutting of Tendon Protrusions

See Subsection 617.3.05.E, *Cutting of Tendon Protrusions*.

I. Redesign

See Subsection 617.3.05.F, *Redesign*.

617.3.06 Quality Acceptance

A. Anchor Testing and Stressing

Perform testing and stressing according to this subsection.

Test each anchor to ensure that the maximum test load does not exceed 80 percent of the guaranteed ultimate tensile strength of the tendon.

Performance test the first 2 anchors installed of each design load capacity and 5 to 10 percent of the remaining anchors (the Engineer will choose the locations). Proof test the remaining anchors.

1. Performance test by incrementally loading and unloading the anchor according to the following schedule.

Cycle	Load
1	AL (AL = Alignment Load)
	0.25P
	AL
2	0.25P
	0.50P
	AL
3	0.25P
	0.50P
	0.75P
	AL
4	0.25P
	0.50P
	0.75P
	1.00P
	AL
5	0.25P
	0.50P
	0.75P
	1.00P
	1.25P
	A L
6	0.25P
	0.50P
	0.75P
	1.00P
	1.25P
	1.50P (Test conditions—hold for at least 50 mins.)

2. Record the tendon movement at each increment to the nearest 0.001 in. (0.025 mm) referring to an independent fixed reference point.
3. Monitor the jack load with the production gauge and load cell calibrated as a set.
4. Adjust to a transfer load of 1.0P. Actual lock-off loads may be somewhat higher to account for seating losses.
5. To prevent misalignment of testing equipment, maintain an Alignment Load (AL) of at least 0.05P.
6. Hold the load at each increment long enough to obtain the movement reading.

Submit the loading and unloading rates (tons [megagrams] per minute) for approval. Each load must be applied in less than 30 seconds after starting the jack pump.

7. Perform the creep test by holding the 1.50P load for 50 minutes while maintaining the load constant. Record the anchor movement (total movement) referenced to a fixed point at 30 seconds, 1, 2, 3, 4, 5, 6, 10, 15, 20, 25, 30, 40, and 50 minutes.

   Begin the observation time when the jack begins to load the anchor from 1.25P to the test load.

8. If performance tests indicate that the loaded substrata is sensitive to creep, maintain the load for an additional 250 minutes and record the movements at 60, 75, 90, 100, 120, 150, 180, 210, 240, 270, and 300 minutes.

9. Have the Engineer review the performance tests to determine if the anchor is acceptable. An anchor is acceptable if:

   - The total movement obtained exceeds 80 percent of the theoretical elastic elongation of the free length and is less than the theoretical elastic elongation of the total of the free length plus 50 percent of the bond length.
   - The creep movement does not exceed 0.08 in. (2.00 mm) during 5- to 50-minute time increments regardless of tendon length and load.
   - If held for an additional 250 minutes, creep movement does not exceed 0.08 in (2.00 mm) from the 30-minute to the 300-minute time increment regardless of tendon length and load.

10. Perform proof tests as follows:

    a. Incrementally load the anchor according to the following schedule:

       - AL
       - 0.25P
       - 0.50P
       - 0.75P
       - 1.00P
       - 1.25P
       - 1.50P (Test conditions—hold for at least 10 minutes)

    b. At each increment, record the movement of the tendon to the nearest 0.001 in. (0.025 mm) referring to an independent fixed reference point.

    c. Monitor the jack load with a production gauge that was calibrated with the load cell used for the performance test.

       If required by the Engineer, monitor the jack load with the production gauge and load cell that were calibrated as a set.

    d. Adjust to a transfer load of 1.0P. Actual lock-off load may be somewhat higher to account for seating losses.

    e. To prevent misalignment of testing equipment, maintain an alignment load (AL) of at least 0.05P.

    f. Perform the creep test by holding the 1.50P load for 10 minutes while maintaining the load constant. Record the anchor movement (total movement) referenced to a fixed point at 30 seconds and 1, 2, 3, 4, 5, 6, and 10 minutes.

       Begin the observation time when the jack begins to load the anchor from 1.25P to the test load.

    g. If the movement between the 1-minute and 10-minute readings exceed 0.040 in. (1.00 mm), maintain the load for an additional 40 minutes. Record the movements at 15, 20, 25, 30, 40, and 50 minutes.

h. Have the Engineer review the proof tests to determine if the anchor is acceptable. An anchor is acceptable if:
   - The total movement obtained exceeds 80 percent of the theoretical elastic elongation of the free length and is less than the theoretical elastic elongation of the total of the free length plus 50 percent of the bond length.
   - The creep movement does not exceed 0.04 in. (1.00 mm) during the 1-minute to 10-minute increment regardless of tendon length and load.
   - If held for an additional 40 minutes, creep movement does not exceed 0.08 in. (2.00 mm) during the 5- to 50-minute increment regardless of tendon length and load.

11. Use the following test equipment:
   a. Use a dial gauge that can measure elongation to the nearest 0.001 in. (0.025 mm).
   b. Use a production gauge with an accuracy of at least 0.5 to 1 percent of full scale with gradation no greater than 100 psi (690 kPa). Ensure that it has a non-parallax dial.
   c. Use test gauges with an accuracy of at least 0.25 of 1 percent of full scale with gradations no greater than 50 psi (345 kPa). Ensure that they have a non-parallax dial.
   d. Use a load cell with a resolution of at least 1/10 of 1 percent constructed to eliminate inaccuracy with uneven loading.
   e. Ensure that the jack, gauges, and load cell are calibrated as a set and independently.

   Check the pressure gauge and load cell calibration every week (or when erratic results are found) against a test gauge that is kept onsite for this purpose. Have the Department's Inspector witness these calibration checks. Perform installation, testing, and stressing in the Department Inspector's presence.

12. Perform lift-off tests when using anchors. Make a lift-off reading after transferring the load to the end anchorage and before removing the jack.
   a. Determine the load within 5 percent of 1.00P. If the lift-off load is less than 0.95P, reset the end anchorage and make another lift-off reading.
   b. Perform additional lift-off tests 7 days after the load was locked-off in the anchor.

   After performing 5 additional lift-off tests, perform lift-off tests randomly. The total number of tests will be performed on no more than 10 percent of the remaining anchors.

617.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

617.4 Measurement

Permanently Anchored Walls are not measured separately for payment.

617.5 Payment

Payment for this work is made per Lump Sum. Payment includes costs for concrete, reinforcing steel, excavation, backfill, lagging, piles, anchors, labor, design, and other materials and equipment. Payment also includes grouting, drilling holes, post-tensioning, performing and evaluating tests, and submitting records of tests, tools, and other items to complete the work.

Payment will be made under:

Item 617	Permanent anchored wall, wall no.___	Per lump sum

Section 627—Mechanically Stabilized Embankment Retaining Wall—Contractor Design

Replace Section 627 with the following:

627.1 General Description

This Specification covers the required materials, design, fabrication, construction, measurement, and payment for Contractor designed Mechanically Stabilized Embankment (MSE) retaining walls.

The scope of work of wall erection includes:

- Grading for wall construction
- Compacting the wall foundation
- General and local dewatering as required
- Constructing leveling pads
- Erecting precast panels
- Placing soil reinforcing devices
- Placing and compacting special embankment backfill within the reinforced volume
- Providing downdrag protection for piles
- Furnishing and placing precast or cast-in-place concrete coping and precast or cast-in-place traffic barrier on the top of the wall if these items are shown in the Plans.

For patented mechanically stabilized embankment retaining walls, obtain panels, soil reinforcing devices, connecting devices, joint materials, attachments, and expertise to construct the walls.

627.1.01 Definitions

Wall foundation—the area underlying the leveling pad and the reinforced volume.

627.1.02 Related References

A. Standard Specifications

Section 106—Control of Materials
Section 208—Embankments
Section 500—Concrete Structures
Section 511—Reinforcement Steel
Section 514—Epoxy Coated Steel Reinforcement
Section 535—Painting Structures
Section 645—Repair of Galvanized Coatings
Section 812—Backfill Materials
Section 848—Pipe Appurtenances
Section 865—Manufacture of Prestressed Concrete Bridge Members
Section 870—Paint

B. Referenced Documents

AASHTO M 243

AASHTO T 22

ASTM A 123/A 123M

ASTM A 153/A 153M

ASTM A 307

ASTM A 563

ASTM A 709 (ASTM A 709M)

ASTM A 1011 (ASTM A 1011M)

ASTM A 1064 (ASTM A 1064M)

ASTM B 695

ASTM D 2240

ASTM F 436 (ASTM F 436M)

ASTM F 3125 (ASTM F 3125M)

GDT 7

GDT 24a

GDT 24b

GDT 35

GDT 75

QPL 9

QPL 28

QPL 58

QPL 107

Standard Operating Procedure 3, Precast/Prestressed Concrete Bridge Members

Standard Operating Procedure 33, Certification of Mechanically Stabilized Embankment Retaining Walls.

AASHTO LRFD Bridge Design Specifications

627.1.03 Submittals

Submit to the Engineer shop drawings and calculations for the wall system, coping, and any special details for review and approval. Submission should be made electronically in a portable document format (pdf) and include an index. Format all drawings to fit 11 in. x 17 in. (279 mm x 432 mm) paper. Present calculations to fit 8.5 in. x 11 in. (216 mm x 297 mm) paper. The submission shall be prepared and stamped by the Design Engineer who shall be registered as a Professional Engineer in the State of Georgia.

Include in the submission:

A. MSE Wall Backfill Information

1. Copy of source approval letter from Office of Materials and Testing, when an on-site source is approved
2. Dry Unit Weight, Optimum Moisture, and Angle of Internal Friction test results for MSE Backfill material
3. Pull out resistance testing results for approved source material or equivalent, if f* values greater than suggested in AASHTO LRFD Bridge Design Specifications are used in design

B. Retaining Wall Design Calculations

1. Internal stability design calculations for each design column in the retaining wall envelope
    - Evaluate Pullout
    - Evaluate Tension in reinforcement and connections
    - Evaluate Tension in reinforcement and connections due to vehicular collision load
2. External stability design verification calculations using project specific MSE Backfill materials
    - Evaluate Sliding Stability
    - Evaluate Eccentricity
    - Evaluate Bearing Capacity

Consider the final construction configuration and loads on the wall when preparing calculations.

C. Traffic Barrier H and Coping B Design Calculations

See Section 627.3.03.B.4.c for barrier coping design requirements.

D. Construction Drawings that include:

1. Plan and Elevation view of proposed wall
2. Details of leveling pad, including steps
3. Details of backfill stabilizing devices, including dimensions, spacing, size, and material type.
4. Details of Coping A, Coping B, or Traffic Barrier H.

    Traffic Barrier~~s~~ H and Coping B may be precast, cast in place, or a combination thereof. In all cases the moment slab shall be cast in place. Align the joints through all elements of the Traffic Barrier H or Coping B sections and detail such that there is no reinforcement crossing the joints. Omit joints in the moment slab as required by design.

    Provide transition details to allow for guardrail connection when necessary.
5. Details, dimensions, and schedules of all reinforcing steel, including dowels and/or studs for attaching the facing to the backfill reinforcement.
6. Details of all precast panels that are not presented in the library of panels approved as part of QPL 107 certification process outlined in SOP 33.
7. All other details necessary for the completion of work, including but not limited to details related to piling, drainage elements, noise barriers, traffic structures, etc.

Ensure that Plans match GDOT plans in size, format, borders, title block, etc. Include the Project Identification Number (P.I.) in or directly above the title block.

Itemize the wall quantities as follows:

1. Wall Envelope Quantities in the Plans. These are the values presented in the contract plans.
2. Adjusted Wall Envelope Quantities. These values are based on the approved survey verification of the Wall Envelope.
3. Material Quantities. These values reflect contractors means and methods and are not for payment.

Wall Envelope Quantities are required in all cases.

The time required for preparation and review of plans and calculations will be charged to the allowable contract time. The final plans and calculations for a wall shall be approved prior to beginning construction on the wall.

The Department will be allowed 45 days to review the plans and calculations and provide either approval or review comments to the contractor. The 45-day review time will begin when the Department has received all of the calculations and drawings concerning the structure. Each new submittal from the Contractor as a result of corrections resulting from the Department's review or changes that are made by the contractor to expedite construction or to correct for field errors will have a 45-day review time.

The Department will be the sole judge of the adequacy of the information submitted. The review and acceptance of the final plans and methods of construction by the Department will not in any way relieve the Contractor of responsibility for the successful completion of the work. Contractor delays due to untimely submissions and insufficient information will not be considered as justification for time extensions.

627.2 Materials

Ensure that items used to construct the mechanically stabilized embankment retaining walls but not mentioned in this Specification conform to the applicable sections of the Standard Specifications.

A. Soil Reinforcing Devices

1. Reinforcing and Tie Strips

   Use tie strips shop-fabricated of hot rolled steel that conform to the minimum requirements of ASTM A 1011 Grade 50 (ASTM A 1011M Grade 345). Hot roll reinforcing strips from bars to the required shape and dimensions. Their physical and mechanical properties shall conform to ASTM A 709 Grade 36 (ASTM A 709M Grade 250).

2. Soil Reinforcing Mesh

   Use soil reinforcing mesh shop-fabricated of cold drawn steel conforming to the minimum requirements of ASTM A 1064/A 1064M.

3. Backfill Stabilizing Geogrid:

   Use Backfill Stabilizing Geogrid that conforms to the requirements of Section 809.

B. Connecting Devices

1. Fasteners

   Use high-strength bolts and nuts that are hexagonal cap screw and that conform to ASTM F3125, grade A325 (F3125M, A325), galvanized. Ensure that they are of the diameter shown in the Plans - 1-1/2 in. (40 mm) long with 3/4 in. (20 mm) thread length.

   Use galvanized washers with galvanizing fastener elements conforming to ASTM A 153/A 153M.

2. Steel Strap Connectors

   Use materials that conform to the following standards:

Material	Conforms to the Requirements of:
Steel strap connection bar and plate	ASTM A 709 Grade 36 steel (ASTM A 709 Grade 250)
Bolts	ASTM A 307 (ASTM A 307M)
Nuts	ASTM A 563
Washers	ASTM F 436 (ASTM F 436M)
Coatings for connecting devices	As specified in the Subsection below

3. Attachments

   a. Use clevis loops and mesh loops fabricated of cold drawn steel wire that conforms to ASTM A 1064 and are welded according to ASTM A 1064/A 1064M. Ensure that they develop a stress of at least 0.9 times the steel’s yield strength. Use loops galvanized according to ASTM A 153/A 153M, Class B 3, or ASTM A 123/A 123M.

b. Use a connector bar that is fabricated of cold drawn steel wire that conforms to ASTM A 1064 and is galvanized according to ASTM A 123/A123M.

4. Geogrid Connection Bar: Use a connection bar 1 inch (25 mm) by 0.2 inches (5 mm) thick by roll width plus 3 inches meeting the same physical and chemical properties as the backfill stabilizing geogrid.

C. Concrete

Use Class AA concrete for precast panels, Traffic Barrier H, and Coping B, except ensure that the 28-day strength is at least 4,000 psi (28 MPa). Except as indicated in the approved mix design, admixtures will not be allowed. Do not use admixtures containing chlorides.

Use Class A concrete for leveling pads and Coping A.

D. Joint Fillers

1. Bearing Pads

Ribbed bearing pads shall be made of SBR rubber with a durometer hardness of 80 plus or minus 10 as determined by ASTM D 2240.

Elastomeric pads shall be made of 100% virgin chloroprene (neoprene) and meet the requirements of the AASHTO LRFD Bridge Design Specifications, Section 14, Elastomeric Bearings.

2. Filter Fabric

In flood plains or other intermittently inundated areas, cover the different joint types as follows:

Joint Type	Action
Joints between panels from an elevation 3 ft. (1 m) above the 100-year flood elevation to the bottom of the wall	Cover on the back side of the wall with a woven plastic filter fabric sheet.
Joints between panels from 3 ft. (1 m) above the 100-year flood elevation to the top of the wall	Cover on the back side of the wall with a woven or nonwoven plastic filter fabric sheet.
All other locations	Cover joints between panels with a woven or nonwoven plastic filter fabric sheet

Use woven and nonwoven plastic filter fabric listed on QPL 28 for work in this Specification, subject to the above requirements.

Use adhesive listed on QPL 58 for attaching filter fabric to panels.

E. MSE Wall Backfill Material

Use material in the MSE Wall Backfill volume that conforms to the requirements of Subsection 812.2.04. In addition, obtain approval for use of the material by the Office of Materials and Testing.

F. Coatings for Steel Soil Reinforcing Devices

Apply coatings to the soil reinforcing devices as follows:

1. Galvanize the entire surface of reinforcing and tie strips, mesh, and connecting devices according to ASTM A 123/A 123M. Or galvanize it mechanically according to ASTM B 695, Class 110, unless otherwise specified on the Plans. Also galvanize the surfaces created by punching holes for bolts.
2. Repair damage sustained by the connecting devices, bolts, or reinforcing devices during phases of fabrication, storage, or erection according to Section 645.

   Repair by brush coating with an approved galvanizing repair compound as specified in Subsection 870.2.05.A.2 to the Engineer's satisfaction at no increase in Contract cost.
3. Galvanize the parts of the connecting devices that are threaded according to ASTM A 153/A 153M, Class C. Hot dip galvanize alignment pins.

4. When the Type 2P coating is required on the Plans:
   a. After manufacturer galvanizing is complete, shop-coat the entire surface for the length indicated on the Plans with a two-component coal tar epoxy system indicated in Subsection 535.3.03.D, “Prepare Steel Piling, Swaybracing, and Concrete Piling Surfaces for Special Protective Coatings,” for a Type 2P coating according to Subsection 870.2.05.A.1.
   b. Use Type 2P coating to field-coat galvanized nuts, bolts, and washers used to connect reinforcing and tie strips. Repair damage to the coating on connecting devices or reinforcing devices from shipping, storage, or erection to the Engineer’s satisfaction at no additional cost.
   c. Use Type 2P coating to field-coat the parts of the connecting devices exposed after installing the soil reinforcing devices.
5. Epoxy coat the entire surface according to Section 514 and Section 867, when required on the Plans.
   a. Do not galvanize the soil reinforcing devices if this coating method is used.
   b. Use Type 2P coating to field-coat galvanized nuts, bolts, and washers used to connect reinforcing and tie strips.
   c. Use Type 2P coating to field-coat the parts of the connecting devices exposed after installing the soil reinforcing devices.
6. Repair damage to the coating on the connecting devices or soil reinforcing devices from shipping, storage, or erection to the Engineer’s satisfaction at no additional cost.

G. Reinforcing Steel

Use reinforcing steel that conforms to the requirements of Section 511.

H. Welded Wire Fabric for Precast Panels

Use welded wire fabric that conforms to the requirements of ASTM A 1064.

I. Certification

The Department will use certified test report as specified in Subsection 106.05, *Materials Certification* and perform routine tests as a basis for material acceptance furnished for The Work.

J. Corrosion Inhibiting Material

For the corrosion inhibiting material, use a bituminous plastic cement material that conforms to the requirements of Section 848, AASHTO M 243 Trowel Grade Asphalt Mastic, or use an approved corrosion-inhibiting grease.

627.2.01 Delivery, Storage, and Handling

Handle, store, and ship panels to eliminate the danger of chipping, cracking, discoloring, fracturing, and excessive bending stresses.

Repair at the plant the panels damaged during handling or storage at the casting plant as directed by the Engineer. Panels damaged during handling, storing, or shipping may be rejected upon delivery at the Engineer’s discretion.

Support panels in storage on firm blocking located immediately adjacent to embedded connecting devices to avoid bending the connecting devices.

Repair the coating on ties or soil-reinforcing devices damaged during handling or placing to the Engineer’s satisfaction.

Ensure geotextile materials are protected from sunlight during delivery and storage.

627.3 Construction Requirements

627.3.01 Personnel

Meet the following personnel requirements:

A. Design

Use a Design Engineer with the following qualifications to design the wall and prepare and submit plans for approval:

- Is registered as a Professional Engineer in the State of Georgia.
- Has knowledge and experience with the design and construction of MSE walls.
- Is available at any time during the life of the Contract to discuss the design of the walls directly with the Department.

B. Construction

The Contractor or Subcontractor shall meet the following requirements:

- Be experienced in the construction of Mechanically Stabilized Embankment Walls.
- Include on staff, a supervising engineer for the Project with at least five years of experience in the construction of Mechanically Stabilized Embankment Walls.

Submit the following proof, whenever requested by the Department, of the ability to design and/or construct Mechanically Stabilized Embankment Walls.

- Evidence of the successful completion of at least five Projects similar in concept and scope to the proposed wall.
- Resumes of the supervising engineer and foremen to be employed on this Project showing the type and number of Mechanically Stabilized Embankment Walls each worked on within the past five (5) years.

The Department will be the sole judge of the acceptability of the qualifications of the design engineer, supervising engineer and foreman.

627.3.02 Equipment

General Provisions 101 through 150.

627.3.03 Preparation

A. General Requirements – Designing and Detailing

The Department's plans will include a Wall Envelope. The Wall Envelope will show:

- The existing and proposed ground line,
- The maximum elevation of the top of the leveling pad
- The proposed top of coping or the proposed gutterline elevations where the barrier is attached to the wall
- The soil parameters for the wall design
- The location of any internal walls required
- The location of other appurtenances including but not limited to:

  --Light standards

  -- Noise barriers

  --Sign supports
- Other obstructions in the wall backfill including but not limited to:

  -- Drainage structures and pipes

-- Bridge columns, caps, wingwalls

-- Bridge piles

- Details of any proposed ditches at the top of the wall
- Proposed pay quantities

Ensure that the wall design is compatible with all horizontal and vertical criteria and backfill loading conditions.

Verify the wall location according to Subsection 149.1.03.E and Subsection 149.3.03.D before the final wall design is submitted. Include in the verification:

- The top and bottom of the wall envelope
- Backfill design conditions
- Depth of wall embedment
- Location of drainage structures and other obstructions in the wall backfill
- Other appurtenances located on the wall.

If any changes to the wall envelope are required by the field survey, submit plan sheets to the Engineer for approval showing the wall envelope as detailed in the plans with the required changes noted.

B. Wall Design

Use the following design criteria for a Contractor designed wall:

1. Provide an approved MSE wall system from QPL 107
2. Design the MSE Wall according to the current AASHTO LRFD Bridge Design Specifications, Section 11.10, except as modified by these specifications.
3. Design MSE wall portions within 100 ft of a bridge to a service life of 100 years. All other MSE walls, including the remainder of walls greater than 100 ft away from a bridge may be designed to a service life of 75 years.
4. Design the MSE wall to account for all live load, dead load and wind load from all traffic barrier, lights, overhead signs, noise barriers and other appurtenances located on top and adjacent to the wall. Design MSE walls to account for all external forces. Also, design abutment walls for all horizontal and vertical loads applied by the bridge. Use the following load definitions as minimums for design:
   a. Live Load Surcharge:
      - Apply a live load surcharge of 0.25 KSF for walls with a pressure surface located within H/2 of a traffic load
      - Apply a live load surcharge of 0.10 KSF for all other walls to account for construction activities

   b. Bridge Loads:

      Provide soil reinforcement devices for the back side of abutments supported on piling that is encased in the MSE backfill. Design these soil reinforcement devices to resist the lateral forces from the bridge. If the lateral forces are not specifically stated on the retaining wall plans, use a minimum factored load of 1.0 k/ft along the length of the abutment cap, applied at the bearing seat height. Include this lateral loading from the bridge in the external stability calculations for the wall.

   c. Rail Loads:

      Traffic Barrier H, Coping B, and walls that include them should be designed for vehicular impact as follows:

      Evaluate precast or cast in place concrete barrier coping for sliding and eccentricity. For this analysis assume a 15 kip load applied over a width of 5 ft at the top of the barrier and distributed in to a maximum length equal to the minimum joint spacing in the moment resisting slab. Apply this same 15 kip load when considering internal and external stability of the reinforced wall mass.

Design the barrier portion of the coping to resist an 80 kip load applied over a width of 5 ft at the top of the barrier. Evaluate the barrier using the yield line analysis procedures presented in the AASHTO LRFD Bridge Design Specifications, Section A13.

Detail the moment slab and connecting elements such that all sections will satisfy a design moment equal to the moment capacity at the base of the barrier about its horizontal axis. For this calculation, take the base of the barrier as the section at the finished grade on the traffic side of the barrier.

5. For MSE walls that are intersected by a box culvert, detail the soil reinforcement devices over the box culverts to a length equal to the soil reinforcement devices in the adjacent sections.
6. Assume responsibility for all temporary shoring that may be necessary for wall construction. Design the shoring using sound engineering principles.
7. Use permanent concrete wall facing panels that are at least 5 1/2 in (139 mm) thick.
8. Provide a minimum length of soil reinforcement of 10 feet (3 m) or seven-tenths (0.7) of the wall height, whichever is greater.
9. At any section of wall, detail all soil reinforcement devices the same, including length, cross section, and corrosive protection.
10. Positively connect all soil reinforcement devices to the precast panels.
11. Ensure that the special wall backfill extends a minimum of 12 in (300 mm) past the end of the soil reinforcement.
12. For MSE Walls at Bridge Ends:

    Ensure that MSE wall backfill extends vertically to the bottom of the approach slab.

    Ensure that the MSE wall backfill extends horizontally to the back limit of the MSE backfill for the wall below the approach slab or 12 inches (300 mm) beyond the end of the stabilizing devices attached to the bridge, whichever is greater.

    Show details of attachments to be cast into the bridge end bent and backwall.

    Do not make attachments to bridge endwalls that are integral to the bridge superstructure and are subject to movement due to superstructure expansion and contraction.
13. Use the Architectural treatment of facing panels as indicated on the Department's drawings.
14. Provide internal walls to allow for future widening if shown on the wall plans. Ensure the internal walls have galvanized wire or concrete facing. Ensure as a minimum that the facing of the internal walls extend to the back limit of the MSE Wall Backfill for the permanent wall.
15. Ensure the maximum panel area does not exceed 50 square feet (4.65 square meters).
16. A Foundation Investigation Report may be available from the Geotechnical Engineering Bureau of the Department. The information contained in this report may be used by the Contractor to assist in evaluating existing conditions for design as well as construction. However, the accuracy of the information is not guaranteed and no requests for additional monies or time extensions will be considered as a result of the Contractor relying on the information in this report.
17. Ensure the following requirements are met:

    The gutterline grade on the proposed top of wall submitted matches the gutter elevations required by the plans.

    The top of coping is at or above the top of coping shown on the envelope.

    The leveling pad is at or below the elevation shown on the wall envelope.

    Any approved changes in Wall Envelope quantities due to the approved survey verification are noted in the contractor's plans as Adjusted Wall Envelope Quantities.

    All changes in quantities due to the proposed walls being outside the wall envelope (step locations, ending wall at full panel, etc.) are shown as Material Quantities.
18. Ensure the minimum embedment of the wall (top of leveling pad) is at least 2 feet (600 mm). If the soil slopes away from the bottom of the wall, lower the bottom of the wall to provide a minimum horizontal distance of 10 ft. (3 m) to the slope. [i.e. a 2:1 slope in front of the wall requires 5 ft. (1.5 m) of embedment; a 4:1 slope in front of the wall requires 2.5 ft. (750 mm) of embedment]

627.3.04 Fabrication

A. Soil-Reinforcing Devices

Have steel soil-reinforcing devices shop fabricated. Use shop fabricated steel mesh of cold drawn steel welded into the finished mesh fabric according to ASTM A 1064/A 1064M.

Cut soil-reinforcing devices to lengths and tolerances shown on the Plans. Punch holes for bolts in the location shown. Ensure that soil-reinforcing devices are true to size and free of defects that may impair the strength or durability.

B. Connecting Devices

Use connecting devices of the dimensions shown on the Plans. Assemble connecting members and soil-reinforcing devices before galvanizing the connecting devices. Ensure that the connecting devices are true to size and are free of defects that may impair the strength or durability.

Tie strips may be partially bent to no more than a 1 in. (25 mm) radius before they are shipped to the precast yard. Perform final bending at the precast yard.

Do not allow connecting devices, reinforcing steel, or welded wire fabric used in the panels to contact each other.

C. Bolts and Nuts

Use bolts and nuts that meet the requirements defined in Subsection 627.2.B, *Connecting Devices*.

D. Precast Panels

Use precast panel materials as specified in Subsection 627.2, *Materials.* Before casting, set the following in place to the dimensions and tolerances shown on the drawings:

- Tie strips
- Mesh attachment straps
- Coil embeds
- Coil bolts
- Reinforcing steel
- Welded wire fabric
- Connecting pins
- Handling devices

Do not allow the metal connecting devices and reinforcing steel to contact each other when in their final position in the panel.

1. Testing and Inspection

   Use precast concrete panels that are cast at a Class A or B plant that conforms to Standard Operating Procedure 3, Precast/Prestressed Concrete Bridge Members. See QPL 9 for a list of approved plants.

2. Casting

   Cast the panels using steel forms.

   a. Cast the front face of the panel (the face exposed to view when installed in the wall) against a steel form or architectural form liner. Float finish the back face.

   b. Place the concrete in each panel without interruption and consolidate it using an approved vibrator. Supplement vibration with hand tamping as necessary to force the concrete into the corners of the forms and prevent the formation of stone pockets or cleavage planes from forming.

   c. Use clear form oil from only one manufacturer throughout the casting operation.

3. Curing

   Cure the panels as specified in Subsection 500.3.05.Z, *Cure Concrete*, or Subsection 865.2.01.B.10, *Concrete Curing.* Cure for at least 12 hours or until the concrete develops the specified compressive strength. The Engineer will reject panels that do not reach specified strength within 28 days.

4. Removing Forms

   Keep forms in place until they can be removed without damaging the panel.

5. Concrete Finishing and Tolerances

   Finish the concrete surface for the front face as designated on the Plans. Float-finish the rear face enough to eliminate open aggregate pockets and distortions greater than 1/4 in. (6 mm).

   Only use panels manufactured within the following tolerances:

   All dimensions are within 3/16 in. (5 mm).

   Angular distortion in the panel's height does not exceed 3/16 in. (5 mm) in 5 ft. (1.5 m).

   Diagonal tolerance from Plan dimensions is no more than 3/8 in. (10 mm).

   For textured finishes, surface defects greater than 5/16 in. (8 mm) in 5 ft (1.5 m) will be rejected.

6. Determining Compressive Strength

   Perform compression tests to determine the minimum strength requirements on cylinders.

   a. Make at least three cylinders to determine when the units may be put into service from each day's production and cure according to GDT 35.D.1.
   b. Make two additional cylinders from each day's production or from each 10 cubic yards of concrete placed, whichever is the lesser amount of concrete, to determine the 28-day strength.
   c. Ensure that the shipping strength is equal to the required 28-day strength for each day's production or for each 10 yd^3 (7.5 m^3) of concrete placed, whichever amount of concrete is less.
   d. Cure according to GDT 35.D.1. Ensure that the 28-day compressive strength is at least 4,000 psi (28 MPa). Perform compressive strength tests according to AASHTO T 22.

7. Rejection

   Panels will be rejected if they do not meet the requirements above. The following defects are also cause for rejection:

   Indications of imperfect molding that result in tolerances being exceeded

   Honeycombed or open texture concrete

8. Marking

   Clearly and permanently mark on the rear face of each panel the date of manufacture, lot number, and type of panel.

E. Precast Coping and Precast Traffic Barrier

To construct the precast portion of the coping or precast traffic barrier, use materials that conform to Subsection 627.2.C, *Concrete.* Use the same procedures for precasting, testing, and inspection as those for precast panels.

627.3.05 Construction

A. Prepare the Foundation

Before beginning construction, prepare the foundation as follows:

1. Grade the foundation for the mechanically stabilized embankment retaining wall level to a width equal to or exceeding the width of the reinforced volume and leveling pad. Use the top of the leveling pad as the grade elevation.
2. Before beginning the wall and leveling pad construction, compact the foundation to at least 95 percent of maximum laboratory dry density as determined by GDT 7.
3. Where walls are used as a bridge abutment, compact the foundation material as follows:
   a. When a portion of the wall is a bridge abutment, ensure that portions of the wall within 100 ft. (30 m) of the lateral limits of the bridge have foundation material compacted to at least 100 percent of maximum laboratory dry density as determined by GDT 7.

- **b.** When walls are used solely as bridge abutments, compact the foundation material for the entire wall to at least 100 percent of maximum laboratory dry density as determined by GDT 7. Place and compact the embankment beneath the wall according to Section 208.

4. If excavating below the leveling pad elevation, reconstruct the area as embankment.
5. Remove and replace foundation soils that are incapable of sustaining the required compaction as directed by the Office of Materials and Testing.
6. At each panel foundation level, provide a non-reinforced concrete leveling pad as shown on the plans.
   - **a.** Place leveling pads so they are level within 1/8 in (3 mm) per pad or per 10 ft. (3 m), whichever length is greater. Repair or replace leveling pads that do not meet this requirement as directed by the Engineer at the Contractor's expense.
   - **b.** If using bearing pads on the leveling pad on the initial row of panels, also use them on all the leveling pads of that wall.
   - **c.** Use neoprene strips 3/16 in. (5 mm) thick as necessary to level panels. Do not use more than 3/8 in. (10 mm) of neoprene strips. If more leveling is required, take other corrective action, such as replacing the leveling pad or replacing panels.
7. Embed the wall at least 5 ft (1.5 m) into an embankment, when shown on the plans. Construct the embankment before constructing the leveling pad and placing backfill for the wall.

B. Wall Erection

Place precast panels so that their final position at the completion of the wall is vertical.

1. Adjust the batter to allow for the effect of backfill type, equipment, and construction method on panel movement.
2. In general, batter the panels 1/2 in. (13 mm) in 4 ft. (1.2 m) into the reinforced volume to allow the panel to move during backfill placement and compaction.
3. Place panels in successive horizontal lifts as backfill is placed.
   - **a.** When placing backfill behind a panel, maintain the panel in a vertical position by placing clamps and temporary wooden wedges in the joints at the junction of two adjacent panels on the external side of the wall.
   - **b.** Use external bracing for the initial lift. Keep the wedges in place until the fourth layer of panels is placed, then remove the bottom layer of wedges.
   - **c.** Remove each succeeding layer of wedges when placing the succeeding panel layers.
   - **d.** When the wall is completed, remove the wedges. Do not use the wedges to level the panels on leveling pads.
   - **e.** Remove the wedges placed below the groundline on the front face of the wall before backfilling this area.

4. Alignment and tolerance are as follows:
   - **a.** Ensure that the horizontal and vertical joint openings between panels are uniform. Ensure that the opening is 7/8 in. ± 3/8 in. (22 mm ± 10 mm).
   - **b.** Ensure that the vertical tolerance (plumbness) and horizontal alignment tolerance as the wall is constructed does not exceed 3/4 in. (20 mm) when measured along a 10 ft. (3 m) straightedge.
   - **c.** Ensure that the overall vertical tolerance of the wall (plumbness from top to bottom) in its final position does not exceed 1/2 in. per 10 ft. (13 mm per 3 m) of wall height.
   - **d.** Place cast-in-place concrete on top of the wall panel as needed to bring the precast coping elements on top of the wall to proper grade. See the plans or construction details.

     Before placing special backfill material on a soil-reinforcing device, complete the connections to the panels.

C. Joint Fillers

Treat joints between the panels as follows:

1. Bearing Pads

   Ensure that horizontal joints between panels contain two 4 by 3 by ¾ in (100 by 75 by 20 mm) ribbed bearing pads or elastomeric pads as specified on the Plans.

2. Filter Fabric

   Cover all horizontal and vertical joints with 12 in. (300 mm) wide plastic filter fabric sheet glued securely to the backside of precast concrete panels. Cover the horizontal joint between the leveling pad and the first lift of panels with plastic filter fabric. Overlap the filter fabric with the joint at least 4 in. (100 mm). When piecing the filter fabric together, overlap at least 4 in. (100 mm).

   In flood plains or other intermittently inundated areas, cover the joints as follows:

   - Use a woven plastic filter fabric sheet to cover the joint on the back side of the wall between panels from 3 ft. (1 m) above the 100-year flood elevation to the bottom of the wall.
   - Use a woven or nonwoven plastic filter fabric sheet to cover the joint on the back side of the wall between panels from 3 ft. (1 m) above the 100-year flood elevation to the top of the wall.

D. MSE Wall Backfill

Place backfill shortly after erecting each lift panel. Follow these guidelines:

1. Place backfill lift to a uniform thickness and place it from the back face of the wall to 1 ft. (300 mm) beyond the end of the soil-reinforcing devices.
2. At each soil-reinforcing device level, compact the backfill to the full length of reinforcing devices and slope it to drain away from the wall before placing and attaching the next layer of reinforcing devices.
3. Level the compacted backfill with the connecting device before connecting the reinforcing device.
4. Repair damaged soil reinforcing devices or panels before attaching and backfilling the reinforcing devices.
5. Place soil reinforcing devices at 90 degrees to the face of the wall, unless otherwise indicated on the Plans or by the Engineer.
6. Ensure that the maximum lift thickness is 8 in. (200 mm) (loose) and closely follows panel erection. Decrease this lift thickness to obtain the specified density, if required.
7. Compact the embankment backfill material to at least 100 percent of maximum laboratory dry density as determined by GDT 7 or GDT 24a, GDT 24b Method A or B, for full depth of the material.
8. Compact the embankment backfill material without disturbing or displacing the reinforcing devices and panels.
9. Compact from the area nearest the wall face to the back of the reinforcing devices except for a strip 3 ft. (1 m) wide adjacent to the backside of the wall.

   After compacting the remainder of the layer, compact this 3 ft. (1 m) strip with light mechanical tampers without causing the panels to move outward.

10. Whenever a compaction test fails on a special embankment backfill lift, do not place additional material over that area until the lift is re-compacted and obtains a passing compaction test.

11. Ensure that the stabilizing geogrid at any layer is held taut, by mechanical means, free of wrinkles, bends or undulations until the special backfill material has been placed and compacted above the restrained layer to the level of the next layer of stabilizing geogrid. Release the uppermost layer of stabilizing geogrid after the final layer of special backfill is placed and compacted.

E. Storm Drains

Provide precast panels that have the appropriate storm drain openings in panels at the elevation and locations indicated on drainage profiles.

Place catch basins so that pipes will enter perpendicular (plan view) to the panels or below the leveling pads as shown on the Plans. Coordinate the catch basin construction and the storm drain placement with the wall construction.

F. Dewatering

Furnish, install, operate, and maintain satisfactory dewatering systems to maintain the site in a dry and workable condition to permit grading, compacting the wall foundation, and erecting and backfilling the wall. Furnish dewatering system equipment and materials and continue the system as long as necessary.

G. Catch Basins and Longitudinal Pipes

When catch basins are located behind the wall use cast in place or precast concrete structures.

When longitudinal pipes are located behind the wall, follow this procedure if specific details are not shown on the Wall Plans:

1. Bend the soil-reinforcing device around the pipe without damaging the device, its coating, or its attachment to the precast panel. See the construction details.
2. If the pipe is too close to the wall to bend the soil-reinforcing device without damaging it, the Engineer will investigate relocating the pipe. The Engineer will contact the design office that designed the drainage system or the office responsible for the pipe and will investigate the pipe relocation.
3. If the pipe cannot be relocated or if the pipe is too large for relocation to be feasible, use the back-up panel procedure indicated on the construction details.

Use precast concrete or cast-in-place concrete for:

- Drainage structures that are within the special embankment backfill
- Drainage structures that are outside the special embankment backfill but that are within 5 ft. (1.5 m) of the front face of the wall

627.3.06 Quality Acceptance

General Provisions 101 through 150.

627.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

627.4 Measurement

A. Excavation and Shoring

Excavation, including any required removal of unstable material, and shoring necessary for construction of the MSE Wall will not be measured for payment.

B. MSE Wall Face

MSE wall face area, complete in place and accepted, will be measured by the square foot (meter) in vertical bands bounded by the limits of each specific height range pay item in the plans. The height will be measured from the maximum top of leveling pad elevation on the wall envelope to the top of Coping A, the top of sidewalk elevation for Coping B, or the proposed gutterline elevation for Traffic Barrier H. Dividing the wall area into segments such as this provides the opportunity for the contractor to bid graduated unit prices that consider backfill volumes and reinforcement lengths.

Any area of cast-in-place facing around drainage structures within the approved wall envelope will be measured as MSE Wall Face. “Dummy” panels will not be measured for payment.

No separate measurement will be made for internal wall facing.

No deduction in area will be made for pipe passing through the wall facing. The area of box culverts that interrupt the wall envelope will not be included in the wall area measured for payment.

C. Backfill Stabilizing Devices

The backfill stabilizing devices will not be measured separately.

D. Backfill

The MSE backfill material used in the MSE wall volume will not be measured separately except as noted below.

- The MSE Backfill required behind bridge endwalls or backwalls and above the top of coping will be measured as additional MSE wall backfill.
- Any additional MSE backfill required as a result of an undercut ordered by the Engineer and requiring the MSE backfill material to provide stability, as determined by the Engineer, will be measured and paid for as additional MSE wall backfill.

Backfill of undercut areas not requiring classes of soils higher than common excavation soils will not be measured separately.

Backfill material required by construction procedures to extend outside the MSE wall volume shall be considered incidental and will not be measured separately.

E. Concrete Leveling Pads

Concrete Leveling Pads will not be measured separately.

F. Coping A, Coping B, and Traffic Barrier H, mounted atop the MSE Wall

These units complete in place and accepted, will be designated on the Plans and measured per linear foot (meter) for each type unit.

The quantities of coping and barrier will be measured as horizontal lengths in linear feet (meters).

627.4.01 Limits

General Provisions 101 through 150.

627.5 Payment

The pay quantities will be the Wall Envelope quantities shown in the Plans unless the Engineer approves Adjusted Wall Envelope. In this case, the pay quantities will be the Adjusted Wall Envelope quantities.

No additional compensation will be made for any additional material, equipment, design, or other items found necessary to comply with the project Specifications as a result of the Department's review except for changes made necessary by the survey verification required by Subsection 149.1.03.E and Subsection 149.3.03.D, or other changes approved by the Engineer.

Include in the unit bid prices all costs necessary to comply with the requirements of this specification. No payment will be made for wall area outside of the Adjusted Wall Envelope.

A. Excavation and Shoring

Excavation, including removing unstable material and shoring for construction of the mechanically stabilized embankment retaining wall, will not be paid for separately.

B. MSE Wall Face

MSE Wall Face area will be paid for at the Contract Unit Price bid per square foot (meter) for each height range in the wall envelope. Payment is full compensation for furnishing materials, including bearing pads, filter fabric, and graffiti-proof coating.

Any area of cast-in-place facing around drainage structures within the approved wall envelope will be paid as wall face. Payment will include all costs for concrete, reinforcing steel in the cast-in-place areas. No additional payment will be made for any “dummy” panels required.

If the wall height changes to a height greater than the maximum height range included in the pay items, the area of wall with a height greater than the maximum will be paid at 120% of the bid price of the maximum height range pay item included in the plans.

No separate payment will be made for architectural treatment.

No separate payment will be made for internal wall facing, internal wall backfill stabilizing devices or additional MSE backfill necessitated by the internal wall.

C. Backfill Stabilizing Devices

The backfill stabilizing devices will not be paid for separately. Include this cost in the unit price bid for MSE wall face.

D. Backfill

The MSE backfill material used in the MSE wall volume will not be paid for separately except as noted below. When not paid for separately, include the cost in the unit price bid for MSE wall face.

Exceptions:

- The cost of MSE Backfill required behind bridge endwalls or backwalls and above the top coping will be paid for as Additional MSE Wall Backfill.
- Any additional MSE backfill required as a result of an undercut ordered by the Engineer and requiring the MSE backfill material to provide stability, as determined by the Engineer, will be paid as additional MSE wall backfill.

Backfill of undercut areas not requiring materials of grades higher than common excavation soils will not be paid for separately. Include the cost in the overall bid price submitted.

Any backfill material required by construction procedures to extend outside the MSE Wall volume is considered incidental. Include this cost in the price bid for contract items.

E. Concrete Leveling Pads

Concrete leveling pads, including steps shown in the Plans will not be paid for separately.

F. Coping A, Coping B, and Traffic Barrier H, mounted atop the MSE Wall

These units, complete in place and accepted, will be designated on the Plans and paid for at the Contract Unit Price bid per linear foot (meter) for each type unit.

G. Dewatering

No separate payment will be made for dewatering. Include the cost of dewatering in the price bid for special embankment backfill.

Payment will be made under:

Item No. 627	MSE wall face, wall No. __0 -10 ft. (0 -3 m)	Per square foot (meter)
Item No. 627	MSE wall face, wall No. __>10 -20 ft. (3 -6 m)	Per square foot (meter)
Item No. 627	MSE wall face, wall No. __>20- 30 ft. (6 -9 m)	Per square foot (meter)
Item No. 627	MSE wall face, wall No. __>30 ft. (>9 m)	Per square foot (meter)
Item No. 627	Coping, A, wall No. ___	Per linear foot (meter)
Item No. 627	Coping, B, wall No.___	Per linear foot (meter)
Item No. 627	Traffic barrier, H, wall No.___	Per linear foot (meter)
Item No. 627	Additional MSE backfill	Per cubic yard (meter)

627.5.01 Adjustments

General Provisions 101 through 150.

Section 638—Structural Supports for Overhead Signs

Replace Section 638 with the following:

638.1 General Description

This item includes the materials, design requirements, fabrication, and erection of structural supports for overhead signs, including excavation, foundations, anchor bolt assemblies, backfill, redressing, and re-grassing but exclusive of signs.

638.1.01 Definitions

Structural supports for overhead signs are defined generally as follows:

Type	Description
I	A SIGN BRIDGE type structure that spans the roadway with more than two horizontal chords supported by two columns, one at each end. Each column shall have at least two braced vertical members.
II	A CANTILEVER type structure with two or more horizontal chords supported by a single column at one end.
III	A BUTTERFLY type structure with two or more horizontal chords extending an equal distance in opposite directions from a single column.
IV	A COMBINATION (Bridge-Cantilever) type structure with more than two horizontal chords supported by two columns, only one at one end and one at an intermediate point. Each column shall have at least two braced vertical members.
V	A CANTILEVER type structure with a maximum of two horizontal chords supported by a single column at one end.
VI	A SIGN BRIDGE type structure that spans the roadway with a maximum of two horizontal chords supported by two columns, one at each end.
VII	A BRIDGE MOUNTED (attached to a highway bridge) structural frame.
VIII	A BUTTERFLY type structure with a maximum of two horizontal chords extending an equal distance in opposite directions from a single column.

Type II and V structures' maximum horizontal dimension shall be 32 ft. (9.75 m). The horizontal dimension is measured from the column's centerline to the furthest point of the structure or sign.

Type III and VIII structures' maximum horizontal dimension shall be 25 ft. (7.6 m). The horizontal dimension is measured from the furthest point of the structure or sign on one side to the furthest point of the structure or sign on the other side. Place the sign(s) on the structure to create a slightly unbalanced condition about the column’s centerline during wind loads.

Types V, VI, and VIII structural supports shall be used with flat sheet aluminum signs. If the vertical dimension of the largest sign is 42 in. (1050 mm) or less, one horizontal chord may be used.

A walkway is required only when called for on the signing plans.

638.1.02 Related References

A. Standard Specifications

Section 207—Excavation and Backfill for Minor Structures

Section 500—Concrete Structures

Section 501—Steel Structures

Section 511—Reinforcement Steel

Section 645—Repair of Galvanized Coatings

Section 700—Grassing

Section 833—Joint Fillers and Sealers

Section 852—Miscellaneous Steel Materials

B. Referenced Documents

AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with interims (SLTS)

AASHTO LRFD Bridge Design Specifications

Current edition of the Manual on Uniform Traffic control Devices for Streets and Highways (MUTCD)

ASTM A 53

ASTM A 123/A 123M

ASTM A 139

ASTM A 153/A 153M

ASTM A 252

ASTM F 436/F 436M

ASTM A 563

ASTM A 709

ASTM F 1554

ASTM F 3125

ANSI/ASME B1.1

API 5L

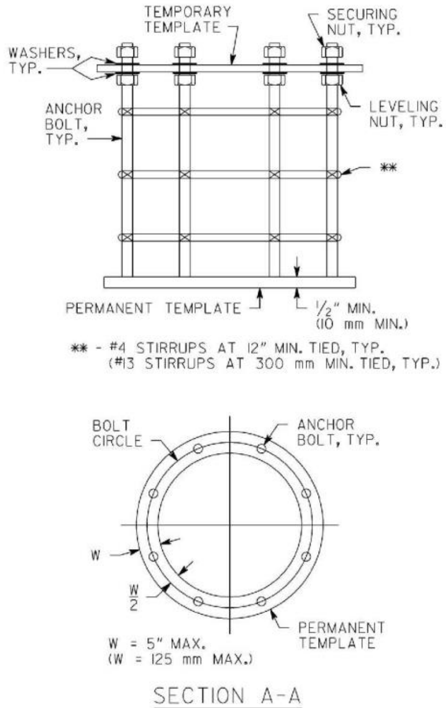


FIGURE 1

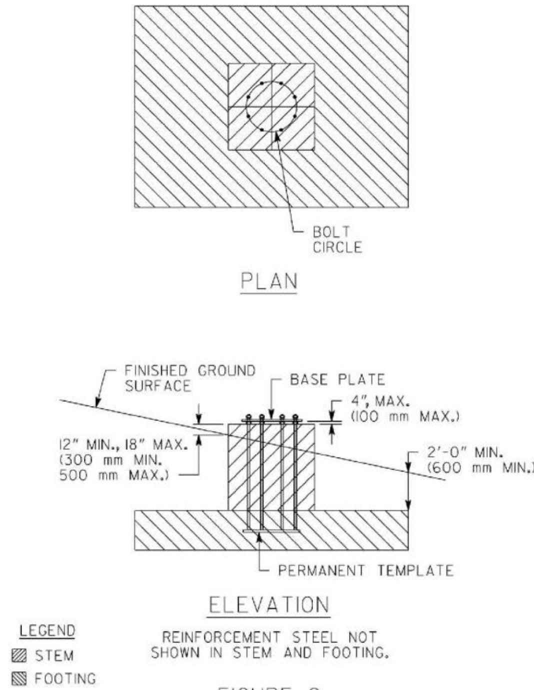


FIGURE 2

Current issue of AASHTO Standard Specification for Transportation Materials and Methods of Sampling and Testing

638.1.03 Submittals

Submit to the Engineer shop drawings and design calculations for the structural supports, anchor bolt assemblies, and foundations for review and approval. Submission should be made electronically in a portable document format (pdf) and include an index. Format all drawings to fit 11 in. x 17 in. (279 mm x 432 mm) paper. Present calculations to fit 8.5 in. x 11 in. (216 mm x 297 mm) paper. The submission shall be prepared and stamped by the Design Engineer who shall be registered as a Professional Engineer in the State of Georgia.

The Engineer will distribute submitted documents to the Bridge Engineer (SLTS@dot.ga.gov) for review and provide the State Traffic Operations Engineer with a copy of the transmittal letter. For installations governed only by a permit, and not a GDOT contract, drawing and calculation submission should be made directly to the Bridge Engineer for review and approval, with a copy to the District Permit Engineer.

Detail the shop drawings to permit replacement of all members and include all dimensions, construction tolerances, elevations at top and bottom of foundations, and sizes of members. The shop drawings shall include the material designations of the structure and of the hardware for attaching the sign, the lane delineation of the roadway under the structure, and the walkway. See Figure 1, Figure 2, and Figure 3.

A. Structural Supports

Structural supports shall be designed to the following wind speeds using a 700 Mean Recurrence Interval (MRI) for the listed counties:

- 140 mph: Bryan, Camden, Chatham, Effingham, Glynn, Liberty, McIntosh
- 130 mph: Brantley, Bulloch, Charlton, Evans, Long, Screven, Tattnall, Wayne
- 120 mph: Appling, Bacon, Brooks, Burke, Candler, Clay, Clinch, Decatur, Early, Echols, Emanuel, Grady, Jeff Davis, Jenkins, Lowndes, Miller, Pierce, Seminole, Thomas, Toombs, Ware
- 115 mph: For all counties not listed above

Structural supports shall be designed using the following criteria:

- Fatigue Category 1
- Truck induced gusts included

Design structural supports to use interchangeable components whenever feasible.

Design Type I, IV, and VI supports for 100 percent of the design sign area shown on the plans and 100 percent of the wind pressure as calculated by the SLTS.

Design bases for a minimum of four anchor bolts per column.

Design Type II, III, V, and VIII supports for 100 percent of the design area shown on the plans and 150 percent of the wind pressure as calculated by the SLTS. Design bases for a minimum of 8 anchor bolts per column.

Design Type VII supports for 100 percent of the design sign area shown on the plans and 100 percent of the wind pressure as calculated by the SLTS.

Type VII bridge mounted structural frames may be attached to concrete barrier, parapet, or deck or steel beams. Structural Supports shall not be attached to prestressed, post-tensioned, or reinforced concrete beams unless inserts were placed in beams during fabrication or construction. Make attachments to the concrete by bolting through the concrete or using chemical anchors not in direct tension. Mechanical anchors will not be allowed.

Attachments shall be flush on the traffic side of the concrete barrier, parapet, or deck. No attachments shall be welded to beams. When bolting to ASTM A 709 Grade 50W (A 709 M Grade 345 W) steel; bolts, nuts and washers shall be made from a steel that meets mechanical properties of ASTM A 325 (A 325M) and has weathering characteristics comparable and compatible to ASTM A 709 Grade 50W (A 709 M Grade 345W) steel. If the Structural Support is attached to a bridge beam, additional bracing will be required between the exterior beam and the first interior beam.

B. Walkways

When walkways are required by the signing plans, place walkways in front of the signs and extend them at least 1 ft. (300 mm) outside of the edge of all overhead signs and at least 2 ft. (600 mm) outside of the right edge of paving, or as directed by the Engineer. Provide walkways in front of the lower front chord, and do not locate a portion higher than the lowest part of any sign. Make the walkway continuous from end to end with a railing along the front side that can be folded down flush with the walkway when not in use.

C. Anchor Bolt Assemblies

Anchor bolt assemblies shall be of the proper length, area, and perimeter to transfer loads from the base plates to the foundations. The permanent template may be used in developing anchor bolts. Anchor bolts shall be at least 1-1/2 in. (38 mm) in diameter. Anchor bolt assemblies shall consist of a permanent template at the base, anchor bolts, leveling nuts, washers, temporary template, securing nuts, and #4 (#13) reinforcing bars.

The distance between the base plate and the top of the stem shall not exceed 4 in. (100 mm). Do not use grout between the base plate and the top of the stem. The anchor bolt shall project 1/4 to 1 in. (6 to 25 mm) above the securing nut. See Figure 1, Figure 2, and Figure 3.

D. Foundations

Unless otherwise required on the plans, design foundations as spread footings with a maximum factored bearing pressure of 3 KSF (140 kPa). No overstressing will be permitted. Drilled shaft foundation shall be used when called for on the plans and will require a soil investigation report that shall be included with your submittal. Drilled shafts shall not be used with Type II and V structures.

Unless otherwise shown on the plans:

- The top of the footing shall be at least 2 ft. (600 mm) below the finished ground surface.
- The bottom of the foundation shall be placed on or below the original ground or on fill compacted to at least 95 percent of the maximum laboratory dry density according to Section 208.
- The clearance between the anchor bolt assembly and the stem reinforcement shall be 2-1/2 in. (65 mm) minimum.
- One foundation per structure shall have a minimum of 2 in. (50 mm) rigid, galvanized steel conduits stubbed up 6 in. (150 mm) above the stem and capped a minimum of 3 ft. (1 m) outside the footing and a minimum of 18 in. (450 mm) below the finished ground surface for connecting to the underground power source or for future use.

638.2 Materials

Except for the Type VII structure, all structural members shall be tubular shapes. All materials shall meet the requirements of the applicable Specification. Do not use a material until the Office of Materials and Testing approves it.

Furnish one legible, reproducible copy of certified mill test reports including chemical analysis and physical test results covering steel and aluminum.

A. Aluminum Structures

Materials for aluminum structures shall comply the SLTS.

B. Steel Structures

All components of steel structures shall be galvanized in accordance with ASTM A 123/A 123 M or ASTM A 153/A 153 M, whichever is applicable. All components galvanized in accordance with ASTM A 123/A 123 M shall be quenched immediately upon removal from the zinc bath. If the contract plans require painting of the structural supports, the structural supports shall be painted with an approved paint system after galvanization.

- Structural steel, including base plates—Shall meet the requirements of the SLTS.
- Steel pipe—Shall meet the requirements of ASTM A 53 Types E or S. Grade B; ASTM A 139 Grade B; ASTM A 252 Grade 2; API 5L-X42; or API 5L-X52. The hydrostatic requirements are waived. Other alloys of steel may be accepted if minimum yield strength of the material is less than or equal to 60,000 psi.
- Walkway and sign connection bolts including U-bolts—Shall meet the requirements of Subsection 852.2.

All other connections shall be made with high strength ASTM A 325 (A 325 M) bolts with washers and nuts meeting all the requirements of Subsection 852.2.

C. Anchor Bolts

Anchor bolts, nuts and washers shall meet the requirements of Subsection 852.2, or ASTM F 1554 (F 1554 M), A 563 (A 563 M) and F 436 (F 436 M), except that threads shall be rolled and shall be 8 UN/8 UNR thread profile according to ANSI B1.1). Bolts shall have Class 2A threads, and nuts shall have Class 2B threads.

The permanent template shall meet the requirements of ASTM A 709 Grade 36 or 50 (A 709 M Grade 250 or 345) or shall be an approved equal. Construct temporary templates from a material rigid enough to prevent any movement and misalignment of the anchor bolts.

D. Concrete Foundations

Class A concrete shall comply with Section 500.

Reinforcement steel shall comply with Section 853, Grade 60 (420).

E. Silicone Caulking Compound

Silicone caulking sealant shall comply with Subsection 833.2.06.A.1.a.1), *Type A.*

F. Neoprene

Neoprene, or its approved equal, shall be approved by the Office of Materials and Testing.

G. Ground Rods

Ground rods shall comply with Subsection 894.2.04.

H. Ground Wire

Ground wire shall comply with Section 922.

I. Threadlocker Adhesive

Threadlocker adhesive shall be an anaerobic threadlocking and sealing compound approved by the Office of Materials and Testing.

J. Rigid Steel Conduit

Rigid steel conduit shall be a 2 in (50 mm) rigid steel conduit meeting the requirements of Subsection 923.2.01.A.2

638.2.01 Delivery, Storage, and Handling

During shipment and handling, protect the metal components to prevent bending the components and damaging the galvanized coating.

Handle galvanized steel components with rope slings or other methods approved by the Office of Materials and Testing.

Do not use metal slings, chains, or hooks on galvanized surfaces.

Repair minor damage to galvanizing, as determined by the Engineer, according to Section 645. Extensive galvanizing damage is cause for rejection.

638.3 Construction Requirements

638.3.01 Personnel

General Provisions 101 through 150.

638.3.02 Equipment

General Provisions 101 through 150.

638.3.03 Preparation

A. Footings

Footings may be designed as spread footings with a maximum factored bearing pressure of 3 KSF (144 kPa). Include a soil investigation and report for other footings in the submittal.

1. Unless shown otherwise on the plans, extend the top of each footing at least 4 in. (100 mm) above the ground. Place the footings to miss present and known future underground installations.

2. Stub at least two 2 in. (50 mm) rigid, galvanized steel conduits up 6 in. (150 mm) into the riser of one footing and cap at a distance of 3 ft. (1 m) outside the foundation. Place the conduit at least 18 in. (450 mm) below the ground level to connect to the underground power feed or for future use.

638.3.04 Fabrication

Fabrication of structural supports and anchor bolt assemblies shall be according to the approved shop drawings and the plans. Only use fabricators of structural supports and anchor bolt assemblies that are listed on the Department's Qualified Products List as a qualified fabricator of structural supports and anchor bolt assemblies.

A. General

Use aluminum or steel supports for signs. Steel supports shall be galvanized after fabrication. Connections may be welded, bolted, riveted, or fastened by other means if the connecting method ensures adequate strength and does not distract from the aesthetics of the structure. Do not weld splice structural members.

Fabricate columns, chords, and struts from one piece of material by using one longitudinal seam weld. Bolted splicing of truss chords may be allowed if shown on approved shop drawings. Use struts to brace all truss chords.

Provide an electrical outlet on the front horizontal chord with a cover for connecting to the power source or for future use. Weld into the column near the base the column with the conduit in the foundation, a handhole assembly, curved on the front to follow the contour of the column. Ensure that the handhole reinforcing frame has a tapped hole to accommodate the grounding lug and secure a cover to the frame with at least two screws. The column shall have a J-hook wire support welded inside near the top.

Provide brackets for mounting signs. These brackets shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degrees from vertical. Obtain this three-degree angle by rotating the top edge of the sign downward toward approaching traffic. All brackets shall be equal in length to the vertical dimension of the signs being supported.

B. Welding

All welding shall be done in the shop by current GDOT certified welders. The welders will weld the steel structures according to the latest AWS Structural Welding Code as modified by the GDOT Specifications and will weld aluminum structures according to Subsection 638.1.02.

C. Fabrication and Testing

Fabricate components in a jig or fixture to prevent distortion during and after welding and to ensure exact alignment at the time of erection.

Carefully check welds by visual and non-destructive inspection, by destructive testing of weld samples fabricated during welding, or by other methods approved by the Engineer. Sufficiently test weld samples to verify the reliability of production welding.

D. Galvanizing

After fabrication, thoroughly clean and galvanize all components of steel structures, including clamps and brackets, using the hot-dip process according to ASTM A 123/A123 M or ASTM A 153/A153 M, whichever is applicable.

Clean and galvanize interior and exterior surfaces of hollow sections. All components galvanized according to ASTM A 123/A 123 M shall be immediately quenched when removed from the zinc bath.

Galvanize Type VII bridge mounted structural frames except where the support is attached to weathering steel. When attached to weathering steel, fabricate the support of ASTM A 709 Grade 50W (A 709 M Grade 345W) steel or paint with an approved paint system to match the color of the weathering steel after galvanization.

638.3.05 Construction

A. Protection of Metal

During shipment and handling, protect all metal components to prevent damage to galvanized coatings. Handle galvanized steel components with rope slings or alternate methods approved by the Office of Materials and Testing before use. Do not use metal slings, chains, or hooks on galvanized surfaces.

Repair minor damage to galvanizing, as determined by the Engineer, according to Sections 645. Metal components will be rejected if they have extensive damage to galvanizing.

B. Foundations

For construction methods, see Sections 207, 500, and 511.

Chamfer the edges of the stems 3/4 in. (19 mm). Stems shall have a Type III finish to at least 6 in. (150 mm) below the finished ground surface unless otherwise noted on the plans. The Engineer shall inspect the anchor bolt assembly installation before the placement of concrete. Complete the anchor bolt assembly installations so as to prevent movement during the concrete placement. Tolerance for the placement of anchor bolt assemblies shall be 3/8 in. (10 mm) horizontally and 1:20 (3 degrees) vertically. Do not remove the temporary template until the footing and stem concrete have been in place at least 24 hours.

The Office of Materials and Testing (OMAT) shall inspect the Type II and V sign structure footings before the column is erected. OMAT will perform a second inspection after the column is erected and will also perform ultrasonic testing of the anchor bolts at this time. Type II and V sign structures will not be accepted until the footing inspections have been performed and approved.

C. Erection

Erecting the structure shall include placing and leveling a leveling nut on each anchor bolt. Use a washer with each leveling nut. Set the column on the washers without the horizontal structure, and place and tighten a washer and securing nut on each anchor bolt. Tightening is turning the nut an eighth of a turn after the nut is snug tight, and then applying the threadlocker adhesive.

After tightening, inspect the connections to ensure full bearing of the top and the bottom washers on the base plate and to ensure that the distance between the top of the stem and the bottom of the base plate does not exceed 4 in. (100 mm). No structure will be accepted if this dimension is greater than 4 in. (100 mm).

Attach the horizontal structure to the column with ASTM A 325 (A 325 M) bolts. Install ASTM A 325 (A 325 M) bolts according to Subsection 501.3.04.F, *High-Tensile Strength Bolt Connections*. Do not reuse bolts and nuts after tightening them.

D. Type VII Bridge Mounted

Coat with silicone sealant all surfaces that are in contact with concrete. Separate with neoprene or an approved equal material all surfaces that are in contact with dissimilar metals.

E. Grounding

Install ground rods for each structural support adjacent to the foundation with the conduit as indicated below:

1. Vertically drive single, 8 ft. (2.4 m) long ground rods until the top of the rod is at least 12 in. (300 mm) below the finished ground.
2. Attach a length of #6 bare copper, 7-strand wire to the ground with suitable ground rod clamps and connect it to the grounding nut of the column.
3. If sufficient penetration cannot be obtained in the above manner, place a ground rod system consisting of 3 parallel ground rods a minimum of 6 ft. (1.8 m) center-to-center in a horizontal pattern and at least 12 in. (300 mm) below the finished ground. Join these rods and connect them to the grounding nut of the column with #6 bare copper, 7-strand wire and suitable ground rod clamps.

F. Finished Ground Surface

Ensure that the finished ground surface matches the typical section adjacent to the structural support. Do not adjust the ground surface around the stem to obtain 12 in. (300 mm) minimum projection above finished ground surface.

638.3.06 Quality Acceptance

General Provisions 101 through 150.

638.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

638.4 Measurement

The quantity measured for payment shall be each structure type at the specified location completed and accepted. This shall include design, fabrication, and construction of structural supports including anchor bolt assemblies, foundations, excavation, backfill, redressing, and re-grassing; but exclusive of signs.

638.4.01 Limits

General Provisions 101 through 150.

638.5 Payment

This item, measured according to Subsection 638.4, “Measurement,” for each structural support for overhead highway signs, is paid for at the Lump Sum Contract Unit Price bid for the complete structure.

Payment will be made under:

Item No. 638	Structural support for overhead highway sign, type I–sta.___	Per lump sum
Item No. 638	Structural support for overhead highway sign, type III–sta.___	Per lump sum
Item No. 638	Structural support for overhead highway sign, type IV–sta.___	Per lump sum
Item No. 638	Structural support for overhead highway sign, type V–sta.___	Per lump sum
Item No. 638	Structural support for overhead highway sign, type VI–sta.___	Per lump sum
Item No. 638	Structural support for overhead highway sign, type VII–sta.___	Per lump sum
Item No. 638	Structural support for overhead highway sign, type VIII–sta.___	Per lump sum

638.5.01 Adjustments

General Provisions 101 through 150.

Section 639—Strain Poles for Overhead Signs and Signal Assemblies

Replace Section 639 with the following:

639.1 General Description

This work includes furnishing and erecting overhead sign and signal support strain poles and steel wire strand cable according to this specification and the plans.

Make concrete or steel strain poles at any one location within the project from the same material unless the plans designate a particular type for that location.

Use timber strain poles only where designated on the plans.

639.1.01 Definitions

General Provisions 101 through 150.

639.1.02 Related References

A. Standard Specifications

Section 500—Concrete Structures

Section 636—Highway Signs

Section 852—Miscellaneous Steel Materials

Section 861—Piling and Round Timber

Section 863—Preservative Treatment of Timber Products

Section 865—Manufacture of Prestressed Concrete Bridge Members

Section 915—Mast Arm Assemblies

B. Referenced Documents

ASTM A 27 / A 27 M

ATSM A 36 / A 36 M

ASTM A 123 / A 123 M

ASTM A 153 / A 153 M

ASTM A 242 M

ASTM A 595

ASTM A 709 (A 709 M)

AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with interims

639.1.03 Submittals

Submit to the Engineer shop drawings for steel and prestressed concrete strain poles for review and approval. Submission should be made electronically in a portable document format (pdf) and include an index. Format all drawings to fit 11 in. x 17 in. (279 mm x 432 mm) paper. Present calculations to fit 8.5 in. x 11 in. (216 mm x 297 mm) paper. The submission shall be prepared and stamped by the Design Engineer who shall be registered as a Professional Engineer in the State of Georgia.

The Engineer will distribute submitted documents to the Bridge Engineer (SLTS@dot.ga.gov) for review and provide the State Traffic Operations Engineer with a copy of the transmittal letter. For installations governed only by a permit, and not a GDOT contract, drawing and calculation submission should be made directly to the Bridge Engineer with a copy to the District Permit Engineer.

A. Design

Strain poles shall be designed to the following wind speeds using a 700 Mean Recurrence Interval (MRI) for the listed counties:

- 140 mph: Bryan, Camden, Chatham, Effingham, Glynn, Liberty, McIntosh
- 130 mph: Brantley, Bulloch, Charlton, Evans, Long, Screven, Tattnall, Wayne
- 120 mph: Appling, Bacon, Brooks, Burke, Candler, Clay, Clinch, Decatur, Early, Echols, Emanuel, Grady, Jeff Davis, Jenkins, Lowndes, Miller, Pierce, Seminole, Thomas, Toombs, Ware
- 115 mph: For all counties not listed above

Strain poles shall be designed using the following criteria:

- Fatigue Category 1
- Truck induced gusts included (required only for mast arm poles)
- Galloping included (required only for mast arm poles)

639.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Class A Concrete	500
Class B Concrete	500
Class AAA Concrete	500
Timber Poles	861.2.02
Seasoning and Preservative Treatment	863.2.01
Steel Wire Strand Cable	915.2.02
Guys and Anchors	Per Plans

A. Steel Strain Poles

Use shafts for steel strain poles fabricated of steel that conforms to one or more of the following:

- ASTM A 242/A 242 M
- ASTM A 709 Grade 50W (A 709 M Grade 345W)

- ASTM A 595
- AISI 1015
- AISI 1020
- SAE: 1015

Ensure that the steel characteristics or strength do not change significantly from welding.

1. Shaft

   Use the appropriate shape of shaft which is a continuous taper and is constructed of corrosion resistant steel, unless otherwise specified, to the dimensions required for the specified classification type.

   Form the shaft from one piece with one electrically welded longitudinal joint and no intermediate horizontal joints.

2. Pole

   Use a pole with a mill certified yield strength of at least 48,000 psi (331 MPa). After forming and welding the pole, the shaft may be longitudinally cold rolled under enough pressure to flatten the shaft to conform to the required yield strength. For Type IV steel strain poles, ensure that the wall thickness is at least 3 gauge or 0.25 in. (6 mm).

3. Traffic Signal Strain Poles

   Assemble traffic signal strain poles as follows:

   a. Weld a handhole assembly, curved on the front to follow the contour of the pole, into the shaft near the base.
   b. Include a tapped hole on the handhole reinforcing frame to accommodate the grounding lug.
   c. Secure the cover to the frame using at least two screws.
   d. Weld a J-hook wire support inside near the top of the shaft for the poles.
   e. If an overhead power source is shown, use a clamp and clevis device to connect the wire to the pole and provide a weatherproof wire inlet close to the attachment. Conceal the other wiring to and from the controllers within the pole.

      For traffic signal strain poles with mounted controller cabinets, provide a 2 in. (50 mm) half coupling wire inlet to mount the controller cabinet on the designated pole. Ensure that the location where cable enters the wire inlets at the top of the traffic signal strainpoles has a neat design and appearance. Do not use junction boxes at the top of poles to facilitate cable entrances.

4. Grounding

   Provide a 0.5 in (13 mm) approved grounding connector in the shaft. Equip the top of the shaft with a removable cap held securely in place.

   Hot-dip galvanize the shaft according to ASTM A 123/A 123 M unless otherwise specified.

5. Base

   Secure to the lower end of the shaft a one-piece cast steel base or a one-piece flat plate base that meets the requirements of ASTM A 27, Grade 65-35/A27 M Grade 450-240, or A 36/ A 36 M, as required.

   a. Ensure that the base, after welding, develops the full strength of the adjacent shaft section to resist bending.
   b. Attach the base to the concrete foundation with four bolts according to this subsection.
   c. Provide four removable cast or pressed steel ornamental covers with each base and attach it to the base.

6. Anchor Bolts

   Furnish each pole with four anchor bolts of the size required in the manufacturer's Shop Drawings. Ensure that the anchor bolts meet the requirements of Subsection 852.2.02.

   Galvanize the threaded portions according to ASTM A 153/A 153 M and the Plan details.

B. Prestressed Concrete Strain Poles

Use shafts for these poles that comply with Subsection 865.2.01.B, except give the poles a steel trowel finish on the unformed side and any required pointing to eliminate air and water holes left by the steel forms. Use Class AAA concrete.

Use a marking tool to identify the pole class and height or cast it with a die in the front face of the pole to produce letters and numbers at least 2 in. (50 mm) high and wide.

C. Miscellaneous Hardware

Use hardware for steel and concrete strain poles with these features:

1. The steel required to fabricate other structural components is weldable and conforms physically and chemically to applicable ASTM specifications.
2. Nuts, bolts, and screws conform to these diameter requirements:
   - If diameters are less than 0.5 in. (13 mm), the hardware is passivated stainless steel that meets the requirements of AISI 300, commercial grade.
   - If diameters are 0.5 in. (13 mm) and larger, the hardware conforms to ASTM physical and chemical qualifications that ensure strength commensurate with the parts being connected. Galvanize the hardware according to ASTM A 153/A 153 M.
3. Use galvanized steel ground rods 5/8 in. (16 mm) diameter, ± 1/16 in., (± 1.6 mm) and 8 ft. (2.4 m) long unless otherwise specified.

   Ensure that galvanizing has a coating of at least 2 oz/ft.^{2} (610 g/m^2) according to ASTM A 153/A 153 M.

D. Strain Poles for ATMS Applications

Provide poles for supporting CCTV, VDS, and microwave radar detection devices that meet the following design specifications:

- Limited to a live horizontal deflection at the top equal to or less than 1% of pole height in a 50 mph wind, with a design load of four static cameras and one movable camera.
- Torsional deflection limited to a 1 degree, maximum.

Install mounting brackets, as illustrated on the plans, which are galvanized steel and are compatible with the mounting design of the specified cameras and pan/tilt devices and are affixed to the pole to prohibit rotation.

Install all wiring internal up to the camera mounting bracket with no external conduit on the pole.

Provide a weatherproof wiring access point or handhole on the pole.

639.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

639.3 Construction Requirements

639.3.01 Personnel

General Provisions 101 through 150.

639.3.02 Equipment

General Provisions 101 through 150.

639.3.03 Preparation

General Provisions 101 through 150.

639.3.04 Fabrication

General Provisions 101 through 150.

639.3.05 Construction

A. Timber Poles

Construct the following according to the plan:

1. Excavate the hole to the proper diameter and depth.
2. Erect the pole to an out-of-plumb position with its base resting on the bottom of the hole.

   Hold the pole in its out-of-plumb position until the cavity around the pole is filled with Class B or better concrete and is set and cured for at least 7 days. Then, apply tension to the pole.

B. Steel Poles

Construct the foundations for steel poles as follows:

1. Excavate a hole the size and depth shown on the plans. Remove and dispose of excavated material as directed by the Engineer.
2. Place the specified type and size anchor bolts according to the pole manufacturer's recommendations. Hold these securely by a template to ensure proper position in the completed foundation.

NOTE: Never attempt to realign the anchor bolts after pouring the foundation.

3. Place conduits in foundations, orient them to accommodate service cables, and securely hold them to avoid displacement.
4. Pour Class A concrete into the excavated area to the following depths:
   a. First pour against undisturbed earth up to 4 in. (100 mm) below the finished ground line.
   b. Then, using an approved form, continue to pour to the finished top of the foundation elevation, as specified.
5. Chamfer the top and formed portions of the foundation edges.
6. Give a Type III finish to all portions of the foundation above finished grade down to at least 2 in. (50 mm) below finished grade, according to Subsection 500.3.05.AB.4, *Type III—Special Surface Coating Finish*.

C. Prestressed Concrete Poles

Drill round holes or dig square holes for prestressed concrete poles.

1. Do not disturb the natural ground adjacent to the foundation more than necessary to construct the foundation.
2. Excavate to the lines and elevations shown on the Plans or established by the Engineer.
   a. Dispose of the excavated materials as directed.
   b. Regrade and grass the disturbed areas to match the contiguous area.
3. Backfill according to the Plans. Furnish and place Class A concrete, as required, according to the applicable portions of Section 500 and Plan details.
4. When leaving lifting eyes or loops on the pole to facilitate handling and erecting, burn them off and patch them after erecting.

D. Ground Rods

Install ground rods for steel and prestressed concrete strain poles adjacent to the strain pole base as follows:

1. Vertically drive the single ground rods 8 ft. (2.4 m) long until the top of the rod is at least 12 in. (300 mm) below the finished ground.
2. Use ground rod clamps to attach a length of No. 6 AWG solid copper wire to the ground rod. Connect the wire to the grounding nut of the strain pole base.

3. When penetration cannot be obtained in the above steps, place three parallel ground rods at least 6 ft. (1.8 m) center-to-center in a horizontal pattern and at least 12 in. (300 mm) below the finished ground.

   Join the rods and connect them to the grounding nut of the pole base with No. 6 AWG solid copper wire and ground rod clamps.

E. Rake

Use the proper rake to erect the pole so that the pole will be plumb after the load is applied.

F. Erecting Cable

Follow these steps to erect the cable:

1. Install the top cable 6 in. (150 mm) from the top of the pole, unless otherwise indicated on the plans.
2. Install the bottom cable no more than 5 ft. (1.5 m) from the top of the pole according to plan details.
3. Secure the cable to each pole as shown on the Plans. Use preformed cable grips instead of cable clamps, if necessary.
4. Apply enough tension to pull timber poles toward each other past the plumb position by one degree.

639.3.06 Quality Acceptance

General Provisions 101 through 150.

639.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

639.4 Measurement

Highway signs are measured and paid for under Section 636.

A. Treated Timber Poles

Treated timber poles of the class and length specified are measured by the number of units installed, including guys, anchors, and hardware.

B. Steel Cable

Steel cable of the specified size are measured by the linear foot (meter), complete in place.

C. Steel Strain Poles

Steel strain poles are classified and measured for payment by each unit and by type according to the following table:

Type	Span Length
I	Less than 60 ft. (18 m)
II	60 to 95 ft. (18 m to 29 m)
III	Greater than 95 ft. (29 m)
IV	Traffic signal strain pole

D. Prestressed Concrete Strain Poles

Prestressed concrete strain poles are measured for payment by each unit and pole type as specified in the above table.

639.4.01 Limits

General Provisions 101 through 150.

639.5 Payment

A. Treated Timber Poles

Treated timber poles of the class and length specified will be paid for at the Contract Price bid per each. Payment is full compensation for poles, concrete encasements, excavation for pole and anchor holes, temporary pole alignment, bracing, guys, and items to complete the Work.

B. Steel Strain Poles

Steel strain poles of the type specified, complete in place and accepted, including foundation, backfill, erection, and necessary re-grassing will be paid for at the Contract Unit price bid for each pole of each type.

C. Prestressed Concrete Strain Poles

Prestressed concrete strain poles of the type specified, complete in place and accepted, including foundation, backfill, erection, and necessary re-grassing will be paid for at the Contract Unit Price bid for each pole of each type.

When neither concrete nor steel strain poles are specified, either type is acceptable. Measurement is specified in Subsections 639.4.C. or 639.4.D. The payment item is Strain Poles, Type___.

D. Steel Cable

Steel cable complete in place and accepted will be paid for at the Contract Unit Price bid per linear foot (meter) of each specified diameter. Payment is full compensation for furnishing and erecting the cable and for providing hardware including thimbles, but not hardware that is a part of the pole.

Payment will be made under:

Item No. 639	Treated timber pole class___, __ ft. (m)	Per each
Item No. 639	Steel strain pole, type____	Per each
Item No. 639	Prestressed concrete strain pole, type___	Per each
Item No. 639	Strain Poles, Type___	Per each
Item No. 639	Steel strand wire cable___in. (mm)	Per linear foot (meter)

639.5.01 Adjustments

General Provisions 101 through 150.

Section 642—Cable Barrier

Replace Section 642 with the following:

642.1 General Description

This work includes furnishing and erecting cable barrier and appurtenances according to the Specifications. Conform to the lines, grades, and locations shown on the Plans or as directed.

Place cable barrier in accordance with manufacturer's recommendations.

Unless provided for on the plans, this work includes:

- Grading to construct approach slopes and set concrete line post foundations as shown on the plans and according to Section 205, Section 208, and Section 209.
- Furnishing and pouring concrete line post foundations according to Section 500.
- Furnishing and setting line posts, wire rope, and all necessary hardware for cable barrier and end terminals as specified by the Plans, Details, or the manufacturer's specifications and as approved by the Engineer.
- Conducting installation and maintenance training prior to the installation of the system.
- Conducting soil analysis at each cable terminal location to properly size each end terminal.

642.1.01 Definitions

General Provisions 101 through 150.

642.1.02 Related References

A. Standard Specifications

Section 205 – Roadway Excavation

Section 208 – Embankments

Section 209 – Subgrade Construction

Section 500 – Concrete Structures

Section 645 – Repair of Galvanized Coatings

Section 700 – Grassing

Section 870 – Paint

Section 913 – Reflectorizing Materials

B. Referenced Documents

General Provisions 101 through 150.

National Cooperative Highway Research Program Report 350 (NCHRP 350).

642.1.03 Submittals

- General Provisions 101 through 150.

- Provide the FHWA approval letters for NCHRP 350 compliance for cable barrier system, terminals.
- Provide manufacturer's drawings for all components proposed for installation.
- Submit material specifications and technical data information on all materials proposed for use on the project to the Engineer.
- Written approval from the State Design Policy Engineer is required prior to installing or constructing any part of the cable barrier system.

642.2 Materials

A. Cable Barrier System

Install a pre-stressed wire rope cable barrier system which has been tested to National Cooperative Highway Research Program (NCHRP) Report 350 Test Level 4 (TL- 4), has also been tested to NCHRP TL- 3 on 4H:1V slopes, and has received FHWA eligibility letters for these tests. Provide high-tension, four-strand cable rail. Install all system materials and components, including wire rope, fittings, posts, reflectorized spacers or post caps, debris caps, cable-to-barrier transitions, and terminals according to the manufacturer's specifications and details. All material must be fully galvanized after fabrication in accordance with ASTM A-123.

B. Concrete

Concrete for line post foundations, cable terminals, and mow strip shall be Class "A" concrete meeting the requirements of Section 500. Give a Type II finish as defined in Subsection 500.3.05.AB, "Finish Concrete" unless otherwise noted on the Plans. Test the surface with a 10 ft (3 m) straightedge laid parallel to the center line. Eliminate irregularities greater than 0.25 in (6 mm) per 10 ft (3 m) while the concrete is still plastic.

Thicknesses are subject to a minus tolerance of 0.5 in (13 mm). Do not perform overlay pours.

C. Training Materials

Provide twenty (20) installation manuals and other materials deemed necessary to conduct training for proper installation and maintenance of the cable barrier system.

642.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

642.3 Construction Requirements

642.3.01 Personnel

General Provisions 101 through 150.

642.3.02 Equipment

General Provisions 101 through 150.

642.3.03 Preparation

General Provisions 101 through 150.

642.3.04 Fabrication

A. Line Posts, Wire Rope, Fittings

Fabricate and install line posts, wire rope, fittings, and other appurtenances according to the Plans, Details, the manufacturer's specifications, or as approved by the Engineer.

B. System Components

All components (i.e., cable barrier terminal, longitudinal cable barrier) of the cable barrier system shall be from one manufacturer. There shall be no intermixing of components from different manufacturers. Additionally, there shall be no mixing of parts from different systems from the same manufacturer unless such parts are common to multiple systems.

642.3.05 Construction

A. Erection of Line Posts

1. Grade slopes between cable barrier location and adjacent travel lane to 4:1 or flatter according to the requirements of Section 210.
2. Grading is not required when existing approach to cable barrier is 4:1 or flatter.
3. Prepare the subgrade surface according to the requirements of Section 209.
4. Pour line post foundations and concrete mow strip, setting line post sleeves for each line post foundation at the positions, depth, spacing, and alignment shown on the plans or the manufacturer's specifications and according to the requirements of Section 500.
5. After curing of the line post foundations, set line posts in the line post sleeves, paying close attention to the horizontal and vertical alignment of the posts. Posts must be set to achieve the proper wire rope height. Posts and foundations not set at the proper line and grade shall be replaced prior to installation of the wire rope.
6. Post spacing shall be no less than 10 feet and no greater than 15 feet.
7. Provide a system with a maximum allowable deflection of nine feet.
8. Install reflectors in accordance with manufacturer's system details no greater than 100 feet apart. Reflectors must be an integral part of the system. No separate posts shall be installed. The diameter or length and width of the reflectors must be 3 inches or greater.
9. Install caps or other manufacturer-approved parts designed to prevent debris from entering each socketed foundation.

B. Erection of Transitions and End Terminals

1. Conduct a soil analysis at each end terminal location and size each end terminal according to the manufacturer's recommendations.
2. Install terminals according to the Plans, Details, the manufacturer's specifications, or as approved by the Engineer.
3. Install end terminals meeting the requirements of NCHRP 350 TL-3. Provide copies of the manufacturer's details and installation instructions to the Engineer prior to installation of the unit. Provide the FHWA approval letter for NCHRP 350 TL- 3 compliance of the assembly to be used. End terminals must provide a separate connection for each cable.
4. Install cable barrier to guardrail transitions at locations indicated on the plans. Transitions must meet the requirements of NCHRP 350 TL-3. Elimination of cable to guardrail transitions requires prior written approval of the State Design Policy Engineer.

C. Install and Tension Wire Rope

1. Install wire rope at the proper height according to the Plans, Details, the manufacturer's specifications or as approved by the Engineer.
2. Tension wire rope immediately after initial installation.
    a. Recheck and adjust tension per the manufacturer's recommendations.

b. Maintain a tension log showing time, date, location, cable temperature, and final tension reading, signed by the person performing the tension reading. Give the log to the Engineer after tensioning is completed, along with the manufacturer's recommended tensioning chart.

3. Wedges may be used only once per cable run.

D. Damaged Spelter Coating

Repair damaged spelter coating according to the requirements of Section 645.

E. Installation and Maintenance Training and Certification

Provide installation and maintenance training and certification by the manufacturer of the system within two weeks of installing the first run of cable.

a. Provide a minimum of four hours of classroom instruction on the installation and maintenance of the system. This training shall be provided in a location central to the project and the local GDOT District Office. The scheduling and location of this training shall be established to maximize participation of all personnel listed in 642.3.05.E.d approved by the Engineer.

b. Provide on-site field instruction by the manufacturer of the system, ideally using a minimum 2000 foot section of the system. The amount of this training will be as necessary to provide field training on all aspects of the system installation, including grading, line post installation, wire rope installation and tensioning, and terminal installation.

c. Provide certification by the manufacturer of the system for the participants of the training. This certification shall require participants to pass a written examination given by the manufacturer of the system. The installation contractor must have certified personnel on site at all times during the installation of the system.

d. Provide the training and certification as required by 642.3.05.E.a,b,c for a maximum of twenty participants, to include the following:

- Prime Contractor and installation subcontractor
- GDOT Personnel including Construction, Maintenance, Traffic Operations, and HERO Operators, if applicable
- FHWA representative when system installed on Federal Aid Projects
- Emergency responders who serve the project area, including wrecker operators, law enforcement, fire, and emergency medical personnel

642.3.06 Quality Acceptance

General Provisions 101 through 150.

642.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

642.4 Measurement

A. Cable Barrier

Cable barrier is measured in linear feet (meters). Measurement does not include terminals or transitions from cable barrier to guardrail.

B. Terminals, including transitions from cable barrier to guardrail

This item is measured by the actual number of each type installed according to the Plans.

642.4.01 Limits

General Provisions 101 through 150.

642.5 Payment

Cable barrier, complete in place including posts, foundations, mow strip, reflectors, debris caps and hardware will be paid for at the Contract Price per linear foot (meter). Payment for cable barrier shall include the cost of training materials, installation training, and maintenance training as specified in Section 642.

Terminals will be paid for at the Contract Price per each assembly, complete in place.

Payment will be made under:

Item No. 642	Cable Barrier	Per linear foot (meter)
Item No. 642	Cable Terminal (NCHRP 350 TL-3 compliant)	Per each

642.5.01 Adjustments

General Provisions 101 through 150.

Section 657—Preformed Plastic Pavement Markings

Replace Section 657 with the following:

657.1 General Description

This work includes placing plastic pavement markings or legends according to the plans and specifications or as otherwise directed.

657.1.01 Definitions

General Provisions 101 through 150.

657.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

ASTM D 638

ASTM D 4061

ASTM D 4505

ASTM D 4592

ASTM E 274

ASTM E 303

ASTM E 1710

ASTM E 2177

US EPA Method 3052

US EPA Method 6010C

Manual on Uniform Traffic Control Devices for Streets and Highways

Federal Test Standard 141, Method 6192

QPL 74

SOP 39

657.1.03 Submittals

Transfer to the Department manufacturer warranties or guarantees for heat-applied and wet reflective preformed plastic marking materials. Ensure that warranties or guarantees state that they are subject to transfer.

657.2 Materials

Select one of the following types of preformed marking material according to the plans and proposal:

- Type TR – Temporary Removable Plastic Marking

- Type TN – Temporary Non-Removable Plastic Marking
- Type PA – Permanent Plastic Marking
- Type PB – Permanent Patterned Plastic Marking
- Type PB-WR – Permanent Patterned Wet Reflective Plastic Markings

For a list of sources, see QPL-46.

A. General Requirements for Preformed Pavement Markings

1. Shapes and Sizes

Use markings that conform to the shapes and sizes outlined in the Manual on Uniform Traffic Control Devices for Streets and Highways.

2. Pigmentation

Use white or yellow pigmented plastic according to each marking type.

3. Adhesion

Use markings that can be affixed to bituminous or Portland cement concrete pavements by pressure-sensitive precoated adhesive or a liquid contact cement.

Ensure that marking adhesive adheres to the roadway under normal climactic and traffic conditions.

4. Conformability

Use markings that will mold to pavement contours, breaks, faults, and the like, by normal action of traffic at normal pavement temperatures.

5. NTPEP Evaluation

Use markings evaluated by the National Transportation Product Evaluation Program (NTPEP).

6. Glass Spheres and/or Reflective Composite Optics

Use markings with a layer of glass spheres and/or reflective composite optics bonded to the surface according to the marking type. Type PB and PB-WR contain glass beads and/or reflective composite optics. Types TR, TN, and PA contain only glass beads.

Do not use glass spheres and /or reflective composite optics containing greater than 200 ppm total arsenic, 200 ppm total antimony, or 200 ppm total lead when tested according to US EPA Methods 3052 and 6010C, or other approved methods.

Use glass spheres with less than 2% by weight showing any milkiness, scoring or scratching. Use clear, transparent spheres that are free from air inclusions and conform to the following:

	Glass Spheres
Refractive Index, (tested by oil immersion)	1.50 minimum
Uniform Distribution of Spheres	0.75 minimum

7. Reflective Intensity (Types TR, TN and PA)

Determine reflective intensity in accordance with ASTM D4061 or E1710.

Ensure that marking types TR, TN, and PA use white or yellow film with the initial reflective intensity indicated in the table below, when measured at the angles shown.

	White	Yellow
Observation Angle	1.05°	1.05°
Entrance Angle	88.8°	88.8°
Reflective Intensity – Millicandelas per square meter per lux	500	300

8. Composition

Use markings made of high-quality polymeric materials and pigments. Ensure types TR and PA contain the following composition of materials:

Material	Min% By Weight
Resins and Plasticizers	20
Pigments	30
Graded Glass Spheres	33

B. Requirements for Temporary Markings (Types TR and TN)

1. Temporary Removable Markings (Type TR)

Use temporary, removable markings that meet the following requirements:

a. Removability

Ensure the marking material can be removed from asphaltic and Portland cement as follows:

- Lifted intact or in large pieces.
- Lifted either manually or with a roll-up device.
- Lifted at temperatures above 40 °F (5 °C) without using heat, solvents, sand blasting, or grinding.

Ensure the pavement shows no objectionable staining or damage after removing the marking.

b. Elongation and Tensile Strength

Elongation	50% maximum
Tensile Strength	40 lbs./in.^{2} (275 kPa) minimum

Test as follows:

1) Cut a 1 in. by 6 in. (25 mm by 150 mm) specimen.

2) Test at a temperature between 70 °F and 80 °F (21 °C and 27 °C).

3) Test at a jaw speed of 12 in./min (300 m/min).

c. Adhesion

Ensure that temporary marking material meets the adhesion requirements of ASTM D4592.

d. Glass Sphere Retention

Confirm the glass Sphere retention quality of marking material in both of the following ways:

1) Laboratory Test

- Take a 2 in. by 6 in. (50 mm by 150 mm) sample.
- Bend the sample over a ½ in. (13 mm) diameter mandrel, leaving the 2 in. (50 m) side perpendicular to the mandrel axis.
- Ensure that the area on the mandrel shows no more than 10 percent of the beads entrapped by the binder less than 40 percent.

2) Field test

Ensure the Spheres cannot be easily removed by scratching the material firmly with the thumbnail.

e. Skid Resistance

Ensure that the material surface provides a 35 BPN minimum skid resistance value when tested according to ASTM E 303.

f. Thickness

Ensure that the removable marking material is at least 20 mils (0.50 mm) thick not including the backing adhesive.

2. Temporary Non-Removable markings (Type TN)

This type of pavement marking may use a conformable metallic foil backing with a precoated pressure-sensitive adhesive. Skid Resistance

a. Ensure the retroreflective pliant polymer surface provides a skid resistance value of at least 35 BPN. Test according to ASTM E 303.

b. Elongation and Tensile Strength

No test for elongation and tensile strength is required for type TN marking.

c. Glass Sphere Retention

Refer to Subsection 657.2.B.1.d, *Glass Sphere Retention*.

d. Thickness

Ensure the nonremovable marking material is at least 20 mils (0.50 mm) not including the adhesive backing.

C. Requirements for Permanent Markings (Types PA, PB and PB-WR)

1. Permanent Plastic Marking (Type PA)

Provide permanent plastic markings with these features:

a. Adhesive and Backing

Use markings supplied with the following:

- A precoated adhesive
- An easily removable backing to protect the adhesive
- An adhesive backing that allows repositioning of the marking on the surface before permanently sticking with greater pressure

In addition, supply rolls of lane lines with a precoated adhesive but without the protective backing material.

b. Pigments

1) White

Use white marking material meeting the initial color requirements of ASTM D4505.

2) Yellow

Use yellow marking material meeting the initial color requirements of ASTM D4505.

3) Appearance

Ensure that each marking meets the following appearance standards:

- Markings are extruded to a uniform thickness.
- Edges are smoothly cut and true.
- Glass spheres are retained on all sides by the plastic base material.
- The wearing surface is free of indentations, displaced spheres, or other irregularities that retain dirt, dust, or other foreign materials.
- Black portions of contrast tapes should be non-reflective under daytime and nighttime lighting conditions and industry standard for black. Black is not considered to be a color just a contract enhancer when used in conjunction with markings utilizing the standard colors (MUTCD Section 3A.05 Colors).

c. Thickness

Ensure the permanent material is at least 60 mils (1.52 mm) thick, without the pre-coated adhesive.

d. Glass Sphere Retention

Confirm that the surface glass spheres are strongly bonded and are not easily removed by traffic. Test them as follows:

1) Use a Taber Abraser with an H-18 wheel and 125-gram load.
2) Inspect the sample at 200 cycles under the microscope to observe the extent and type of bead failure.
3) Ensure that no more than 15 percent of the spheres have popped-out.
4) Verify that the predominant mode of failure is “wear-down” of the spheres.

e. Tensile Strength and Elongation

Ensure that the permanent markings have the following elongation and tensile strength when tested according to ASTM D 638:

Elongation	50% maximum
Tensile Strength	150 psi (1035 kPa) minimum

Test as follows:

NOTE: Run this test 3 times and base the result on an average of the 3 tests.

1) Cut 3 specimens, 1 in. by 6 in. (25 mm by 150 mm) each.
2) Place 1 in.^{2} (625 mm^2) of carborundum extra-coarse emery cloth or its equivalent at each end of the test specimens to prevent the adhesive from sticking to test equipment.
3) Test at a temperature between 70 ° and 80 °F (21° and 27 °C).
4) Test at a jaw speed of 10 to 12 in./min (250 mm to 300 mm/min).

f. Skid Resistance

Test the plastic surface to verify that it provides a skid resistance value of at least 45 BPN. Test according to ASTM E 303.

g. Adhesive

Ensure permanent markings meet the adhesion requirements of ASTM D4505.

2. Permanent Patterned Plastic Marking (Type PB)

Use patterned plastic markings with these features:

a. Patterned Surface

Ensure that the patterned surface has the following characteristics:

A reflective layer of glass spheres and/or reflective composite optics bonded to a durable polyurethane topcoat.

The raised area comprises approximately 40% ± 15% of the total marking face.

The surface presents a near vertical face (β angle of 0o to 60o) to traffic from any direction.

The Office of Materials and Research approves the pattern configuration.

The channels between raised areas are free of exposed beads or particles.

b. Adhesive and Backing

Refer to Subsection 657.2.C.1.a, *Adhesive and Backing*.

c. Pigments

Refer to Subsection 657.2.C.1.b, *Pigments*.

d. Glass Spheres and Reflective Composite Optics

Ensure that the top layer of glass spheres and/or reflective composite optics are bonded to a durable polyurethane surface.

e. Thickness

Ensure the permanent material is at least 60 mils (1.52 mm) thick at the thickest portion of the patterned cross-section, and at least 20 mils (0.508 mm) at the thinnest portion of the cross-section.

f. Tensile Strength and Elongation

Refer to Subsection 657.2.C.1.e, *Tensile Strength and Elongation*.

g. Skid Resistance

Refer to Subsection 657.2.C.1.f, *Skid Resistance*.

h. Dry Reflective Intensity

Determine reflective intensity in accordance with ASTM D 4061 or E1710. Initial minimum dry reflective values are as follows:

	White	Yellow
Observation Angle	1.05°	1.05°
	White	**Yellow**
Entrance Angle	88.8°	88.8°
Reflective Intensity – Millicandelas per square meter per lux	600	400

3. Permanent Patterned Wet Reflective Plastic Marking (Type PB-WR)

Use patterned plastic markings with these features:

a. Patterned Surface

Ensure that the patterned surface has the following characteristics:

- A reflective layer of glass spheres and/or reflective composite optics bonded to a durable polyurethane topcoat.

  The raised area comprises approximately 40% ± 15% of the total marking face.

  The surface presents a near vertical face (β angle of 0o to 60o) to traffic from any direction.

  The Office of Materials and Research approves the pattern configuration.

  The channels between raised areas are free of exposed beads or particles.

b. Adhesive and Backing

Refer to Subsection 657.2.C.1.a, *Adhesive and Backing*.

c. Pigments

Refer to Subsection 657.2.C.1.b, *Pigments*.

d. Glass Spheres Beads and Reflective Composite Optics

Ensure that the top layer of glass spheres and/or reflective composite optics are bonded to a durable polyurethane surface.

e. Thickness

Ensure the permanent material is at least 60 mils (1.52 mm) thick at the thickest portion of the patterned cross-section, and at least 20 mils (0.508 mm) at the thinnest portion of the cross-section.

f. Tensile Strength and Elongation

Refer to Subsection 657.2.C.1.e, *Tensile Strength and Elongation*.

g. Skid Resistance

Refer to Subsection 657.2.C.1.f, *Skid Resistance*.

h. Dry Reflective Intensity

Determine reflective intensity in accordance with ASTM D 4061 or E1710. Initial minimum dry reflective values are as follows:

	White	Yellow
Observation Angle	1.05°	1.05°
Entrance Angle	88.8°	88.8°
Reflective Intensity – Millicandelas per square meter per lux	600	400

i. Wet Reflective Intensity

Determine wet reflective intensity in accordance with ASTM E2177.
Ensure that markings meet the following initial minimum wet retroreflective intensity.

	White	Yellow
Divergence Angle	1.05°	1.05°
Incidence Angle	88.8°	88.8°
Reflective Intensity --Millicandelas per square meter per lux	250	200

657.3 Construction Requirements

General Provisions 101 through 150.

657.3.01 Personnel

Send a factory-trained representative from the material manufacturer to the jobsite at the start of each project.

657.3.02 Equipment

General Provisions 101 through 150.

657.3.03 Preparation

General Provisions 101 through 150.

657.3.04 Fabrication

General Provisions 101 through 150.

657.3.05 Construction

Remove existing pavement markings according to Subsection 653.3.05.B, *Removing Existing Stripe*.

A. Pre-Conditions for Applying Markings (Types PB and PB-WR)

1. Meet the following conditions before applying markings onto new asphaltic pavements:
    - The ambient temperature is 40 °F (4 °C) and rising.
    - New asphaltic pavement temperature is at least 120 °F (49 °C).
    - The plastic can be applied to new asphaltic pavement immediately before the new surface is rolled for the final time.
    - Conventional steel rollers and water used with them do not impede the plastic’s application.
2. Meet the following conditions before applying markings onto all pavements:
    - The ambient temperature is 40 °F (4 °C) and rising.
    - The pavement temperature is at least 40 °F (4 °C) and rising.
    - The previous night temperature did not fall below 40 °F (4 °C).
    - No significant rainfall occurred 24 hours prior to the plastic’s application.

B. Pre-Conditions for Applying Markings (Types TR, TN, and PA)

1. Meet the following conditions before applying markings onto new asphaltic pavements:
    - The ambient temperature is 60 °F (15 °C) and rising.
    - New asphaltic pavement temperature is at least 120 °F (49 °C).
    - The plastic can be applied to new asphaltic pavement immediately before the new surface is rolled for the final time.
    - Conventional steel rollers and water used with them do not impede the plastic’s application.
2. Meet the following conditions before applying markings onto all pavements:
    - The ambient temperature is 60 °F (15 °C) and rising.
    - The pavement temperature is at least 70 °F (21 °C) and rising.
    - The previous night temperature did not fall below 40 °F (4 °C).
    - No significant rainfall occurred 24 hours prior to the plastic’s application.

C. Remove Existing Stripe

Remove at least 90% of existing traffic stripe under either of the following conditions:

- On Portland cement concrete pavement where the new stripe is to be placed at the same location as the existing marking

- On all pavements where the new stripe is to be placed at a location different from the existing marking

D. Applying Markings

Apply markings as follows:

1. Thoroughly clean the pavement. Clean with compressed air, hand brooms, rotary brooms, scrapers, or other approved methods which leave the pavement thoroughly clean and undamaged. Remove all vegetation and road film from the area to be striped. Mechanically wire brush or abrasive blast clean all new Portland cement concrete pavement surfaces to remove all laitance and curing compound from the area to be striped.
2. Apply an adhesive activator according to the manufacturer's recommendations, when required.
3. Position markings according to the plans.
4. Press positioned markings firmly onto the pavement.
5. Offset longitudinal lines at least 2 in. (50 mm) from construction joints of Portland cement concrete pavements.

E. Tolerances and Appearance

1. Cut off all stripe ends squarely and cleanly.
2. The length of the 10 ft. (3 m) segment for skip stripe and the 30 ft. (9 m) gap between segments may vary plus or minus 1in. (25 mm). Do not allow the alignment of skip stripe to deviate from the intended alignment by more than 0.5 in. (13 mm). Do not allow the alignment of edge stripe to deviate from the intended alignment by more than 0.5 in. (13 mm) on tangents and on curves with a radius up to and including one degree. Do not allow the alignment of edge stripe to deviate from the intended alignment by more than 1 in. (25 mm) on curves exceeding one degree.
3. Stop work when deviation exceeds the above dimensions and remove the nonconforming stripe.

657.3.06 Quality Acceptance

A. General

Segments of preformed plastic traffic stripe that have been placed according to the plans and specifications may be accepted 30 days after the required work is complete in that segment. If Preformed Plastic Traffic Stripe fails to meet plan details or specifications or deviates from stated dimensions, correct it at no additional cost to the Department. If removal of pavement markings is necessary, perform it according to Section 656 and replace it according to this Specification. No additional payment will be made for removal and replacement of unsatisfactory striping.

Obtain pavement marking retroreflectivity values with a 30-meter geometry retro-reflectometer.

B. Initial Retro-reflectivity

1. Longitudinal Lines

   Within 30 days of installation, ensure the in-place markings meet the following minimum reflectance values:

   a. Type PB

	White	Yellow
Dry (ASTM E 1710)	600 mcd/lux/m^2	400 mcd/lux/m^2

   b. Type PB-WR

	White	Yellow
Dry (ASTM E 1710)	600 mcd/lux/m^2	400 mcd/lux/m^2
Wet recovery (ASTM E 2177)	250 mcd/lux/m^2	200 mcd/lux/m^2

For each center line, edge line, and skip line, measure retro-reflectivity 9 times for each mile; 3 times within the first 500 ft. (152 m), 3 times in the middle, and 3 times within the last 500 ft. (152 m). For projects less than one mile in length, measure retro-reflectivity 9 times as above.

Record all retro-reflectivity measurements on the form OMR CVP 66 in SOP 39.

2. Messages, Symbols, and Transverse Lines

Within 30 days of installation, ensure both Type PB and Type PB-WR in-place markings when tested according to ASTM E 1710 meet the following minimum reflectance value of 600 mcd/lux/m2.

Perform at a minimum, one retro-reflectivity measurement at one message, one symbol and one transverse line per intersection. Take one measurement per mile for locations other than intersections (i.e. school messages, railroad messages, bike symbols etc.)

C. Six Month Retro-reflectivity (Longitudinal Lines)

Maintain the following minimum reflectance values for 180 days after installation:

1. Type PB

	White	Yellow
Dry (ASTM E 1710)	600 mcd/lux/m^2	400 mcd/lux/m^2

2. Type PB-WR

	White	Yellow
Dry (ASTM E 1710)	600 mcd/lux/m^2	400 mcd/lux/m^2
Wet recovery (ASTM E 2177)	250 mcd/lux/m^2	200 mcd/lux/m^2

Retest the in-place markings according to Subsection 657.3.06.B.1 180 days after installation to ensure these minimum retro-reflectance values are maintained.

NOTE: The Contractor is responsible for retro-reflectivity testing. Furnish initial test results to the Engineer within 30 days of application. Furnish 6-month test results to the Engineer within 180 days of application or prior to final acceptance, whichever comes first.

D. Corrective Work

For each mile section, if preformed plastic pavement marking traffic stripe fails to meet plan details or specifications or deviates from stated dimensions, correct it at no additional cost to the Department. If removal of pavement markings is necessary, perform it according to Section 656 and place it according to this specification. No additional payment will be made for removal and replacement of unsatisfactory striping. Ensure corrective work is completed at no additional cost to the Department. Perform testing according to this specification. Any retest due to failures will be performed at no additional cost to the Department. Furnish all test reports to the Department.

Retro-reflectivity Longitudinal Line Deficiency: A deficiency will ensure when two or more Location Average results as recorded on form OMR CVP 66 within a One-Mile Section do not meet the performance criteria herein. The entire line within this one-mile section will be determined to be deficient. If the evaluated section is less than 1.0

mile, a single Location Average result not meeting the performance criteria herein will result in the entire line to be determined to be deficient.

Retro-reflectivity Transverse Markings and Symbol Deficiency: A single Location Average result on the marking or symbol not meeting the performance criteria herein will result in the marking or symbol to be determined to be deficient.

657.3.07 Contractor Warranty and Maintenance

A. Warranties

Transfer all warranties or guarantees normally furnished by the manufacturer to the Department. Include a provision that warranties are subject to transfer. Warrant Type PB and Type PB-WR Plastic Markings to adhere to the pavement and to provide a minimum (ASTM E 1710) dry coefficient of retroreflection of 100 mcd/lux/m^2 when measured using a 30-meter geometry retro-reflectometer for a period of at least 6 years for longitudinal markings and at least 2 years for intersection markings and symbols under normal traffic conditions.

B. Maintenance

Use the following according to manufacturer's instructions to ensure effective marking performance:

- Solvents or adhesives
- Appropriate equipment
- Recommendations for application

657.4 Measurement

Preformed plastic pavement markings complete in place and accepted are measured as follows:

A. Solid Traffic Stripe

Solid stripe is measured by the linear foot (meter) or linear mile (kilometer) as specified. Breaks or omissions in solid lines and stripes at street or road intersections are not measured for payment.

B. Skip Traffic Stripe

Skip stripe is measured by the gross linear foot (meter) or gross linear mile (kilometer) as specified. The unpainted spaces between the stripes are included in the overall measurement, if the plan ratio is not interrupted. Measurement begins and ends on a stripe.

C. Payment by Square Yard (Meter)

When preformed pavement markings are paid for by the square yard (meter), the number of square yards (meters) covered is measured. The space between the markings is included in the overall measurement. The color, width, and type are according to the plans.

D. Preformed Plastic Word or Symbol

Each preformed plastic word or symbol, complete according to plan dimensions, is measured by the unit. The code for each word or symbol is stated in the plans.

E. Removing Existing Pavement Markings

Measurement and payment for removing pavement markings will be according to Section 656 when shown in the proposal as a payment Item. Otherwise, removal will not be paid for separately, but will be included in the payment for other work under this Section.

657.4.01 Limits

General Provisions 101 through 150.

657.5 Payment

Payment in each case is full compensation for applying markings, including adhesives, cleaning, application, and traffic control necessary to complete the Item.

Payment will be made under:

Item No. 657.	Preformed plastic solid pavement markings_____ in. (mm), (color), (type)	Per linear foot (meter)
Item No. 657.	Preformed plastic solid pavement markings_____ in. (mm), (color), (type)	Per linear mile (kilometer)
Item No. 657.	Preformed plastic skip pavement markings_____ in. (mm), (color), (type)	Per gross linear foot (meter)
Item No. 657.	Preformed plastic skip pavement markings_____ in. (mm), (color), (type)	Per gross linear mile (kilometer)
Item No. 657.	Preformed plastic pavement markings	Per square yard (meter)
Item No. 657.	Preformed plastic pavement markings, words or symbols (color), (type)	Per each
Item No. 657.	Wet reflective preformed solid pavement markings_____ in. (mm), (color), (type)	Per linear foot (meter)
Item No. 657.	Wet reflective preformed solid pavement markings_____ in. (mm), (color), (type)	Per linear mile (kilometer)
Item No. 657.	Wet reflective preformed skip pavement markings_____ in. (mm), (color), (type)	Per gross linear foot (meter)
Item No. 657.	Wet reflective preformed skip pavement markings_____ in. (mm), (color), (type)	Per gross linear mile (kilometer)
Item No. 657.	Wet reflective preformed pavement markings	Per square yard (meter)
Item No. 657.	Wet preformed pavement markings, words or symbols (color), (type)	Per each

657.5.01 Adjustments

General Provisions 101 through 150.

Section 702—Vine, Shrub, and Tree Planting

Replace Section 702 with the following:

702.1 General Description

This work includes furnishing and planting vines, shrubs, trees and plants, treating regenerated areas, and environmental mitigation planting for riparian buffers and tidal marsh areas.

702.1.01 Definitions

General Provisions 101 through 150.

702.1.02 Related References

A. Standard Specifications

Section 108—Prosecution and Progress

Section 214—Mitigation Site Construction

Section 700—Grassing

Section 882—Lime

Section 891—Fertilizers

Section 893—Miscellaneous Planting Materials

B. Referenced Documents

Standardized Plant Names

ANSI A300 Part 1 Pruning Standards

ANSI Z60.1 American Standards for Nursery Stock

702.1.03 Submittals

A. Certificates of Inspection

Submit certificates of inspection with the invoice for each shipment of plants as required by law for transportation.

File certificates with the Engineer before the material is accepted. Plants may be rejected at the site regardless of Federal or State government inspections at the place of growth.

B. Substitutions

When both primary and alternate plants are specified, use the alternate only after providing written proof that the primary plants specified are not available. In this case a Supplemental Agreement is not required to use the alternate plants.

When a primary or an alternate plant cannot be furnished, provide the Engineer written proof that neither is available. A Supplemental Agreement is required for substitute plants in this case.

Use approved substitute plants, as designated by the Engineer, equal in value to specified plants. Request substitutions at least thirty (30) days before the end of the planting season in the area.

702.2 Materials

Ensure that materials meet the requirements of the following specifications:

Material	Section
Water	700.2.B
Agricultural Lime	882.2.01
Fertilizers	891.2.01
Plant Topsoil	893.2.01
Landscape Mulch	893.2.02
Vines, Shrubs, Trees, and Miscellaneous Plants	893.2.03
Tree Paint	893.2.06
Prepared Plant Topsoil	893.2.07
Stakes	893.2.08
Organic Soil Additives	893.2.09

A. Plant Specifications

Furnish plants according to the plant name and specifications included on the plan sheets.

1. Plant Names

   Ensure that the botanical and common names of plants specified conform to the most current edition of Standardized Plant Names, as adopted by the American Joint Committee on Horticultural Nomenclature.

2. Plants should be clearly labeled at the nursery. Labels should remain on the plants until inspected by the engineer.

3. Grades

   Ensure that plants meet the grade requirements of the most current American Nursery and Landscape Association ANSI Z60.1 and any other requirements.

   Caliper used for establishing plant grades or trunk sizes is measured according to the American Nursery and Landscape Association ANSI Z60.1. Plant trees with straight stems and symmetrical branches according to their natural growth. Trees with broken or damaged terminal or main stems will be rejected. There shall be a single dominant leader to the top of the all large canopy shade trees. There can be a double leader in the top 10% of the tree height.

   Trees should be rooting into the root ball so that soil or media remains intact and trunk and root ball move as one when lifted, but not root bound. The trunk should bend when gently pushed and should not be loose so it pivots at or below the soil line.

   There shall be no roots greater than 1/10 diameter of the trunk circling more than one-third the way around in the top half of the root ball. Roots larger than this may be cut provided they are smaller than one-third the trunk diameter.

   The leaf-bearing crown should be full and uniform. Leaves should show no evidence of chlorosis, necrosis, disease or insect infestation.

4. Ensure that all plants supplied for this project are grown in Georgia. Provide documentation from supplier indicating source of plants.

B. Bare root seedlings

Use nursery-grown bare root seedlings which are a minimum of three (3) ft. (1 meter) in height above the ground with a 1/4 in. (6.35mm) caliper, and a minimum primary root length of five in. (5) unless specified differently on the plan drawings.

Use approved substitute plants, as designated by the Engineer, equal in value to specified plants. Request substitutions at least 30 calendar days before the end of the planting season in the area. Wet swale bare root *Juncus effuses* shall be fresh divisions with a full, dense root base.

C. Nursery Plants

Unless otherwise specified, use plants stock-grown in a licensed nursery under intensive care and cultivation for at least one year. The largest branches of shade trees should be spaced at least 6 inches apart. The branch system shall be normally developed and free of disease, injurious insects, disfiguring knots, sun-scald, injuries, bark abrasions, dead or dry wood, broken terminal growth, or other disfigurements. Stems should show no evidence of die-back. Ensure that proper certificates of inspection and a complete list of the nursery growers accompany nursery grown plants. See Subsection 893.2.03.

D. Approval and Selection of Materials and Work

Select materials and execute operations required under the specifications and drawings with the approval of the Engineer. Remove rejected materials from the site promptly.

702.2.01 Delivery, Storage, and Handling

A. Bare-Rooted Plants

Protect bare root plants from drying out until planted. Uncovered roots without moisture-loss gel coating shall be exposed to air no longer than 15 minutes.

B. Balled and Burlapped Plants (B&B)

1. Burlap shall be a natural biodegradable material. Do not use synthetic burlap.
2. Replace plants rejected because of broken or loose balls, or balls of less diameter than that specified.
3. Protect the roots of balled and burlapped plants from moisture loss, unless they are planted immediately after they are delivered.
4. Plants shall be harvested with the ball of earth in which they are growing intact.

C. Container-Grown Plants

Keep container-grown plants moist but well drained until planted. Handle plants by the container or soil ball and not by the top growth.

D. Heeled-in Plants

Properly maintain heeled-in plants until they are planted. Do not allow plants to remain heeled-in over the summer or for over 30 days without the Engineer's consent.

E. Injury Prevention

Injured plants will be rejected. Protect tops of shrubs and trees while in transit to prevent windburn.

F. Live Willow Stake Material

Live stakes shall be moistened, capable of rooting, without injury and stripped of all stems and leaves with a minimum of scarring. The stakes shall be from 5 to 8 ft. (1.5m to 2.4m) in length with a basal end of 0.5 to 1.5 in. (1.27cm to 3.8cm) in diameter. The top ends shall be blunt and cut square and the butt ends angled.

702.3 Construction Requirements

702.3.01 Personnel

General Provisions 101 through 150.

702.3.02 Equipment

General Provisions 101 through 150.

702.3.03 Preparation

A. Inspect Plant Material before Digging

The Engineer will inspect trees or plants from the bidder's source for acceptability and conformity to specification requirements for approval by the Engineer. When rejecting the trees or plants, the Engineer reserves the right to pursue and examine other sources of plants to find acceptable specimens. This change will not constitute an increase in cost to the State.

B. Clear and Grub

Clear and grub the planting area before planting or beginning to prepare the plant bed, unless noted differently on the plans. See Section 201.

C. Prepare Plant Bed

Prepare for planting as follows:

1. Planting Limits

   Stake planting limits according to plan details and the Engineer. Have the Engineer approve the method of plant identification before planting.

   For median plantings, keep any woody plant a minimum of 3 ft. (1m) from the edge of the plant bed to avoid vegetative growth into the roadway.

   For stream buffers identified as "Stream Buffer" or "wet swales", on plans, the plant species shall be planted in a random, intermixed manner throughout the entire planting area. At the edges of the planting zone, keep new plants a minimum of 8 ft. (2.4m) from existing trees or permanent structures.

2. Applications of Soil Additives

   a. Apply fertilizer and lime to the plant bed according to the soil test report.

   b. Spread an organic soil additive, (See Subsection 893.2.09), evenly throughout the designated area to at least 2 in. (50 mm) deep. Thoroughly dig it into the soil to at least 6 in. (150 mm) deep using a rotary hoe type tiller or other equipment that evenly mixes the soil, lime, fertilizer, and organic soil additive.

   c. Till the area until the surface is smooth and free of weeds, roots, rocks, and other debris, to the satisfaction of the Engineer.

   d. If the planting area lies within a multitrophic native planting area, stream buffer, wetland, wet swale, or marsh the addition of fertilizer or lime is prohibited.

702.3.04 Fabrication

General Provisions 101 through 150.

702.3.05 Construction

A. Seasonal Limitations for Planting

For geographic seasonal limitations, refer to the Planting Zones Map found in Subsection 700.3.05. Plant in Zones 1 and 2 between October 15 and March 15. Plant in Zones 3 and 4 between November 1 and January 1.

B. Planting Operations

Plant using the method called for on the details and plan sheets. Before beginning planting of each area, have available the necessary materials including prepared plant topsoil (see Subsection 893.2.07), water, stakes, and mulch. Plants shall be installed as straight/upright as possible. Any plants found to be leaning or broken will not be accepted or paid for by the engineer.

When seasonal limitations and weather conditions permit, continuously water, mulch, guy, provide tree guards, and stake as indicated on the plans and details until completing the last operation.

After completing planting, provide a method for retaining water adjacent to the plant according to the details shown on the plans or as directed by the Engineer.

Protect marsh restoration areas from vehicles and machinery. Typical protective barriers are not to be used in tidal areas. Stakes that remain secure and are taller than the highest tide, flagged with highly visible flagging tape, are required to mark the area to be protected and off-limits for vehicles and machinery.

1. Planting by the Pit Method
   a. Placing Bare-Rooted Plants

      Plant bare-rooted plants delivered to the pit area. Protect roots from drying out until placing them in the pit.

      1) Center plants in pits and spread roots as they originally grew.
      2) Cover and prepare the topsoil according to details shown on the plans.

   b. Placing Balled and Burlapped Plants

      Immediately plant these plants after they are delivered to the pit site.

      1) The pit diameter shall be a minimum of 3 times the diameter of the rootball. Center the ball in the prepared pit, leaving the top of the ball 1 in (25 mm) above the top of the ground for settlement.
      2) Cut away and remove the top 1/3 of burlap from the rootball. Cut all ropes and twine, pull the nails, and drop the remaining burlap to the bottom of the hole. Cut away and remove all wire from the root ball.
      3) Partially fill the pit with prepared plant topsoil and compact the soil enough to hold the ball firmly. Add mycorrhizal innoculant to plant topsoil if specified in plans.

   c. Placing Container-Grown Plants
      1) When the container is delivered to the pit site, split the container from top to bottom and carefully remove the plant.
      2) The pit diameter shall be a minimum of 3 times the diameter of the rootball. Spread into the hole any major roots growing around the container or prune them to remove any circular growth.
      3) Place the ball in the center of the prepared pit, leaving the top of the ball 1 in. (25 mm) above the top of the ground for settlement.
      4) Partially fill the pit with prepared plant topsoil and compact the soil enough to hold the ball firmly. Add mycorrhizal innoculant to plant topsoil if specified in plans.

   d. Completing Pit Plantings

      After placing pit plantings, water plants thoroughly the same day regardless of weather or soil moisture conditions.

      1) After the water has soaked in, add prepared plant topsoil and compact firmly up to 2 in. (50mm) below the adjacent ground.
      2) Stop compacting when the compacted prepared topsoil is 2 in (50 mm) below the adjacent ground.
      3) Fill the remainder of each pit with loose, prepared plant topsoil according to the details shown on the plans.
      4) Prepare the loose topsoil to retain water adjacent to the plant according to the Plans or as directed by the Engineer.

   e. Live Stake Plantings
      1) Plant live willow stakes at four (4) ft. (1.2m) intervals or as indicated on the drawings with the buds facing upward.
      2) Eighty (80) percent of the stake shall be installed below ground, leaving twenty (20) percent extending above ground.

3) Stakes shall be placed deep enough to reach the water table during the dry season at an angle perpendicular to the slope.

4) Pack soil firmly around the hole after installation.

5) Install live willow (*Salix spp.)* stakes only in the dormant season, according to the planting details and landscape plan notes.

6) Replace any live stakes that split during installation.

2. Planting using a Dibble, Hoedad, or Reinforced Planting Shovel for Wet Swale and Bare Root Seedlings.

Planting shall only be done when there is adequate moisture in the ground and when the ground is not frozen.

Provide proper root positioning and contact with the soil and eliminate all air pockets around roots. Roots of seedlings shall not be pinched or bent in a sideways or upturned direction.

Each tree, division, or seedling shall be inserted into the hole such that the root collar of the tree will be at ground level after backfilling is complete. Allowance for burying the root collar below ground level shall not exceed one-half inch in depth. In no case shall planting result in the root collar remaining above ground level. The soil back-filled around the root system shall be compacted sufficiently to support the plant. Mow or use a string trimmer to a height of 1 in. (25 mm) in the area designated for restoration. Do not trim wet swales or retention basins where standing water is present.

Grass the area designated for restoration with a native restoration or riparian seed mix and apply wheat straw mulch to the area before planting seedlings.

Plant within 48 hours after mowing or string trimming the site.

3. Restoration and enhancement of tidal marsh areas are subject to possible wave energy, requiring the use of a plant anchor for each plant. See planting plan sheets and details for plant anchor and anchoring descriptions.

C. Landscape Mulching

1. For Pit Plantings

Follow these requirements when mulching for pit plantings:

a. Where the distance between plants is 8 ft. (2.4 m) or less, spread mulch throughout and 3 ft. (900 mm) beyond the outermost plants. Where plants are more than 8 ft. (2.4 m) apart, apply mulch in a circular fashion around each plant, forming a ring 5 ft. (1.5 m) in the outside diameter.

b. If plant pits are greater than 5 ft. (1.5 m) in diameter, ensure that the mulch extends out to cover the berm as shown in the planting details on the plans.

c. Apply mulch within 3 days of planting at least 4 in. (100 mm) in depth to obtain a compacted depth of at least 3 in. (75 mm).

d. Compaction occurs naturally. Check compaction at least two months after spreading and exposing the mulch to the elements.

e. If the compacted depth is less than 3 in. (75 mm), apply additional mulch to deficient areas within 1 month following notification.

f. Apply mulch to a uniform depth and remove lumps for a neat appearance. Tuck mulch neatly against all paving edges, drainage structures, and where planting beds meet grassed areas.

g. Leave a 1 in. (25 mm) to 2 in. (50 mm) ring of non-mulched area directly around all tree trunks.

h. Do not mulch with Cypress Mulch.

2. For Plantings using a Dibble, Hoedad, or Reinforced Shovel

Apply landscape mulch according to Subsection 702.3.05.C.1 with the following exceptions:

a. Apply mulch before planting.

b. Use only wheat straw mulch in restoration areas.

c. Ensure that the mulch coverage is open enough to allow seed germination to take place and dense enough to conserve moisture in the seed bed.

3. For Native Multitrophic or Stream Buffer Restoration Planting Areas, wheat straw shall be the only types of mulch used.
4. Do not use mulch in a tidal marsh area. Do not mulch wet swale or retention ponds where standing water is present.

D. Wrapping

Do not wrap the trucks of tree unless specified in the plans. When wrapping is specified, tightly wrap the trunks of deciduous trees over 1.25 in. (32 mm) in caliper. Wrap in strip burlap or waterproof crepe tree wrapping paper or other approved materials.

1. Begin wrapping at the ground and extend spirally up and beyond the first rosette of branches with an overlap of one half the width of the wrapping material.
2. Tie the wrapping material securely with binder twine spaced every 12 in. (300 mm) for the full length of the wrapping. Wrap immediately after planting.

E. Staking and Guying

1. Do not use staking and guying unless specified in the plans or details.
2. Perimeter Staking
3. Place perimeter stakes 2 in. x 2 in. x 36 in. (50 mm x 50 mm x 900 mm). Stake the perimeter of indicated regenerated areas within specified planting dates according to the Plans or as directed by the Engineer. Keep staking for tidal marsh areas secured with supports taller than the highest tide with highly visible flagging tape to mark the area as off-limits for vehicles and machinery.
4. Vine, Shrub, and Miscellaneous Plant Staking
5. Use stakes to identify isolated vines, shrubs, and miscellaneous plants outside of solid mulched beds according to plan details.
6. Tree Staking and Guying
7. Stake trees using a system that will prevent trees from leaning or tilting and keep the root ball stable until the roots become anchored. The system should allow the top some movement and flexibility without damaging the tree.

F. Pruning

1. Prune plants on the site before planting and after initial inspection by the Engineer as needed for the health of the plant. Never prune severely to get plants to meet specifications.
   a. Follow ANSI A300 Part 1 standards and use approved tools designed for pruning.
   b. Lopping, topping, or shearing trees or shrubs is not permitted.
   c. Prune back damaged, scarred, frayed, split, and skinned branches, limbs, and roots to live wood nearest to the next sound, outside lateral bud, branch, limb, or root.
   d. Leave the terminal leaders or buds in trees intact.
   e. Prune roots, when necessary, as directed by the Engineer.
   f. Prune Crape Myrtles to maintain natural form only. Severely cutting back or stump pruning crape myrtles is not permitted. Remove sucker growth from Crape Myrtles.
   g. Damaged, scarred, frayed, split and skinned branches, limbs and roots shall be pruned back to live wood nearest to the next viable outside lateral bud, branch, limb or root.

G. Watering

1. Apply water in a manner to prevent erosion. Water plants deeply and thoroughly at the time of planting. Water after applying fertilizer called for in Subsection 702.3.05.H and as necessary to maintain enough moisture to promote plant growth. Use water reservoir bags if specified in plans or details.
   a. Apply enough water to wet the soil to a depth slightly below the roots. Direct the water to the ground around the plant, not the tops.
   b. Do not allow plant foliage to dry out or plants to defoliate from lack of water. Remove plants in such condition from the site immediately. Apply supplemental watering to maintain vigorous growth and to keep plants moist and as directed by the Engineer.
   c. Apply water once per week throughout the planting season in which the plants are installed. Follow Subsection 702.3.07.B and 702.3.07.C for shrub and tree watering requirements throughout the life of the project.

H. Spring Application of Fertilizer

1. Method and Rate of Application

   Follow these requirements when applying fertilizer in the spring:

   a. Trees

      Apply a slow-release fertilizer according to soil test results. Assume 8-12-12 with a rate of 1 cup (0.25 L) per caliper inch of tree for bidding purposes.

2. Shrubs and vines

   Fertilize shrubs according to soil test results with a slow release fertilizer by spreading fertilizer around the base of the plant and working it into the soil by hand. Assume 6-12-12 with a rate of 0.5 cup (0.12 L) per foot of shrub height for bidding purposes.

   Bed Areas

   Spread fertilizer on bed areas (defined by method of planting in Subsection 702.3.05.B), over the mulch according to soil test results. Assume 3 lbs./100ft2 of 6-12-12 for bidding purposes. Thoroughly water in the plants.

3. Native Restoration or Stream Buffer Areas

   The addition of fertilizer or lime is prohibited within the native restoration or stream buffer planting areas.

4. Tidal March Areas

   The addition of fertilizer or lime is prohibited within marsh areas.

5. Time of Spring Fertilizer Application

   Apply fertilizer in the spring in Zones 1 and 2 (with reference to the Planting Zones specified in Subsection 702.3.05.A) between April 1 and April 15. Apply between March 15 and April 1 for Zones 3 and 4.

   For late plantings, do not apply fertilizer less than 30 days after the plantings.

6. Additional Fertilizer

   Approximately one month after the spring fertilizer is applied; the Engineer will inspect planted areas and determine if an additional application of fertilizer is needed for any plant or group of plants.

   If the Engineer determines additional fertilizer is required, apply fertilizer according to soil test results between June 15 and July 15th.

I. Tree Guards for Stream Buffer Saplings

Each planted bare root, sapling-sized plant shall be fitted with a tree guard to protect the saplings from wildlife browsing. The tree guards shall be at least 36 in. tall, with appropriately sized wooden stakes or bamboo to securely support the tree guard [i.e., a 4 ft. (1.2 meter) stake for a 36 in. (914.4 mm) guard]. Mesh tube-type tree guards are required. Vexar tubes, or equivalent, are to be used. All tree guards shall be removed from the saplings at final inspection.

J. Restoration and Cleanup

Restore areas where existing grass has been damaged or scarred during planting operations at no expense to the Department. Restore the disturbed areas to their original conditions as directed by the Engineer. Clean up debris, spoil piles, and containers and leave the Project area clean.

Clean up and remove all debris, spoil piles, containers, water reservoirs, trash, etc. and leave the project area in an acceptable condition. Inspect all installed erosion control devices weekly and clean out or repair as required. Remove all erosion control devices at final acceptance unless otherwise instructed by the Engineer.

702.3.06 Quality Acceptance

Preserve the plants in a healthy growing condition and keep plants moist, particularly during drought conditions (no rain for any two-week period). The acceptability of the plant material planted and maintained as specified will be determined at the end of an establishment period.

The plant establishment period is the period from the last planting specified in Subsection 702.3.05.B until the following October 1. Plant all plants in one planting season unless otherwise approved by Engineer.

A. First Establishment Period

At the end of the first planting season, the first establishment period begins. The Department will make the first semi-final inspection 30 days before the end of the first establishment period. Replace dead, dying, diseased, unsatisfactory, and missing plants, by January 20 of the next (second) planting season. For stream buffer areas, all replacement plants shall be tagged with 18 in. (457.2 mm) lengths of brightly-colored survey tape. Tree guards shall be placed around all replacement saplings. All costs for replanting, tagging and tree guards for replacement trees shall be included in the contract price bid for the original planting.

B. Second Establishment Period

At the end of the second planting season, the second plant establishment period begins. The Department will make the second semi-final inspection 30 days before the end of the second establishment period. Again, replace dead, dying, diseased, unsatisfactory, and missing plants, by January 20 of the next (third) planting season. For stream buffer areas, all replacement plants shall be tagged with 18 in. (457.2 mm) lengths of brightly-colored survey tape. Tree guards shall be placed around all replacement saplings. All costs for replanting, tagging and tree guards for replacement trees shall be included in the contract price bid for the original planting.

C. Final Inspection

The Department will make the final inspection of the plants during May, following any needed replacements during the previous planting season. Assume responsibility for the plants until the Final Acceptance of the project or a portion of the project.

702.3.07 Contractor Warranty and Maintenance

Project maintenance includes, but is not limited to, watering, cultivating, weeding, pruning, repairing, adjusting guys and stakes, and performing other work as ordered by the Engineer until final acceptance.

Promptly remove from the project area dead plants or those that no longer conform to the requirements of Subsection 702.2.A.2.

Mow the entire right-of-way within the limits of the project up to a maximum of four times per calendar year. Do not mow native restoration areas, wet swales, or riparian mitigation sites.

A. Leaning Trees

Straighten leaning trees as directed by the Engineer. Follow Staking and Guying requirements for replacements or repairs as per Subsection 702.3.05.E.

B. Shrub Maintenance

1. Pruning

   Prune dead or diseased limbs to provide for plant health and appearance as directed by the Engineer.

2. Landscape Mulching

   Continuously maintain shrub and tree beds with a clean, freshly mulched appearance using the mulch originally specified. See Subsection 702.3.05.C. Do not mulch shrub and tree beds within riparian mitigation sites.

   a. Apply a 2 in. (50 mm) loose layer of specified mulch (top-dressing) on top of all areas, including tree pits, initially mulched, at the following times:

      1) In August, during the first plant establishment period.

      2) In April, during the second plant establishment period.

      3) In August, during the second plant establishment period.

      4) In April, prior to the final inspection.

3. Applying Fertilizer

   See Subsection 702.3.05.H.

4. Applying Pesticides

   a. Inspect all planted or seeded vegetation for insects, grubs, mites, diseases, etc., once every two weeks. Apply insecticides, fungicides, and herbicides according to the manufacturer's recommendations to effectively control or eradicate the problem.

   b. Perform all pesticide applications under the direct supervision of a trained licensed commercial pesticide operator whose license includes subcategory 27 – Right of Way Pest Control. Carry the pesticide license/certification on the work site during applications. Carry all labeling associated with the chemical being applied at the work site.

   c. Submit all product information data sheets and EPA approval numbers on all pesticides proposed to be used prior to application for approval.

   d. Notify the Engineer a minimum of 48 hours prior to any and all pesticide applications.

   e. Add a blue dye to all spray applications unless approved otherwise by the Engineer.

   f. Monitor the weather and spray under proper weather conditions. Spraying shall not occur when the weather is greater than 10 miles per hour.

   g. Wear the proper safety attire. Wear long sleeve shirts, long pants, gloves, and safety glasses. Wear or use any additional protective safety attire or gear as recommended by the product's manufacturer.

   h. Repair any damage that is a result of mishandling or misuse of materials, at no expense to the Department, to the satisfaction of the Engineer.

   i. For stream buffer and marsh restoration areas, pesticides are not to be used unless approved by the Department Ecology Manager.

5. Edging

   a. Edge all shrub pits, shrub beds, and tree pits once a month throughout the life of the project such that the vee-cut edging detail specified on the plans is maintained. Prevent grass and weeds from growing over or into the shrub beds and tree pits.

   b. Use equipment specifically designed for edging. Line trimming equipment shall not be used.

6. Watering

a. Check all planted material once a week throughout the contract for dryness by removing the mulch from their base and "sampling the soil" approximately 4 in. (100mm) deep. Water if the soil is not moist.
b. Water all planted material if a drought (no rain for two weeks) occurs. Provide the water required to meet the watering requirements.
c. Water each plant thoroughly until the ground is saturated to a depth slightly below the root ball. Apply water in a manner to prevent erosion.

7. Weed Control

Perform weed control throughout the project, a minimum of once every two weeks, in all areas within the project limits to maintain tree pits, shrub beds, sidewalks, curb and gutter, walkways, ditch paving, concrete medians, and other pavement weed free. Meet the following conditions:

a. Perform weed control to prevent weeds from becoming established, setting seed, or from becoming visible in the planting beds.
b. Completely remove all undesirable plants (weeds) by hand pulling. Removal of weeds may be accomplished using herbicides if approved by the Engineer. However, the use of herbicides is prohibited in stream buffer areas unless approved by the Department Ecology Manager.
c. Apply an approved pre-emergent herbicide twice each year, once in the spring and once in the fall, throughout the contract. The use of pre-emergent herbicides is prohibited in stream buffer areas. Apply pre-emergent to all shrub beds and tree pits. Notify the Engineer 48 hours prior to spraying. Use a blue dye in all applications unless approved otherwise by the Engineer.
d. Eradicate all invasive exotic pest plants found within the project limits throughout the life of the project, including stream buffer and marsh areas. Volunteer, non-invasive plant material within stream buffer restoration areas is acceptable.
e. Dispose off site on a daily basis all weed, exotic plants, clippings, litter, and debris generated.

8. Policing

Remove debris such as paper, broken limbs, bottles, cans, etc., a minimum of the first and third week of each month from all areas within the project limits while maintaining the site.

9. Mitigation Areas

Pruning, mulching, edging, and applying spring fertilizer are not required within wet swales, native restoration areas, stream buffers and regenerated forest areas.

C. Tree Maintenance

1. Watering

See Subsection 702.3.07.B.6

2. Landscape Mulch

See Subsection 702.3.07.B.2

3. Fertilizer

See Subsection 702.3.05.H.

4. Abnormal Conditions

Periodically (once every two weeks) observe trees and shrubs for abnormal conditions such as insects, borers, web worms, red spiders, etc., and immediately treat.

5. Sucker Growth

Remove sucker growth once a month. Sucker growth is the shoots that sprout out around the base of the tree trunk.

6. Pruning and Deadwood

Remove deadwood at least two times a year. Prune dead branches. Paint cuts, and wounds or scars with tree paint only when specified in the plans. Do not top Crape Mrytles. See Subsection 702.3.05.F.

7. Pesticide Control

NOTE: Apply pesticides as necessary to control harmful insects and diseases. Follow the manufacturer's instructions. See Subsection 702.3.07.B.4**. NOTE: Use chemicals according to Federal, State and county directives on environmental control that carry an EPA approval number.**

8. Weed Control

   See Subsection 702.3.07.B

9. Staking and Guying

   Remove all support guy wires, strapping and stakes from plants which have gone through one complete growing season.

702.4 Measurement

A. Plants

Plants of the name and size specified are measured for payment according to the number planted that are still living and viable and in an acceptable condition at the time of Final Acceptance. A viable plant must have a minimum of 75 percent of the leaf-bearing crown with healthy foliage.

B. Fertilizer

Spring application fertilizer applied to planted and regenerated areas will be the actual number of pounds (kilograms) placed and accepted. Fertilizer, lime, and plant topsoil used in prepared plant topsoil or plant bed preparation are not measured for separate payment. For stream buffer and marsh areas, the addition of fertilizer or lime is prohibited.

C. Perimeter Stakes

Perimeter stakes is not measured for payment unless such item is shown as a separate Pay Item in the proposal.

D. Clearing and Grubbing

Clearing and grubbing is not measured for payment unless the Item is shown as a separate Pay Item in the proposal.

E. Landscape Mulch

The quantity of landscape mulch and top-dressing measured for payment will be the actual number of square yards (meters) completed as specified and accepted. The presence of weeds or other growth, or foreign material, will be cause for rejection.

702.4.01 Limits

General Provisions 101 through 150.

702.5 Payment

A. Plants

Plants measured for payment will be paid for as follows:

1. After planting satisfactorily, the Department will pay 50 percent of the Contract Unit Price bid per each on the next estimate.
2. Until Final Acceptance, perform all required maintenance according to Subsection 702.3.07 when necessary or as ordered by the Engineer.

If the Contractor fails to properly maintain the landscaping, daily charges shall be assessed against any money due or that may become due the Contractor in accordance with the schedule of deductions shown in Subsection 108.08, but not less than $150 per calendar day, and will continue until project maintenance is approved by the Engineer.

The charges are in addition to those specified for delay or failure in completing the Work within the specified time.

3. After the first semi-final inspection, the Department will pay 15 percent of the Contract Unit Price bid per each of the live, viable plants.
4. After the second semi-final inspection, the Department will pay 15 percent of the Contract Unit Price bid per each of the live, viable plants.
5. At Final Acceptance, the Department will pay the remaining 20 percent less the Full Contract Unit Price bid per each plant not accepted.

   Payments are full compensation for furnishing, planting, replanting as required, pruning, staking, guying, soil conditioning, and preparing plant beds, including applying additives, digging plant pits, preparing plant topsoil and mulch, disposing of waste material, and maintaining the plants during the plant-establishment period.

B. Fertilizer

All grades of fertilizer applied in the spring, measured as specified above, are paid for at the Contract Price per pound (kilogram) or per ton (megagram), whichever is indicated in the proposal. Payment is full compensation for furnishing and applying and for watering regenerated areas.

For native restoration, stream buffer and marsh restoration areas, the addition of fertilizer or lime is prohibited.

C. Perimeter Stakes

Perimeter stakes will not be measured for payment. The cost will be included in the overall contract price.

D. Landscape Mulch

Landscape mulch measured for payment will be paid for as follows:

1. After mulching satisfactorily, the Department will pay 40 percent of the Contract Unit Price bid per square yard (meter).
2. After satisfactorily completing mulch (topdressing) in August of the first plant establishment period, the Department will pay 15 percent of the Contract Unit Price bid per square yard (meter).
3. After satisfactorily completing mulch (topdressing) in April of the second plant establishment period, the Department will pay 15 percent of the Contract Unit Price bid per square yard (meter).
4. After satisfactorily completing mulch (topdressing) in August of the second plant establishment period, the Department will pay 15 percent of the Contract Unit Price bid per square yard (meter).
5. After satisfactorily completing mulch (topdressing) in April of the final planting season, (a month before the Final Inspection), the Department will pay 15 percent of the Contract Unit Price bid per square yard (meter). Such payment shall be full compensation for furnishing, installing, topdressing, and maintaining mulch as required.
6. Do not mulch marsh restoration areas.
7. Do not apply additional applications of mulch after the initial application in stream buffer restoration areas.

Payment will be made under:

Item No. 702	Plant Name and Size	Per each
Item No. 702	Fertilizer, Spring Application	Per ton (megagram)
Item No. 702	Landscape Mulch	Per square yard (meter)
Item No. 702	Spring Application Fertilizer	Per pound (kilogram)
Item No. 702	Live Stakes and Planting	Per each
Item No. 702	Perimeter Stakes	Per each
Item No. 702	Bare Root Seedling Planting	Per each

702.5.01 Adjustments

General Provisions 101 through 150.

Section 801—Fine Aggregate

Replace Section 801 with the following:

801.1 General Description

This section includes the requirements for fine aggregate. All aggregate shall be the specified type, class, and grade.

801.1.01 Related References

A. Standard Specifications

Section 800—Coarse Aggregate

Section 441—Miscellaneous Concrete

B. Referenced Documents

GDT 4

GDT 5

GDT 63

GDT 75

GDT 132

QPL 1

SOP 1

AASHTO T 11

AASHTO T 21

AASHTO T 27

AASHTO T 112

AASHTO T 303

ASTM C 295

801.2 Materials

801.2.01 Fine Aggregate for Cushion

A. Requirements

Use the type, class, and grade of fine aggregate specified.

1. Types

   Use fine aggregate for cushion under granite curb or brick that is natural or manufactured sand with hard, strong, durable particles. Make manufactured sand from crushed gravel or stone meeting the requirements of Section 800. For a list of fine aggregate sources, see QPL 1.

2. Grades

Use fine aggregate for cushion with less than 10 percent total silt and clay. Grade as follows:

Size	Percent by Weight
Passing No. 4 (4.75 mm) sieve	100
Passing No. 16 (1.18 mm) sieve	25-75
Passing No. 100 (150 µm) sieve	0-25

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

- Sieve analysis—AASHTO T 27

D. Materials Warranty

General Provisions 101 through 150.

801.2.02 Fine Aggregate for Portland Cement Concrete of All Types and for Mortar

A. Requirements

1. Concrete and Mortar

   Use fine aggregate for concrete and mortar that consists of natural sand, manufactured sand, or blends of natural and manufactured sands, having hard, clean, strong, durable, uncoated particles, meeting the requirements of the Specifications.

2. Manufactured Sand

   Manufactured sand used in concrete for construction of Portland cement concrete pavement, approach slabs, and bridge decks, shall be made from Group II aggregates as specified in Subsection 800.2.01.A.2.

3. Miscellaneous Concrete

   Sand manufactured from synthetic aggregate may be blended with natural sands or manufactured sands made from crushed stone or gravel for use in miscellaneous concrete as described in Section 441.

   Blend at least 50 percent natural sand or manufactured sand made from crushed stone or gravel.

4. Concrete Sand

   Concrete sand that passes the No. 10 (2 mm) sieve shall have these characteristics:

Characteristic	Requirement
Durability index	70 or greater
Sand equivalent	70 or greater

5. Detrimental Substances

Keep detrimental substances within these limits:

Substance	Maximum Percent by Weight
Clay lumps	0.5 maximum in total sample
Coal and lignite	0.5 maximum in total sample
All detrimental substances (any combination)	2.0 maximum in total sample
NOTE: Do not use fine aggregate in Portland cement concrete that is capable of producing a deleterious reaction with Portland cement	

a. Provided the material passing the No. 16 (1.18 mm) sieve is petrographically determined to be essentially free of detrimental substances, test results for coal and lignite and other detrimental substances listed will be based upon a petrographic analysis of material retained on the No. 16 (1.18 mm) sieve.

b. Calculations will be based upon the weighted average for the total sample.

c. Other detrimental substances include constituents such as shale, weathered or decomposed rock, soft or friable particles, coated grains, or other substances that might be considered detrimental for the use intended.

6. Organic Impurities (natural sands only)

Ensure all fine aggregate is free from detrimental amounts of organic impurities.

Do not use materials that have colorimetric test (AASHTO T 21) results darker than the Reference Standard color plate.

7. Grades

Grade fine aggregates for Portland cement concrete and mortar as follows:

Size No.	Description	Total Percent by Weight Passing Each Sieve					
		3/8 in. (9.5 mm)	No. 4 (4.75 mm)	No. 16 (1.18 mm)	No. 50 (300 µm)	No. 100 (150 µm)	No. 200 (75 µm)
10 NS	Natural concrete sand	100	95-100	45-95	5-30	0-10	0-3
20 NS	Natural mortar sand	100	100	90-100	15-50	0-15	0-5
10 SM	Standard manufactured concrete sand	100	95-100	45-95	8-30	1-10	0-4
10 FM	Fine manufactured concrete sand	100	95-100	45-95	15-42	6-22	0-9

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Petrographic analysis	ASTM C 295
Material that passes a No. 200 (75 µm) sieve	AASHTO T 11
Organic impurities	AASHTO T 21
Sieve analysis	AASHTO T 27
Sand equivalent	GDT 63
Reactivity	AASHTO T 303
Durability index	GDT 75
Clay lumps	AASHTO T 112
Friable Particles	GDT 132
NOTE: The percent passing the No. 200 sieve (75 µm) for size 10FM will be based upon the total percent determined by AASHTO T-11 and AASHTO T-27. The percent passing the No. 200 sieve (75 µm) for sizes 10NS, 20NS and 10SM will be as determined by AASHTO T-11 only.	

D. Materials Warranty

General Provisions 101 through 150.

Section 812—Backfill Materials

Replace Section 812 with the following:

812.1 General Description

This section includes the requirements for material used as backfill: foundation backfill, Pipe, Types I and II, imperfect trench backfill, Type III, and mechanically stabilized embankment backfill.

812.1.01 Related References

A. Standard Specifications

Section 810—Roadway Materials

Section 800—Coarse Aggregates

B. Referenced Documents

AASHTO T 11

AASHTO T 21

AASHTO T 27

AASHTO T 96

AASHTO T 104

AASHTO T-267

AASHTO T-288

AASHTO T-289

ASTM C295

ASTM D4327

GDT 4

GDT 6

GDT 7

GDT 24a

GDT 24b

GDT 63

GDT 67

GDT 75

SOP 1

812.2 Materials

812.2.01 Foundation Backfill, Type I

A. Requirements

1. Use natural or artificial mixtures of materials consisting of hard, durable particles of sand or stone, mixed with silt, clay and/or humus material for Type I backfill.
2. Have the final blend of material meet the requirements of Class I or II soils in Subsection 810.2.01.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Soil gradation	GDT 4
Volume change	GDT 6
Maximum density	GDT 7 or GDT 67

D. Materials Warranty

General Provisions 101 through 150.

812.2.02 Foundation Backfill, Type II

A. Requirements

1. Type

   Use material meeting the requirements of Section 800, Class A or B aggregate, and SOP 1. Crushed concrete may be used provided it meets the requirements of Section 800 that are applicable to Group 2 Aggregates.

   Do not use backfill aggregate containing soil or decomposed rock.
2. Gradation

   Use material meeting the following gradation requirements:

Sieve Size	% Passing by Weight
1-1/2 in. (37.5 mm)	100
1 in. (25 mm)	80-100
No. 8 (2.36 mm)	0-5

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Sieve analysis	AASHTO T 27

D. Materials Warranty

General Provisions 101 through 150.

812.2.03 Imperfect Trench Backfill, Type III

A. Requirements

1. Type

Use material made from either of the following for Type III backfill:

- A natural soil with a density of less than 95 lb./ft.^{3} (1520 kg/m^3) when tested with GDT 7
- An artificial mixture of soil and organic material, such as hay, leaves, or straw

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The laboratory will:

1. Test the soil density with GDT 7.
2. Review the mixture and the percentages of each material and approve a mixture suitable for the Project.

D. Materials Warranty

General Provisions 101 through 150.

812.2.04 Mechanically Stabilized Embankment Backfill

A. Requirements

Use material comprised of crushed stone, natural sand, or a blend of crushed stone and natural sand from sources listed on Qualified Products Lists 1 and 2, or approved by the Office of Materials and Testing. Ensure material is within the following limits for soils, organics or any other deleterious substances meeting the following additional requirements:

NOTE: Deleterious substances include but are not limited to: wood, brick, asphalt, shale recycled concrete, construction waste and shall meet the following limits:

Substance	Maximum Percent by Weight
Sand Equivalent Group 1	≥ 20
Sand Equivalent Group 2	≥ 28
Any combination of Brick, Shale, Asphaltic Concrete, Recycled Concrete, Weathered Rock, Construction Waste, Soil, or Wood	2

1. Crushed Stone

Use a material manufactured from Class A or B stone that meets the requirements of Section 812.2.04.A, has a soundness loss of not more than 15 percent, and conforms to the stockpile requirements of SOP 1.

2. Natural Sand

May be used in conjunction with an approved, non-corrodible, extensible reinforcement. Use non-plastic material consisting of strong, hard, durable particles having a durability index of at least 70 and meeting for class IIB3 or better in accordance with section 810.2.01.A.1. Use Natural Sand from an approved source on Qualified Products List – 1 or from a source approved by the Office of Materials and Testing. Requirements for approval will be provided by the Technical Assistance Bureau.

3. Gradation

Sieve Size	% Passing by Weight
4 in. (100 mm)	100
2 in. (50 mm)	80 -100
No. 10 (2 mm)	20 - 90*
No 200 (75 µm)	0 - 15
* Natural Sand may be 20 - 100	

4. Chemical

Ensure the material meets the following chemical requirements:

Test Method	Requirement
pH	*5.0 – 9.5
Resistivity	>3000 ohms/cm
Chlorides	<100 ppm
Sulfates	<200 ppm
Note: These chemical requirements are not applicable to MSE walls stabilized with an approved, non-corrodible, extensible reinforcement.	
*Sources of select backfill material having a pH between 4.5 and 5.0 may be used provided the interior face of the MSE wall panels have 3 inches of concrete cover over the reinforcement.	

5. Maximum Dry Density

Use backfill material with a maximum dry density equal to or greater than the design unit weight shown on the plans.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test the material as follows:

Test Method	Requirement
Percent Wear	AASHTO T96 (“A” Grading)
Sieve Analysis	AASHTO T 27
Material Passing No. 200 (75 µm) Sieve	AASHTO T 11
Organic Impurities	AASHTO T 21
Durability Index	GDT 75
Sand Equivalent	GDT 63
Volume Change	GDT 6
Petrographic Analysis	ASTM C295
Maximum Dry Density	GDT 7 or GDT 24a, GDT 24b
Soundness (Magnesium Sulfate)	AASHTO T 104
Determining Minimum Laboratory Soil Resistivity	AASHTO T-288
Determining pH of Soil for Use in Corrosion Testing	AASHTO-289
Chlorides	ASTM D4327
Sulfates	ASTM D4327
Organic Content	AASHTO-267

Section 815—Graded Aggregate

Replace Section 815 with the following:

815.1 General Description

This section includes the requirements for material to be used for base, subbase, or shoulder course material, and includes graded aggregate, unconsolidated limerock base, and recycled concrete base.

815.1.01 Related References

A. Standard Specifications

Section 800—Coarse Aggregate

B. Referenced Documents

AASHTO T 11

AASHTO T 27

AASHTO T 193

ASTM C 295

ASTM D 3042

FL DOT Method FM5-515

SOP–1

QPL-2

GDT 63

EPA Method 3050/6010

EPA Method 1311

EPA Polarized Light Microscopy Method

EPA Transmission Electron Microscopy Method

815.2 Materials

815.2.01 Graded Aggregate

A. Requirements

1. Type

   Use graded aggregate base, subbase, or shoulder course material of uniform quality.

   a. Obtain the graded aggregate from an approved source or deposit that will yield a satisfactory mixture meeting all requirements of this specification.

   b. Use material that is crushed or processed as a part of the mining operations, or, mix two grades of material so that when combined in the central mix plant, the mixture meets the specifications.

   c. May use material that is a blend of not more than 30 percent (max) recycled crushed concrete from known sources (see 815.2.03.A.1.a) and virgin aggregate if approved by the Office of Materials and Testing.

2. Retained on the No. 10 (2 mm) sieve

Ensure the material retained on the No. 10 (2 mm) sieve is Class A or B aggregate that meets the requirements of Section 800.

3. Passing the No. 10 (2 mm) sieve

   Ensure material passing the No. 10 (2 mm) sieve is relatively free of detrimental substances, such as soil overburden, decomposed rock, and/or swelling silts.

4. Stabilized Mixtures

   Ensure mixtures to be stabilized react satisfactorily when mixed with Portland cement. The Engineer will specify the percentage of Portland cement to use.

5. Gradation

   Grade the graded aggregate base, subbase, or shoulder material as follows:

Sieve Size	Percent Passing By Weight
Group I Aggregates	
2 in. (50 mm)	100
1-1/2 in. (37.5 mm)	95-100
3/4 in. (19.0 mm)	60-95
No. 10 (2 mm)	25-50 (Note 1, 2 and 3)
No. 60 (250 µm)	10-35
No. 200 (75 µm)	7-15
Group II Aggregates	
2 in. (50 mm)	100
1-1/2 in. (37.5 mm)	95-100
3/4 in. (19 mm)	60-90
No. 10 (2 mm)	25-45 (Note 2 and 4)
No. 60 (250 µm)	5-30
No. 200 (75 µm)	4-11
NOTE 1: Group I aggregates having less than 37% passing the No. 10 (2 mm) sieve, shall have at least 9 percent passing the No. 200 (75 µm) sieve.	
NOTE 2: For graded aggregate stabilized with Portland Cement, 30-50 percent by weight shall pass the No. 10 (2 mm) sieve. All other requirements remain the same.	
NOTE 3: Material passing the No. 10 (2 mm) sieve shall have a sand equivalent of at least 20 for Group I aggregates.	
NOTE 4: Material passing the No. 10 (2 mm) sieve shall have a sand equivalent of at least 28 for Group II aggregates. Sand Equivalent values as low as 20 will be acceptable provided they are attributed exclusively to rock flour and the percent passing the No. 10 (2 mm) sieve does not exceed 40.	

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Material that passes a No. 200 (75µm) sieve	AASHTO T 11
Gradation	AASHTO T 27
Sand Equivalent	GDT 63

D. Materials Warranty

General Provisions 101 through 150.

815.2.02 Unconsolidated Limerock Base

A. Requirements

1. Type

   Use limerock base, subbase, or shoulder course material of uniform quality.

   a. To ensure uniform quality, the Department may restrict approved sources to specific mining areas, mining processes at a specific mining site, or both.

   b. Use a limerock base that yields a mixture to meet these specifications.

   c. Use material that is crushed or processed as a part of the mining operations, or mix two grades of material so that when combined in the central mix plant the mixture meets the specifications.

   d. Use limerock base, subbase, or shoulder material that has the following characteristics:

Limerock bearing ratio	At least 100.
Deleterious substances	Do not allow chert or other extremely hard pieces that will not pass the 2 in. (50 mm) sieve. Do not allow clay, sand, organics, or other materials in quantities that may damage bonding, finishing, or strength. All material passing the No. 40 (425 µm) sieve shall be non-plastic.
Carbonate content (magnesium or calcium)	At least 80%.

2. Gradation

   Grade the limerock base so at least 97 percent by weight passes the 3-1/2 in. (90 mm) sieve.

   a. Grade the material uniformly to dust. The fine portion passing the No. 10 (2 mm) sieve shall all be dust of fracture.

   b. Crush or break the limerock base, if necessary to meet size requirements before placing the material on the road.

   c. Ensure materials having soundness losses of 20 percent or less, comply with the following gradation requirements:

GRADATION REQUIREMENTS

Sieve Size	Percent Passing By Weight
2 in. (50 mm)	100
1-1/2 in. (37.5 mm)	95-100
¾ in. (19 mm)	60-95
No. 10 (2.00 mm)	25-45
No. 60 (250 µm)	10-30
No. 200 (75 µm)	7-20

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Material that passes a No. 200 (75µm) sieve	AASHTO T 11
Gradation	AASHTO T 27
Limerock bearing ratio	FL DOT Method FM5-515
Petrographic analysis	ASTM C 295
Total carbonates (insoluble residue)	ASTM D 3042

D. Materials Warranty

General Provisions 101 through 150.

815.2.03 Recycled Concrete Base

A. Requirements

1. Sources

   Use recycled concrete materials from sources approved by the Office of Materials and Testing and listed on Qualified Products List 2. The criteria for approval will be as outlined in Standard Operating Procedure No. 1, “Monitoring the Quality of Coarse and Fine Aggregates” except the raw material will be recyclable concrete as specified herein rather than a geological deposit of aggregate.

2. Type

   a. **Recycled Concrete Base from Known Sources**

      Use recycled concrete derived exclusively from Portland cement concrete pavement or structural concrete as a base, subbase, or shoulder course.

   b. **Recycled Concrete Base from Unknown Sources**

      Use recycled concrete derived from sources of demolition materials that comply with the following requirements as a base, subbase or shoulder course. Due to the condition and type of raw material used to produce this base and the resulting difficulty in producing a consistent product, refer to SOP-1 for environmental requirements and preferred production procedures.

Ensure the finished product does not exceed the regulatory limit for asbestos of 1 percent (based on microscopy) and the regulatory limit for lead of 5 ppm. These determinations must be made prior to shipping.

Ensure the California Bearing Ratio (CBR) of the finished product is not less than 120.

3. Gradation and Load-Bearing Capacity

Ensure the finished product meets the quality and gradation requirements of Subsection 815.2.01 for Group II aggregates, except the material finer than a No. 200 (75µm) sieve shall be 2 – 11 percent.

4. Contaminants

Ensure the recycled concrete is substantially free of foreign materials such as steel reinforcement, wood, clay balls, soils, epoxy expansion material and non-construction materials.

Note – Substantially free, in the context of this specification, shall mean concentrations of the above-mentioned foreign materials individually shall not exceed 0.1 percent by weight, nor shall the total concentration of these materials exceed 0.5 percent by weight.

Ensure the finished product does not exceed the regulatory limit for asbestos of 1% (based on microscopy) and the regulatory limit for lead of 5 ppm.

Keep the following ancillary materials within these limits:

Substance	Maximum Percent by Weight
Brick	2
Asphaltic Concrete	5
Weathered Rock	2
Any combination of Brick, Asphaltic Concrete or Weathered Rock	7

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Gradation	AASHTO T 27
Material that passes a #200 (75µm) sieve	AASHTO T 11
Sand Equivalent	GDT 63
California Bearing Ratio (CBR)	AASHTO T 193
Petrographic Analysis	ASTM C 295
Total Lead	EPA Method 3050/6010
Toxicity Characteristic Leaching Procedure	EPA Method 1311
Asbestos	EPA Polarized Light Microscopy Method or EPA Transmission Electron Microscopy Method

D. Materials Warranty

General Provisions 101 through 150.

Section 820—Asphalt Cement

Replace Section 820 with the following:

820.1 General Description

This section includes the requirements for asphalt cements prepared from crude petroleum.

820.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

AASHTO R 28

AASHTO R 92

AASHTO T 44

AASHTO T 48

AASHTO T 49

AASHTO T 51

AASHTO T 53

AASHTO T 179

AASHTO T 240

AASHTO T 313

AASHTO T 314

AASHTO T 315

AASHTO T 316

AASHTO T 350

AASHTO M 332

ASTM D 7173

SOP 4

SOP 15

QPL 7

QPL 65

QPL 98

QPL 106

C. Definitions

Performance Grade (PG): Method of classifying an asphalt cement binder relative to its rated performance at different testing temperatures.

Polymer Modified Asphalt (PG 76-22 PMA): Engineered asphalt cement which incorporates Styrene-Butadiene-Styrene (SBS) or Styrene-Butadiene (SB) polymers.

Highly Modified Polymer Asphalt (PG 76E-22): Engineered asphalt cement which incorporates significantly higher levels of Styrene-Butadiene-Styrene (SBS) or Styrene-Butadiene (SB) polymers than PG 76-22 PMA.

Terminal Blended Polymer-Rubber Hybrid (PG 76-22 TBPRH): An engineered blended polymer-ground tire rubber modified hybrid asphalt cement which is fully compliant with PG binder (PG76-22 PMA) specifications. TBPRH is blended at a refinery or terminal that is approved on GDOT's QPL 7 "Georgia's List of Approved Bituminous Materials Facilities" and transported to the asphaltic concrete producer's asphalt plant in a tanker.

Asphalt Rubber Binders (PG 76-22 ARB): Engineered asphalt cement which incorporates Styrene-Butadiene-Rubber (SBR) or Ground Tire Rubber (GTR). The GTR may incorporated into the asphalt concrete mixtures via a dry method when approved by the Office of Materials and Testing.

Hot Applied Non-Tracking Bituminous Tack: A non-tracking engineered asphalt cement based bituminous tack coat material that is applied using a conventional heated distributor.

820.2 Materials

820.2.01 Asphalt Cement

A. Requirements

1. Type

Use a material homogenous and water-free and will not foam when heated to 347 °F (175 °C).

Ensure blend used to produce a specified performance grade meets the following requirements:

- Is uniform and homogeneous without separation
- Uses PG 64-22 or PG 67-22 described below for the base asphalt with the exception of PG76E-22, where a different base PG binder may be used with the approval of the Office of Materials and Testing.
- Consists of production materials not being "air-blown".
- Contains < 0.5% acid (including Polyphosphoric Acid (PPA) modification, when approved by the Office of Materials and Testing.
- Only additives or modifiers approved by the Office of Materials and Testing are to be used.

2. Grade

Use the various grades of asphalt cement meeting the requirements shown in the test requirements for Petroleum Asphalt Cements.

Add Styrene-Butadiene-Styrene (SBS) or Styrene-Butadiene (SB) to neat asphalt to produce a binder meeting requirements for PG 76-22 PMA or PG 76E-22, when specified, when roadway ADT is equal to or greater than 100,000 for Stone Matrix Asphalt (SMA) and Porous European Mix (PEM) or Open Graded Friction Course (OGFC) Mixtures. When approved by the Office of Materials and Testing, PG 76-22 TBPRH meeting all the requirements for PG 76-22 PMA and subsection 820.2.01.2, Note g, may be used when roadway ADT is equal to or greater than 100,000 ADT for SMA, PEM and OGFC mixtures.

Styrene Butadiene Rubber (SBR) or crumb rubber modified PG 76-22 are acceptable alternatives to SBS or SB modified asphalt cement at contractor's discretion, when roadway ADT is less than 100,000, provided the SBR or crumb rubber modified asphalt cement meets the tests' requirements specified in Table 8.

For SBR modified PG 64-22 or PG 67-22 to meet PG 76-22 ARB, use only SBR currently approved on QPL 65 "Georgia's List of Approved Latex Suppliers". For crumb rubber modified PG 64-22 or PG 67-22 to meet PG 76-22 ARB, use only GTR approved on QPL 106 "Georgia's List of Approved Ground Tire Rubber Suppliers" at a minimum 10% of weight of neat asphalt cement content of the asphaltic concrete mixture. Ensure Trans-Polyoctenamer is added at 4.5% of the weight of the crumb rubber to achieve better particle distribution. Other workability additives approved on QPL 98 "Georgia's List of Approved Workability Additives" may be used, provided the end product meets the specified requirements of PG 76-22 ARB. PG 76-22 ARB produced using ≥8%<10% GTR incorporating an approved GTR and workability additive combination is approved in accordance with Table 8 and Note c. Ensure the end product is homogenous and shows no separation or coagulation. Percentage of ambient or cryogenic ground tire rubber is neat asphalt source dependent to meet specification requirements for PG 76-22 ARB.

Performance Graded Binders approved on QPL 7 "(Georgia's List of Approved Bituminous Materials)" shall conform to the following PG requirements.

SUPERPAVE BINDER TABLE 1 – HOT APPLIED NON-TRACKING BITUMINOUS TACK

Test and Method	Test Temperature	Specification	Notes
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	180 °F (82 °C)	Minimum 1.00 kPa	
Penetration, 100g, 5 sec, AASHTO T 49	77 °F (25 °C)	Maximum 25	
Softening Point (°F) AASHTO T 53		Maximum 158 °F (70 °C)	

SUPERPAVE BINDER TABLE 2 – PG 58-22

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	136 °F (58 °C)	Minimum 1.00 kPa	
Solubility of Bituminous Materials AASHTO T 44	Standard Test 77 ±0.5 °F (25 ±0.25 °C) Re-test 100 ±0.5 °F (37.8 ±0.25 °C)	Minimum 99.0%	d
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	136 °F (58 °C)	Minimum 2.20 kPa	
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	72 °F (22 °C)	Maximum 6000 kPa	
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA	
		m-value Minimum 0.300	

SUPERPAVE BINDER TABLE 3 – PG 64-22

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	147 °F (64 °C)	Minimum 1.00 kPa	
Solubility of Bituminous Materials AASHTO T 44	Standard Test 77 ±0.5 °F (25 ±0.25 °C) Re-test 100 ±0.5 °F (37.8 ±0.25 °C)	Minimum 99.0%	d
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	147 °F (64 °C)	Minimum 2.20 kPa	
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	77 °F (25 °C)	Maximum 6000 kPa	
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA	
		m-value Minimum 0.300	

SUPERPAVE BINDER TABLE 4 – PG 67-22

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	153 °F (67 °C)	Minimum 1.00 kPa	
Solubility of Bituminous Materials AASHTO T 44	Standard Test 77 ±0.5 °F (25 ±0.25 °C) Re-test 100 ±0.5 °F (37.8 ±0.25 °C)	Minimum 99.0%	d
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	153 °F (67 °C)	Minimum 2.20 kPa	
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	80 °F (26.5 °C)	Maximum 6000 kPa	
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA	
		m-value Minimum 0.300	

SUPERPAVE BINDER TABLE 5 – PG 76-22 PMA

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 1.00 kPa	
Dynamic Shear, Phase Angle δ AASHTO T 315,	169 °F (76 °C)	Maximum 75°	e
Solubility of Bituminous Materials AASHTO T 44	Standard Test 77 ±0.5 °F (25 ±0.25 °C) Re-test 100 ±0.5 °F (37.8 ±0.25 °C)	Minimum 99.0%	d
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 2.20 kPa	
Multiple Stress Creep Recovery, J_{nr}, 3.2 AASHTO T 350	147 °F (64 °C)	Maximum 0.50 kPa^{-1} Maximum $J_{nr\ diff}$ = 75%	h
Multiple Stress Creep Recovery, % Recovery AASHTO M 332	147 °F (64 °C)	$\%Recovery_{3.2} > 29.37 (J_{nr\ 3.2})^{-0.2633}$	
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	80 °F (26.5 °C)	Maximum 6000 kPa	

Test and Method	Test Temperature	Specification	Notes
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA	
		m-value Minimum 0.300	

SUPERPAVE BINDER TABLE 6 – PG 76E-22

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 5.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 3.00 kPa	
Solubility of Bituminous Materials AASHTO T 44	Standard Test 77 ±0.5 °F (25 ±0.25 °C) Re-test 100 ±0.5 °F (37.8 ±0.25 °C)	Minimum 99.0%	d
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 5.00 kPa	
Multiple Stress Creep Recovery, J_{nr}, 3.2 AASHTO T 350	169 °F (76 °C)	Maximum 0.50 kPa^{-1} Maximum $J_{nr\ diff}$ = 75%	f, h
Multiple Stress Creep Recovery, % Recovery AASHTO M 332	169 °F (76 °C)	$\%Recovery_{3.2} \geq 90$	f
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	80 °F (26.5 °C)	Maximum 6000 kPa	

Test and Method	Test Temperature	Specification	Notes
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA	
		m-value Minimum 0.300	

SUPERPAVE BINDER TABLE 7 – PG 76-22 TBPRH

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 1.00 kPa	
Dynamic Shear, Phase Angle δ AASHTO T 315,	169 °F (76 °C)	> 42 ≤ 75°	e
Solubility of Bituminous Materials AASHTO T 44	Standard Test 77 ±0.5 °F (25 ±0.25 °C) Re-test 100 ±0.5 °F (37.8 ±0.25 °C)	Minimum 99.0%	d
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 2.20 kPa	
Multiple Stress Creep Recovery, J_{nr}, 3.2 AASHTO T 350	147 °F (64 °C)	Maximum 0.50 kPa^{-1} Maximum $J_{nr\ diff}$ = 75%	h
Multiple Stress Creep Recovery, % Recovery	147 °F (64 °C)	$\%Recovery_{3.2} > 29.37\ (J_{nr\ 3.2})^{-0.2633}$	f

Test and Method	Test Temperature	Specification	Notes
AASHTO M 332			
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	80 °F (26.5 °C)	Maximum 6000 kPa	
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA	
		m-value Minimum 0.300	
OTHER TESTS			
Polymer Separation Test ASTM D 7173	325.4 ± 9 °F (163 ±5 °C)	Maximum 18 °F (10 °C) difference between top and bottom specimens	
All PG 76-22 TBPRH Materials must meet initial evaluation requirements detailed in Note g			

SUPERPAVE BINDER TABLE 8 – PG 76-22 ARB

Test and Method	Test Temperature	Specification	Notes
Flash Point AASHTO T 48		Minimum 446 °F (230 °C)	
Rotational Viscosity AASHTO T 316	275 °F (135 °C)	Maximum 3.0 Pa-s	a, b
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 1.00 kPa	b
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240			
Mass Loss % AASHTO T 240	325 ±1.8 °F (163 ±1 °C)	Maximum 1.0	b
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	169 °F (76 °C)	Minimum 2.20 kPa	b
ROLLING THIN FILM OVEN TEST RESIDUE (RTFO) AASHTO T 240 PG76-22 ARB USING ≥ 8 < 10% GTR			
Multiple Stress Creep Recovery, J_{nr}, 3.2 AASHTO T 350	147 °F (64 °C)	Maximum 0.50 kPa^{-1} Maximum $J_{nr\ diff}$ = 75%	b, c, h

Test and Method	Test Temperature	Specification	Notes
Multiple Stress Creep Recovery, % Recovery AASHTO M 332	147 °F (64 °C)	$\%Recovery_{3.2} > 29.37\ (J_{nr\ 3.2})^{-0.2633}$	b, c
PRESSURE AGING VESSEL (PAV) AASHTO R 28			
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	80 °F (26.5 °C)	Maximum 6000 kPa	b
Creep Stiffness AASHTO T 313 @ 60 sec	10 °F (-12 °C)	S (Stiffness) Maximum 300 MPA m-value Minimum 0.300	b
OTHER TESTS			
Polymer Separation Test ASTM D 7173	325.4 ±9 °F (163 ±5 °C)	Maximum 18 °F (10 °C) difference between top and bottom specimens	b
AASHTO T 51, 5 cm per min, cm	77 °F (25 °C)	Ductility Minimum 15 cm	b
All PG 76-22 ARB Materials must meet initial evaluation requirements detailed in Note g			

Notes:

a. The Department may waive this requirement if the supplier warrants the asphalt binder can be adequately pumped and mixed at temperatures meeting all applicable safety standards.

b. PG 64-22 or PG 67-22 modified to meet PG 76-22 ARB using crumb rubber, via dry method, will be evaluated using complete analysis for compliance with PG 76-22 ARB requirements prior to mixture production using laboratory blended materials. PG 64-22 or PG 67-22 modified to meet PG 76-22 ARB using crumb rubber via dry method, will be evaluated for compliance with original DSR testing requirements for PG 76-22 during mixture production using abson recovery in accordance with GDT 119 in compliance with AC sampling frequencies established in GSP 21 sub-section A.9.

c. AASHTO T 350 and R 92 shall be used in lieu of AASHTO 51 for PG 76-22 ARB incorporating ≥ 8 < 10% GTR in accordance with Table 8.

d. Ensure Solubility testing results performed in accordance with AASHTO T 44 are included on all Performance Graded and TBPRH binders' Certificates of Analysis (COA) submitted with annual QPL 7 documents. The Department may sample and perform Solubility testing at greater than minimum required frequencies.

e. Phase Angle testing shall be conducted in lieu of AASHTO T 350 and R 92 for all "Start-up" samples which are required when an asphalt plant has not produced mixture for more than seven (7) calendar days,

f. MSCR testing in accordance with AASHTO T 350 and R 92, shall also be conducted for all "Start-up" samples which are required when an asphalt plant has not produced mixture for more than seven (7) calendar days in addition to the standard testing requirement use.

g. All asphalt binders incorporating GTR require three (3) successful minimum one (1) year trial test sections, for that GTR Modifier and Workability Additive combination, prior to approval on QPLs 98 and 106. Additionally, all GTR Modifier and Workability Additives combinations will be approved mix type specific, requiring a minimum of one (1) acceptable test section for each mix type, prior to its use in that mix type project wide.

h. The $J_{nr\ diff}$ requirement shall not apply to asphalt binders having a $J_{nr\ 3.2}$ value of 0.5 kPa^{-1} or lower at the selected temperature.

Thoroughly blend the composite materials at the supply facility prior to being loaded into the transport vehicle if modification is required in accordance with 820.2.01. Ensure all blending procedures, formulation, and operations are approved by the Office of Materials and Testing.

3. Certification:

Provide certified test results from an approved, certified laboratory of blends for proposed PG asphalt for each specification characteristic of the asphalt cement proposed for shipment. Provide the certified results to the State Materials Engineer as required in Standard Operating Procedure (SOP 4).

The State Materials Engineer may interrupt production until test results are known in the event there is reason to suspect a sample will be outside specification limits. Mixture placed incorporating modified binders determined to not meet specification requirements may be subject to removal at the recommendation of the State Materials Engineer.

B. Materials Warranty

General Provisions 101 through 150.

Section 821—Cutback Asphalt

Replace Section 821 with the following:

821.1 General Description

This section includes the requirements for asphalt cements that have been fluxed with petroleum distillates.

821.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

AASHTO T 44

AASHTO T 48

AASHTO T 49

AASHTO T 51

AASHTO T 55

AASHTO T 78

AASHTO T 79

AASHTO T 201

AASHTO T 295

821.2 Materials

821.2.01 Cutback Asphalt

A. Requirements

1. Type: Use an asphalt cement that is uniformly consistent and shows no separation or curbing.
2. Grade: Use various grades of cutback asphalts that meet the requirements shown in Table 1 and Table 2.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follow:

Test	Method
Water	AASHTO T 55
Flash point	AASHTO T 79 & T 48
Specific Gravity (API Method)	AASHTO T 295
Viscosity	AASHTO T 201
Distillation	AASHTO T 78
Ductility	AASHTO T 51
Solubility	AASHTO T 44
Penetration	AASHTO T 49

D. Materials Warranty

General Provisions 101 through 150.

TABLE 1—PROPERTIES OF MEDIUM CURING CUTBACK ASPHALTS

Requirements	Viscosity Grade									
	MC-30		MC-70		MC-250		MC-800		MC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water percent		0.2		0.2		0.2		0.2		0.2
Flash point, Cleveland Open Cup, °F (°C)	100 (38)		100 (38)		150 (65)		150 (65)		150 (65)	
Specific Gravity (API Method)	Report and Use for Distillation Test									
Kinematic viscosity at 140 °F, centistokes (60 °C, mPa·s)	30	60	70	140	250	500	800	1600	3000	6000
Distillation test: Distillate, percentage by volume of total distillate to 680 °F (360 °C)										
to 437 °F (225 °C)		25		20		10				
to 500 °F (260 °C)	40	70	20	60	15	55		35		15
to 600 °F (315 °C)	75	93	65	90	60	87	45	80	15	75
Residue from distillation to 680 °F (360 °C) Volume percentages of sample by difference	50		55		67		75		80	
Tests on residue from distillation:										
Penetration, 100g, 5 sec., at 77 °F (25 °C), (dmm)	80	250	80	250	80	250	80	250	80	
Ductility at 77 °F (25 °C), at 5 cm per min., (cm)	100		100		100		100		100	250
Solubility in trichloroethylene, percent by weight	99.5		99.5		99.5		99.5		99.5	

TABLE 2—PROPERTIES OF RAPID CURING CUTBACK ASPHALTS

Requirements	Viscosity Grade									
	RC-30		RC-70		RC-250		RC-800		RC-3000	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Water percent		0.2		0.2		0.2		0.2		0.2
Flash point, Tagliabue Open Cup, °F (°C)					80 (25)		80 (25)		80 (25)	
Specific Gravity (API Method)	Report and Use for Distillation Test									
Kinematic viscosity at 140 °F (60 °C, mPa·s)	30	60	70	140	250	500	800	1600	3000	6000
Distillation test: Distillate, percentage by volume of total distillate to 680 °F (360 °C)										
to 374 °F (190°C)	15		10							
to 437 °F(225 °C)	55		50		35		15			
to 500 °F (260 °C)	75		70		60		45		25	
to 600 °F (315 °C)	90		85		80		75		70	
Residue from distillation to 680 °F (360°C): Volume percentages of sample by difference	50		55		65		75		80	
Tests on residue from distillation:										
Penetration, 100g, 5 sec., at 77 °F (25 °C), (dmm)	60	120	60	120	60	120	60	120	60	120
Ductility at 77 °F (25 °C), at 5 cm per min., (cm)	100		100		100		100		100	250
Solubility in trichloroethylene, percent by weight	99.5		99.5		99.5		99.5		99.5	

Section 828—Hot Mix Asphaltic Concrete Mixtures

Replace Section 828 with the following:

828.1 General Description

This specification includes the requirements for hot mix asphaltic concrete mixtures, including:

- Open-graded surface mixtures (OGFC and PEM)
- Stone Matrix Asphalt mixtures (SMA)
- Superpave mixtures
- Fine-graded (4.75 mm) mixtures

828.1.01 Definitions

The Nominal Maximum Sieve Size is one standard sieve size larger than the first sieve to retain more than ten percent of the aggregate, per AASHTO R35. Mixture types in this section are identified according to Nominal Maximum Sieve Size.

828.1.02 Related References

A. Standard Specifications

Section 400-Hot Mix Asphaltic Concrete Construction

Section 402-Hot Mix Recycled Asphaltic Concrete

Section 800–Coarse Aggregate

Section 802–Aggregates for Asphaltic Concrete

Section 819–Fiber Stabilizing Additives

Section 820–Asphalt Cement

Section 831–Admixtures

Section 882–Lime

Section 883–Mineral Filler

B. Referenced Documents

AASHTO R30

AASHTO R35

AASHTO TP 108

AASHTO T 112

AASHTO T 209

AASHTO T 245

AASHTO T 305

AASHTO T 312

AASHTO T 321

AASHTO T 324

AASHTO T 331

AASHTO T 340

SOP-2

SOP-36

GDT 1

GDT 56

GDT 63

GDT 66

GDT 114

GDT 115

GDT 123

QPL 1

QPL 2

QPL 7

QPL 26

QPL 41

QPL 77

QPL 81

828.2 Materials

A. Requirements

Use approved hot mix asphalt concrete mixtures that meet the following requirements:

1. Produce each asphalt mixture according to a Department approved Job Mix Formula and Asphalt Mix Design, see Subsection 400.1 for submittal and approval of Job Mix Formulas.
2. Ensure individual acceptance test results meet the Mixture Control Tolerances specified in the appropriate table below, Subsections 828.2.01 through 828.2.04.
3. Ensure the Engineer approves all materials used to prepare and place the mixtures before incorporating them into the Work. Use only the ingredients listed in the approved Asphalt Mix Design and Job Mix Formula. For virgin aggregates use sources meeting the requirements of Section 802 and are listed in QPL 1 or QPL 2; for mixes in which local sand is permitted, use the approved sand source identified in the mix design. For mixtures containing Reclaimed Asphalt Pavement (RAP), use only RAP from the approved stockpile identified in the mix design. Use asphalt cement meeting the requirements of Section 820, from a source listed in QPL 7.
4. Obtain approved Open-Graded Friction Course (OGFC), Porous European Mix (PEM), Stone Matrix Asphalt Mix (SMA), Superpave and 4.75 mm mix designs from a mix design laboratory certified by the Department. Ensure all SMA mix designs are designed in accordance with GDT-123 (“Determining the Design Proportions of Stone Matrix Asphalt Mixtures”). Ensure all OGFC and PEM mix designs are designed in accordance with GDT 114 “Determining Optimum Asphalt Content for Open-graded Bituminous Paving Mixtures and Sub-section 828.2.01.Ensure OGFC, PEM and SMA mix designs are verified and approved by the Department prior to use. Batched materials, and gyrated specimens where applicable, for required mix design verification are to be submitted with the initial mix design approval request. Ensure Superpave and 4.75 mm mix designs are designed in accordance with SOP-2 ("Control of Superpave Bituminous Mixture Designs") and are approved

by the Department as provided therein. Ensure all mixes are designed by a laboratory and technician certified in accordance with SOP-36, ("Certification of Laboratories and Personnel for Design of SMA and Superpave Asphalt Mixtures"). Mix Design Technicians certified to design SMA mixtures are approved to design OGFC and PEM mixtures. The Department approves submitted mix designs for compliance with specified requirements and laboratory performance test data. The contractor is responsible for the placement in accordance with Sections 400 and 402 for the GDOT approved mix designs.

Use only mixtures composed of the aggregate groups and blends indicated in the Proposal and Plans by their pay item designations, defined as follows:

TABLE 1 – AGGREGATE GROUPS

Pay Item Designation	Allowable Aggregate Groups
Group I or II	Group I, Group II, or Blend I
Group II only	Group II only
Blend I	Either 100% Group II material or a blend of Group I and Group II. Do not use Group I material for more than 60%, by weight, of the total aggregate nor more than 50%, by weight, of the coarse aggregate fraction.

5. For patching or leveling use Group I, Group II, or Blend I. Mix types for patching and leveling are specified in Subsection 400.3.03.B.
6. Include lime (hydrated lime) from an approved source and meeting the requirements of Section 882 in all paving courses except as otherwise provided in the Contract. For a list of approved sources of lime, see QPL 41.
    a. Add lime to each mixture at the rate prescribed in the approved mix design.
    b. Ensure mix designs using only virgin aggregate include lime at a minimum rate of 1.00% of the total dry aggregate weight. Ensure mix designs using RAP include lime at a minimum rate equal to 1.00% of the virgin aggregate fraction plus 0.50% of the aggregate in the RAP fraction.
    c. Add more lime or add lime plus an approved Heat-Stable Anti-Stripping Additive meeting the requirements of Section 831, if necessary to meet requirements for mixture properties, and pursuant to an approved mix design. However, the Department will not make additional payment for these materials. For a list of sources of Heat-Stable Anti-Stripping Additives, see QPL 26.
    d. Where specifically allowed in the contract and pay item on local assistance, airport, and parking lot projects, an approved Heat-Stable Anti-Stripping Additive meeting the requirements of Section 831 may be substituted for hydrated lime. Ensure the mix gradation is adjusted to replace the lime with an equivalent volume of fines passing the 0.075 mm sieve. Add Heat-Stable Anti-stripping Additive at a minimum rate of 0.5 percent of the asphalt cement portion.
7. Use performance grade PG 64-22 or PG 67-22 asphalt cement in all mix designs and mixtures except as follows:
    a. The State Materials Engineer will determine the performance grade to be used, based on Table 2 – Binders Selection Guideline for Reclaimed Asphalt Pavement (RAP) Mixtures, AASHTO M323 and laboratory testing results as required in Section 828.2.B for mixtures containing ≥ 25% equivalent binder replacement for RAP/RAS mixtures.
    b. Use only grade PG 76-22, excluding shoulder construction in the following mixes: all SMA, 12.5 mm PEM, 9.5 mm and 12.5 mm OGFC, 12.5 mm Superpave, on projects with two-way ADT greater than 25,000; and in all mixtures for which polymer-modified asphalt is specified in the pay item.

8. Use of local sand is restricted as follows:
   a. Do not place mixtures containing local sand on the traveled way of the mainline or ramps of the Interstate System. Mixtures with local sand may be used for shoulder construction on these facilities.
   b. Ensure local sand will not constitute more than 20 % of the total aggregate weight of any mix design or production mix.
   c. Subject to the above limits, 19 mm, 12.5 mm, and 9.5 mm Superpave mix designs and 4.75 mm mix designs containing local sand may be used on projects with a current ADT not exceeding 4,000 VPD providing that all performance testing meets specified requirements.
   d. 25 mm Superpave mix designs containing not more than 20 % local sand may be used on all facilities except the main line and ramps of the Interstate System.
   e. Obtain local sand for use in asphalt mixtures from a source approved by the Department.
   f. Approval of local sand sources: The Department will sample, test, and approve sources of local sand. Ensure local sand contains no more than 7.0% clay by weight and is free of foreign substances, roots, twigs, and other organic matter. Ensure sand is free of clay lumps, as determined by AASHTO T 112, and has a sand equivalent value exceeding 25%, as determined by GDT 63.

B. Fabrication

1. Design procedures: For all Superpave and 4.75 mm mixes, ensure conformance with the Superpave System for Volumetric Design (AASHTO T 312 and AASHTO R30), as adapted in SOP-2. Ensure Superpave mixes are designed at a design gyration number (N_{des}) of 65 gyrations and initial gyration number (N_{ini}) of 6 gyrations. Ensure 4.75 mm mixes, (N_{des}) are designed at 50 gyrations, and (N_{ini}) at 6 gyrations. Open-graded mix designs will be designed by the Department in accordance with GDT 114. In all cases, the procedure for measuring Maximum Specific Gravity (G_{mm}) is AASHTO T 209. In addition to gradation and volumetric analysis, ensure mix designs include the following performance tests, as applicable.
2. Performance Test:
   a. Permeability test: Ensure Superpave and Stone Matrix mix designs include testing according to GDT -1 Measurement of Water Permeability of Compacted Asphalt Paving Mixtures. Ensure specimen air voids for this test are 6.0 ±1.0 %. The average permeability of three specimens may not exceed 3.60 ft per day (125 ×10–5cm per sec).
   b. Moisture Susceptibility test: For all mixtures excluding OGFC and PEM mixtures, fabricate and test specimens in accordance with GDT 66, when required by the Office of Materials and Testing due to visible signs of stripping in laboratory fabricated or plant produced asphaltic concrete mixtures. GDT 66 may also be used to evaluate moisture damage susceptibility for virgin asphaltic concrete 4.75 mm and 9.5 mm Types I and II Superpave surface mixtures failing to meet GDOT specified Hamburg Stripping Inflection Point requirements. These mixtures must comply with Hamburg Wheel Tracking Test rutting requirements. Ensure specimen air voids for this test are 7.0 ±1.0% for all mixes excluding Stone Matrix mixes. Ensure specimen air voids for this test are 6.0 ± 1.0% for Stone Matrix mixes. For all mix types, the minimum tensile splitting ratio is 0.80, except a tensile splitting ratio of no less than 0.70 may be acceptable if all individual strength values exceed 100 psi (690 kPa). Ensure individual splitting strength of the three conditioned and three controlled samples are not less than 60 psi (415 kPa). Ensure retention of coating as determined by GDT 56 is not less than 95%.
   c. Hamburg Wheel-Tracking Test for rutting and moisture susceptibility test: Ensure mix designs of all mix types except Open-graded Surface Mixes (OGFC and PEM), and Open-graded Crack Relief Interlayer (OGI) mix, include testing in accordance with AASHTO T 324. Ensure specimen air voids for this test are 7.0 ± 1.0% for all mix types, other than SMA mixes and at a testing temperature of 50°C (122°F). Ensure specimen air voids for this test are 6.0 ±1.0 % for SMA mixtures and at a testing temperature of 50°C (122°F). Use the testing and acceptance criteria established in Table 2.

TABLE 2 – HAMBURG WHEEL TRACKING DEVICE TESTING AND ACCEPTANCE CRITERIA

Binder Performance Grade (PG)	Mix Type	Number of Passes	Maximum Rut Depth	Stripping Inflection Point
PG 64-22 and PG 67-22	4.75 mm, 9.5 mm SP Type I, and 9.5 mm SP Type II	15,000	≤ 12.5 mm	> 15,000
PG 64-22 and PG 67-22	12.5 mm SP, 19 mm SP and 25 mm SP	20,000	≤ 12.5 mm	> 20,000
PG 76-22	All Mix types	20,000	≤ 12.5 mm	> 20,000

Tested specimens shall be inspected for any visible signs of stripping and any mix design's tested specimens that fail to maintain 95% of asphalt cement coating, as described in GDT 56 section D.2.d, will be required to meet specified requirements for GDT 66 as detailed in 828.2.B.2.b.

d. Fatigue testing: The Department may verify dense-graded mix designs by fatigue testing according to AASHTO T 321 or other procedure approved by the Department.

e. Abrasion Loss of Asphaltic Mixture testing: The Department will evaluate Open-graded Friction Course, Porous European Mix and SMA Types in accordance with AASHTO TP 108. In accordance with AASHTO T 312, compact OGFC and PEM specimens using the Superpave Gyrator Compactor to a specimen height of 115 ± 5 mm and specimen air void content range specified in Sub-section 828.2.01.A. Specimen air voids for the SMA specimens shall be 6.0 % ± 1.0 % with a specimen height of 115 ± 5 mm. Bulk Specific Gravity of the compacted open-graded mixtures shall be determined using Corelok vacuum-sealing device in accordance with AASHTO T 331. Individual specimen and average of three specimens for OGFC and PEM and SMA shall be reported for mix design acceptance.

C. Acceptance

See Subsection 106.03 and Section 400. Ensure individual test results meet the Mixture Control Tolerances listed in Subsections 828.2, 828.2.01 ,828.2.02, 828.2.03, or 828.2.04, whichever applies with the following exception. Ensure field verification results for rutting susceptibility tests performed on laboratory fabricated and/or roadway cores obtained from asphalt plant produced mixtures meet specified requirements for AASHTO T 324 as detailed in Subsection 828.2.B.2.c. All GDOT approved mix designs are required to have full field mix design verifications, using plant produced mixture, sampled by the contractor and submitted to the applicable GDOT laboratory (Central or District) at a minimum of once per two years. Field mix design verification results that fail to comply with performance testing specified in Subsection 828.2.B will require a complete laboratory mix design verification, to be completed by the original mix designer, for continued use of that design. If a mix design has not been produced within two years, a full field mix design verification will be sampled by the contractor and submitted to the applicable GDOT laboratory (Central or District) on the first Lot produced thereafter. Any mix design that fails to meet performance test requirements established in Subsection 828.2.B, using laboratory fabricated specimens due to failing field mix design results, may subject that mix design to invalidation after the field mix design verification results are confirmed with a second field mix design verification. Field mix design verifications as specified in Section 402, Section 400, SOP 2 and GSP 21, are not precluded by the requirements specified herein.

D. Materials Warranty

See General Provisions 101 through 150.

828.2.01 Open-Graded Surface Mixtures

A. Requirements

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure Open-Graded Surface Mixtures meet the following mixture control tolerances and mix design criteria:

Sieve Size	Mixture Control Tolerance, %	Design Gradation Limits, % Passing		
		9.5 mm OGFC	12.5 mm OGFC	12.5 mm PEM
3/4 in. (19 mm) sieve	±0.0		100*	100*
1/2 in. (12.5 mm) sieve	±6.1	100*	85-100	80-100
3/8 in. (9.5 mm) sieve	±5.6	85-100	55-75	35-60
No. 4 (4.75 mm) sieve	±5.7	20-40	15-25	10-25
No. 8 (2.36 mm) sieve	±4.6	8-15	5-15	5-10
No. 200 (75 µm) sieve	±2.0	4 - 6	3-5	2-4
Range for % AC	±0.4	6.25-7.25	6.00-7.25	5.75-7.00
Range for Mix Design Air Voids %		15 - 18	15 - 20	18 - 22
Class of stone (Section 800)		“A” only	“A” only	“A” only
Drain-down (AASHTO T305), %		<0.3	<0.3	<0.3
Abrasion Loss % (AASHT0 TP 108)		Report	Report	Report

* Mixture control tolerance is not applicable to this sieve for this mix.

1. In 12.5 mm and 9.5 mm OGFC and 12.5 mm PEM mixes, use only PG 76-22 asphalt cement (specified in Section 820).
2. Ensure all OGFC and PEM mixes include a stabilizing fiber of the type (cellulose or mineral) specified in the mix design and meeting the requirements of Section 819. Ensure the dosage rate is as specified in the mix design and sufficient to prevent drain-down exceeding the above tolerance.

B. Fabrication

See Section 400.

828.2.02 Stone Matrix Asphalt Mixtures

A. Requirements

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure Stone Matrix Asphalt mixtures meet the following mixture control tolerances and mix design criteria:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing		
		9.5 mm SMA	12.5 mm SMA	19 mm SMA
1 in. (25 mm) sieve	±0.0			100*
3/4 in. (19 mm) sieve	±7.0	100*	100*	90-100
1/2 in. (12.5 mm) sieve	±6.1	98-100**	85-100	44-70
3/8 in. (9.5 mm) sieve	±5.6	70-100	50-75	25-60
No. 4 (4.75 mm) sieve	±5.7	28-50	20-28	20-28
No. 8 (2.36) mm sieve	±4.6	15-30	16-24	15-22
No. 50 (300 µm) sieve	±3.8	10-17	10-20	10-20
No. 200 (75 µm) sieve	±2.0	8-13	8-12	8-12
Range for % AC (Note 1)	±0.4 (Note 2)	6.0-7.5	5.8-7.5	5.5-7.5
Design optimum air voids (%)		3.5 ±0.5	3.5 ±0.5	3.5 ±0.5
% aggregate voids filled with AC (VFA)		70-90	70-90	70-90
Tensile splitting ratio after freeze-thaw cycle GDT-66		≥ 80%	≥ 80%	≥ 80%
Drain-down (AASHTO T305), %		<0.3	<0.3	<0.3
Abrasion Loss % (AASHT0 TP 108)		Report	Report	Report

*Mixture control tolerance is not applicable to this sieve for this mix.

**Mixture control tolerance is ± 2.0% for this sieve for 9.5 mm SMA mixes placed at spread rates greater than 135 lb./yd^2. For 9.5 mm SMA mixes placed at spread rates of 135 lb./yd^2 or less, 100 % passing is required on this sieve.

Note 1: Range for % AC is Original Optimum AC (OOAC) at 35 gyrations (Gyratory compactor) or 50 blows (Marshall compactor) prior to Corrected Optimum AC (COAC) calculation detailed in GDT 123 (Appendix A)

Note 2: Quality Acceptance Test Results for AC content that deviate > ± 0.3% from the approved Job Mix Formula (JMF) consistently over three lots may subject the mix to a revised AC content on project JMF at the discretion of the State Materials Engineer based on statistical trend.

1. Ensure SMA mixtures are compacted at 35 gyrations with the Superpave Gyratory compactor or 50 blows with the Marshall compactor.
2. Ensure SMA mixtures contain mineral filler and fiber stabilizing additives and meet the following requirements:
   a. Asphalt cement grade PG-76-22 (specified in Section 820) is required in all SMA mixtures.
   b. Aggregates for SMA meet the requirements of Subsection 802.2.02.A.3.
   c. Use the approved mineral filler specified in the mix design and meeting the requirements of Section 883 Approved sources of mineral filler are listed in QPL 81.

   Use the approved Fiber Stabilizing Additive of the type (cellulose or mineral) specified in the mix design and meeting the requirements of Section 819. Approved sources of Fiber Stabilizing Additive are listed in QPL 77.

The dosage rate will be as specified in the mix design and sufficient to prevent drain-down exceeding the above tolerance.

B. Fabrication

See Section 400.

828.2.03 Superpave Asphalt Concrete Mixtures

A. Requirements for Superpave Mixtures (except Parking Lot Mixtures)

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure Superpave Asphalt Concrete mixtures meet the following mixture control tolerances and mix design limits:

1. Gradation limits for Superpave mixtures are as follows:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing				
		9.5 mm Superpave Type I	9.5 mm Superpave Type II	12.5 mm Superpave (Note 1)	19 mm Superpave	25 mm Superpave
1½ in. (37.5 mm)						100*
1 in. (25.0 mm)	± 8.0			100*	100*	90-100
3/4 in. (19.0 mm)	±8.0**	100*	100*	98-100****	90-100	55-89**
1/2 in. (12.5 mm)	±6.0***	98-100****	98-100****	90-100	60-89***	50-70
3/8 in. (9.5 mm)	±5.6	90-100	90-100	70-89	55-75	
No. 4 (4.75 mm)	±5.6	65-85	55-75			
No. 8 (2.36 mm)	±4.6	48-55	42-47	38-46	32-36	30-36
No. 200 (75 µm)	±2.0	5.0-7.0	5.0-7.0	4.5-7.0	4.0-6.0	3.5-6.0
Range for % AC (Note 3)	± 0.4 (Note 2)	5.50-7.25	5.25-7.00	5.00-6.25	4.25-5.50	4.00-5.25

*Mixture control tolerance is not applicable to this sieve for this mix.

**Ensure mixture control tolerance is within ± 10.0% for this sieve for 25 mm Superpave.

***Ensure mixture control tolerance is within ± 8.0% for this sieve for 19 mm Superpave.

****Ensure mixture control tolerance is within ± 2.0% for this sieve for 12.5 mm and 9.5 mm mixes.

Note 1: Use PG 76-22 in 12.5 mm Superpave, excluding shoulder construction, on all projects with ADT greater than 25,000 as detailed in the Contract Pay Item.

Note 2: Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.

Note 3: Range for % AC is Original Optimum AC (OOAC) at 65 gyrations prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D).

2. Volumetric limits are as follows:

Design Parameter	Mix Type	Limits
% of Max. Specific Gravity (Gmm) at design gyrations, (Ndes)	All	96%
% Gmm at the initial number of gyrations, Ni	All	91.5% maximum
% voids filled with asphalt (VFA) at Ndes	9.5 mm Type I	Min. 72; Max. 80
	9.5 Type II and 12.5 mm	Min. 72; Max. 76
	19 mm	Min. 71; Max 76
	25 mm	Min. 69; Max 76
Fines to effective asphalt binder ratio (F/Pbe)	9.5 mm Type I	0.6 to 1.4
	All other types	0.8 to 1.6
Minimum Film Thickness (microns)	All	> 7.00
Minimum % Voids in Mineral Aggregate (VMA) Note: VMA shall be calculated using the effective specific gravity of the aggregate (Gse). See SOP-2SP.	25 mm	13.0
	19 mm	14.0
	12.5 mm	15.0
	9.5 Type I	16.0
	9.5 Type II	16.0

B. Requirements for Superpave Parking Lot Mixes (NOT FOR STANDARD HIGHWAY/STREET PAVING)

1. Surface layers for parking facilities:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing		
		4.75 mm Mix	9.5 mm Superpave Type I	9.5 mm Superpave Type II
1 in. (25.0 mm) sieve	± 8.0			
3/4 in. (19.0 mm) sieve	±8.0**		100*	100*
1/2 in. (12.5 mm) sieve	±6.0	100*	98-100****	98-100****
3/8 in. (9.5 mm) sieve	±5.6	90-100	90-100	90-100
No. 4 (4.75 mm) sieve	±5.6	75-95	65-85	55-75
No. 8 (2.36 mm) sieve	±4.6	60-65	48-55	42-47
No. 50 (300 μm) sieve	+3.8	20-50		
No. 200 (75 μm) sieve	±2.0	4-12	5.0-7.0	5.0-7.0
Range for Total AC	+ 0.4	6.00 - 7.50	5.50 - 7.25	5.25 - 7.00

2. Subsurface layers for parking facilities:

Sieve Size	Mixture Control Tolerance	Design Gradation Limits, Percent Passing		
		12.5 mm Superpave	19 mm Superpave	25 mm Superpave
				100*
1 in. (25.0 mm) sieve	± 8.0	100*	100*	90-100
3/4 in. (19.0 mm) sieve	±8.0**	98-100****	90-100	55-89**
1/2 in. (12.5 mm) sieve	±6.0***	90-100	60-89***	50-70
3/8 in. (9.5 mm) sieve	±5.6	70-89	55-75	
No. 8 (2.36 mm) sieve	±4.6	38-46	32-36	30-36
No. 200 (75 µm) sieve	±2.0	4.5-7.0	4.0-6.0	3.5-6.0
Range for Total AC	+ 0.4	5.00 - 6.25	4.25 - 5.50	4.00 - 5.25

All * and notes apply to both 828.2.03.B.1 and 828.2.03.B.2.

*Mixture control tolerance is not applicable to this sieve for this mix.

**Ensure mixture control tolerance is within ±10.0% for this sieve for 25 mm Superpave mixes.

*** Ensure mixture control tolerance is within ±8.0% for this sieve for 19 mm Superpave mixes.

****Ensure mixture control tolerance is within ±2.0% for this sieve for 12.5 mm and 9.5 mm Superpave mixes.

Note 1: Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.

Note 2: Range for % AC is Original Optimum AC (OOAC) at 65 gyrations prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D).

3. Volumetric limits for parking facilities are as follows:

Design Parameter	Mix Type	Limits
% of Max. Specific Gravity (Gmm) at design gyrations, Ndes)	All	96%
% Gmm at the initial number of gyrations, Ni	All	91.5 % maximum
% voids filled with asphalt (VFA) at Ndes	9.5 mm Type I	Min. 72; Max. 80
	9.5 Type II and 12.5 mm	Min. 72; Max. 78
	19 and 25 mm	Min. 71; Max 76
Fines to effective asphalt binder ration (F/Pbe)	9.5 mm Type I	0.6 to 1.4
	All other types	0.8 to 1.6
Minimum Film Thickness (microns)	4.75 mm	> 6.00

Design Parameter	Mix Type	Limits
	All other types	> 7.00
Minimum % Voids in Mineral Aggregate (VMA)	25 mm	13.0
	19 mm	14.0
Note: VMA shall be calculated using the effective specific gravity of the aggregate (Gse). See SOP-2	12.5 mm	15.0
	9.5 mm Types I, II	16.0

C. Fabrication

See Section 400.

828.2.04 Fine-Graded Mixtures

A. Requirements

Produce the mixture according to an approved mix design and Job Mix Formula. Ensure that fine-graded mixtures meet the following mixture control tolerances and design limits:

ASPHALTIC CONCRETE - 4.75 mm Mix		
Sieve Size	**Mixture Control Tolerance**	**Design Gradation Limits, % passing**
1/2 in. (12.5 mm) sieve*	±0.0	100*
3/8 in. (9.5 mm) sieve	±5.6	90-100
No. 4 (4.75 mm) sieve	±5.7	75-95
No. 8 (2.36 mm) sieve	±4.6	60-65
No. 50 (300 µm) sieve	±3.8	20-50
No. 200 (75 µm) sieve	±2.0	4-12
Range for % AC	±0.4	6.00 – 7.50
Design optimum air voids (%)		4.0 – 7.0
% Aggregate voids filled with AC		60 - 80
Minimum Film Thickness (microns)		> 6.00

* Mixture control tolerance is not applicable to this sieve for this mix.

Note 1: Quality Acceptance Test Results for AC content deviating > ± 0.3 % from the approved Job Mix Formula (JMF) consistently over three Lots may subject the mix to a revised AC content on the project JMF at the discretion of the State Materials Engineer based on statistical trend.

Note 2: Range for % AC is Original Optimum AC (OOAC) at 50 gyrations prior to the Corrected Optimum AC (COAC) calculation detailed in SOP 2 (Appendix D).

B. Fabrication

See Section 400.

C. Acceptance

See Subsection 106.3 and Section 400. Ensure individual test results meet the Mixture Control Tolerances listed in Subsections 828.2, 828.2.01, 828.2.02, 828.2.03, 828.2.04, whichever applies.

D. Materials Warranty

See General Provisions 101 through 150.

Section 830—Portland Cement

Replace Section 830 with the following:

830.1 General Description

This section includes the requirements for Portland cement, including Portland-limestone cement, Portland blast-furnace slag cement and Portland-Pozzolan cement.

830.1.01 Related References

A. Standard Specifications

Section 831–Admixtures

B. Referenced Documents

AASHTO M 85

AASHTO M 240

QPL 3

830.2 Materials

830.2.01 Portland Cement

A. Requirements

Use only Portland cements that are listed in QPL 3.

1. Type

   Use Portland cement that meets the requirements in AASHTO M 85 or a Blended Hydraulic Cement that meets the requirements in AASHTO M 240.

   Type IL Portland-limestone cement may be used anywhere that Type I or Type II Portland cement is specified.

   Cement types include:

Use	High Early Strength Concrete	Remaining Portland Cement Concrete
*Portland cement	Types I or III	Types I or II
**Portland-limestone cement	Type IL	Type IL

*Portland cement – a hydraulic cement produced by pulverizing clinker consisting essentially of hydraulic crystalline calcium silicates, and usually containing one or more of the following: water, calcium sulfate, up to 5% limestone, and processing additions.

** Portland-limestone cement – a hydraulic cement produced by pulverizing clinker consisting essentially of hydraulic crystalline calcium silicates, and usually containing one or more of the following: water, calcium sulfate, up to 15% limestone, and processing additions.

2. Do not use cement that is damaged, partially set, lumpy, or caked.
3. Store cement in a weather-tight building to protect it from dampness.

4. Do not mix or store different brands or types of cement in the same bin. Do not mix or store the same brand of cement from different mills in the same bin.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

See the requirements in AASHTO M 85 or AASHTO M 240.

D. Materials Warranty

General Provisions 101 through 150.

830.2.02 Portland Blast-Furnace Slag Cement

A. Requirements

Use Portland blast-furnace slag cement in cement stabilization that meets the requirements of AASHTO M 240, Type IS.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

See requirements of AASHTO M 240, Type IS.

D. Materials Warranty

General Provisions 101 through 150.

830.2.03 Portland-Pozzolan Cement

A. Requirements

Use Portland-Pozzolan cement that meets the requirements of AASHTO M 240, Type IP, with the following modifications:

1. Limit the fly ash content to a maximum of 25 percent by weight.
2. Limit the Pozzolan to fly ash that meets the requirements of Subsection 831.2.03.
3. If grinding fly ash with Portland cement clinker to produce Portland-Pozzolan cement, do the following:

   Exclude the fineness and the loss-on-ignition requirements of Subsection 831.2.03.

   Ensure that the final blend of Portland-Pozzolan cement meets AASHTO M 240, Type IP requirements.
4. Wherever the Standard Specifications allow or specify Portland cement that meets the requirements of Subsection 830.2.01, you may substitute Portland-Pozzolan cement that meets the requirements of this Subsection.
5. If the substitute cement results in a higher cement factor than required for Type I cement, the cost of the additional cement will be borne by the Contractor.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

See the requirements of AASHTO M 240, Type IP.

D. Materials Warranty

General Provisions 101 through 150.

Section 833—Joint Fillers and Sealers

Replace Section 833 with the following:

833.1 General Description

This section includes the requirements for joint fillers and sealers, as follows:

Joint Sealers	Joint Fillers
• Hot-poured • Preformed elastic • Silicone sealant and bond breaker • For bridge decks: • Neoprene • Ethylene propylene diene monomer • For inductive loops: • One component or two components sealant	• Preformed • Preformed foam • Water-blown urethane • Elastomeric polymer type joint compound

833.1.01 Related References

A. Standard Specifications

Section 106–Control of Materials

Section 461–Sealing Roadway and Bridge Joints and Cracks

B. Referenced Documents

AASHTO M 153

AASHTO M 213

AASHTO M 220

AASHTO T 42

AASHTO C 679

AASHTO C 793

AASHTO C 1016

AASHTO D 412

ASTM D 471

ASTM D 573

ASTM D 746

ASTM D 792

ASTM D 822

ASTM D 1056

ASTM D 1171

ASTM D 1149

ASTM D 1622

ASTM D 1623

ASTM D 1752

ASTM D 2240

GDT 15

GDT 47

GDT 62

GDT 70

GDT 106

QPL 20

QPL 66

QPL 75

833.2 Materials

833.2.01 Preformed Joint Filler

A. Requirements

General Provisions 101 through 150.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Use preformed joint filler that meets either AASHTO M 153 or AASHTO M 213 requirements. For a list of sources, see QPL 20.

Ensure that cellulose fiber types meet the requirements of AASHTO M 213 (except for the asphalt content) and contain minimums of 0.2 percent zinc borate as a preservative and 1.5 percent waterproofing wax.

D. Materials Warranty

General Provisions 101 through 150.

833.2.02 Hot-Poured Joint Sealers

A. Requirements

1. Type

   Use a hot-poured joint sealer that is a mixture of materials compatible with asphalt, with or without rubber. The sealer shall have the following characteristics:

   - Forms a resilient and adhesive compound
   - Effectively seals joints and cracks in pavements against moisture during repeated cycles of expansion and contraction
   - Does not flow from the joint and cannot be picked up by vehicle tires at an ambient temperature of 125 °F (50 °C)

2. Compound Characteristics

   Use a compound that has a uniform pouring consistency capable of completely filling joints without forming large air holes or discontinuities.

a. Do not pour if the compound temperature is above 450 °F (230 °C).

b. Follow the pouring temperature and safe heating temperature set by the compound manufacturer for each lot or batch.

c. Be sure the temperatures are shown on the label. The safe heating temperature is defined as the highest temperature to which the sealing compound can be heated and still meet all the requirements.

3. Physical Characteristics

Use a hot-poured joint sealer that has the following properties:

Property	Required Measurement
Penetration	Less than 0.35 in. (9 mm.)
Flow	Less than 0.12 in. (3 mm).
Resilience	Minimum recovery of 60%.
Bond to concrete 0 °F, ± 2 °F (–18 °C, ± 1 °C)	The compound does not separate or have gaps within or between the compound and the blocks.
Compatibility (with asphaltic concrete)	Adhesion does not fail. Oily exudate does not form at the interface between the sealing compound and the asphaltic concrete. The sealant does not soften or have deleterious effects on the asphaltic concrete.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will test as follows:

Test	Method
Hot-poured joint sealers	GDT 62

D. Materials Warranty

General Provisions 101 through 150.

833.2.03 Elastomeric Polymer Type Joint Compound

A. Requirements

1. Type

Furnish elastomeric polymer-type joint sealing compound in two components—a base compound and a curing agent.

a. Base compound: A gasoline-resistant elastometric polymer modified with plasticizers, activators, and inert fillers.

b. Curing agent: A blend of accelerators and extenders.

2. Compound Characteristics

Use a sealing compound that can be mixed to a homogenous consistency at the site and applied by an approved mechanical device or poured and troweled manually.

a. If a compound is to be machine-mixed and applied, it shall have a minimum work life of 5 minutes at 80 °F, ± 5 °F (27 °C, ± 3 °C).
b. If a compound is to be manually mixed and applied, it shall have a minimum work life of 30 minutes at 80 °F, ± 5 °F (27 °C, ±3 °C).
c. Use a mixture that completely fills the joints without forming air holes or discontinuities, when mixed according to the manufacturer's instructions.
d. Use a compound that is self-leveling when placed in the joint, but that does not show appreciable flow or movement along a superelevated joint.
e. Use material that does not soften or show any apparent defect after being immersed in water for 7 days.
f. Use a material that forms a tack-free, rubber-like compound that seals pavement or bridge joints within 24 hours of application.

3. Physical Properties

Use material that has the following physical properties:

Property	Required Measurement
Cone penetration	Between 0.1 in. (2.5 mm) and 0.39 in. (10 mm)
Flow	No appreciable flow
Resilience (air- and oven-cured samples)	Minimum recovery of 75%
Bond	No cracks, separation, or other opening over 1/ 4 in. (6 mm) deep in the sealer or between the sealer and block
Solubility	Not to exceed 2 percent; no apparent defects that affect the material as a sealant

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will test as follows:

Test	Method
Elastomeric joint compound	GDT 15

D. Materials Warranty

General Provisions 101 through 150.

833.2.04 Preformed Elastic Joint Sealer

A. Requirements

This section also covers adhesives and lubricants for the sealers.

1. Type

Use a preformed elastic joint sealer that is a vulcanized elastomeric compound using polymerized chloroprene as the only basic elastomer. The joint sealers include both open and closed cell sealers.

2. Certification

a. Submit certified test results of each lot of the joint sealer materials furnished to each Project, either from your tests or from the manufacturer of the preformed joint sealer.

b. The Department will conduct the joint sealer recovery test on random samples from each shipment received or each manufacturer's lot.

c. Submit certified test results of each lot of the lubricant furnished to each Project, either from your tests or from the manufacturer of the joint sealer lubricant/adhesive or adhesive.

3. Preformed Open Cell Joint Sealer

a. Bridge and Roadway Seals: Use sealer that meets the following physical requirements:

Physical Property	Requirement
Tensile strength	Min. 2,000 psi (14 MPa)
Elongation at break	Min. 250%
Hardness, Type A durometer	55±5
Oven aging, 70 hours @ 212 °F (100 °C) Tensile strength, change Elongation, change Hardness, change	 Max. -30% Max. -40% +10 points
Oil swell, ASTM oil No. 3: Volume change, 70 hrs. @ 212 °F (100 °C)	 Max. 80%
Ozone resistance, 20% strain: 300 ppm in air, 70 hrs. @ 100 °F (38 °C) (wipe with solvent to remove surface contaminants)	No cracks
Joint sealer recovery under 50% deflection: Recovery after 70 hrs. @ 212 ºF (100 ºC) Recovery after 72 hrs. @ 14 ºF (-10 ºC) Recovery after 22 hrs. @ –20 ºF (-29 ºC)	 Min. 85% Min. 88% Min. 83%

b. Bridge Seals: Use a sealer that meets the following compression/deflection requirements:

Nominal Size, In. (mm)	Movement Capability*, In. (mm)	Min. Force 4 lb. per linear inch (18 N per 25 mm) @ Width, In. (mm)	Min. Force–30 lb. per linear inch (133 N per 25 mm) Max. Force–100 lb. per linear inch (445 N per 25 mm) @ Width In. (mm)
2 (50)	13/16 (20)	1-7/8 (47)	1-1/16 (27)
2-1/2 (63)	1-1/8 (28)	2-3/8 (60)	1-1/4 (32)
3 (75)	1-3/8 (34)	2-7/8 (73)	1-1/2 (38)
3-1/2 (88)	1-5/8 (40)	3-3/8 (86)	1-3/8 (34)
4 (100)	1-3/4 (43)	3-7/8 (98)	2-1/8 (54)
*Movement capability is the movement allowed within the widths of the specified maximum and minimum forces. The design maximum and minimum joint width is based on these widths. The installation width depends on the temperature at the time of installation.			

c. Roadway Seals: Use a compression/deflection sealer that accommodates the movement specified on the Plans with a minimum force of 4 lbs. per linear inch (18 N per linear 25 mm), not exceeding 20 lbs. per linear inch (89 N per linear 25 mm), exerted on the joint faces.

4. Preformed Closed Cell Joint Sealer for Roadways

a. Use a preclosed cell polychloroprene joint sealer that meets the following physical requirements:

Physical Property	Requirement
Dimensions	Meet Plan requirements for movement and depth
Surfaces	Smooth and clean
Compression/deflection	Allow movement specified on the Plans with a minimum force of 4 lbs. per linear inch (18 N per linear 25 mm) exerted on the joint faces and maximum deflection equal to 50% of the original width
Joint sealer recovery under 50% deflection	85% recovery (compressed to half original thickness for 22 hours @ 158 °F (70 °C), then compression removed for 48 hours at room temperature) 85% recovery after 22 hours at 0 °F (-18 °C)
Water absorption	Maximum 5% weight increase
Ozone resistance	No cracking after exposure of sample at 20% strain to 100 ppm ozone for 70 hours at 100 °F (38 °C)

5. Joint Sealer Lubricants/Adhesives

a. Lubricant/Adhesive for Preformed Roadway Seals: Use a lubricant/adhesive with the joint sealer that is a one-component polychloroprene compound, containing only soluble phenolic resins blended with antioxidants and acid acceptors in an aromatic, hydrocarbon solvent mixture. The lubricant shall have the following physical properties:

Physical Property	Requirement
Average net weight per gallon (liter)	Min. 7.84 lbs. (940 grams)
Solid content	22-28% by weight
Film strength	
Tensile strength	Min. 2,300 psi (16 MPa)
Elongation before breaking	Min. 750%

b. Adhesive for Preformed Bridge or Roadway Seals: Use an adhesive that is a one-part or two-parts moisture curing sealant and hydrocarbon solvent mixture with the following physical properties:

Physical Property	Requirement
Average net weight per gallon (liter)	Min. 8 lbs. (960 grams)
Solids content	Min. 72% by weight
Film strength (ASTM D 412)	Min. 1,200 psi (8 MPa)
Elongation before breaking	Min. 350%
Viscosity	Perform suitably with the installation equipment Remain fluid from 5 to 120 °F (-15 to 49 °C)

6. Product Delivery

Deliver each lot of the lubricant/adhesive in containers plainly marked with the manufacturer’s name or trademark, lot number, and date of manufacture.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

1. Preformed Open Cell Joint Sealer

Test	Method
Tensile strength and elongation	ASTM D 412
Hardness	ASTM D 2240
Oven-aging	ASTM D 573
Oil swell	ASTM D 471
Ozone Resistance	ASTM D 1149
Joint sealer recovery	GDT 47
Compression/Deflection	GDT 70

2. Preformed Closed Cell Joint Seals for Roadway

Test	Method
Compression/Deflection	GDT 70
Joint sealer recovery (Run the hot recovery at 158 °F (70 °C) instead of 212 °F (100 °C). Allow seals to recover for 48 hours at room temperature before measuring.)	GDT 47
Water Absorption	ASTM D 1056
Ozone Resistance	ASTM D 471

3. Joint Sealer Lubricants/Adhesives

Test	Method
Film Strength	ASTM D 412

D. Materials Warranty

For joint sealer lubricants/adhesives:

1. Store the lubricant/adhesive at 50 ° to 80 °F (10 ° to 27 °C).
2. Retest any lubricant/adhesive not used within 270 days of its manufacture.

833.2.05 Water-Blown Urethane Joint Filler

A. Requirements

1. Type

   Furnish water-blown urethane joint filler in two components.

   a. Mix according to the manufacturer's recommendations and use in pressure relief joints and regular expansion joints.

   b. Mix the material at the site and foam it in the joint. Use closed-cell material.

2. Physical Requirements

   a. Use the material that meets the following requirements after mixing:

Times at 80 °F, ± 5 °F (27 °C, ± 3 °C)	Minimum	Maximum
Cream time (interval after mixing the two components and before the material begins to expand).	1 minute	5 minutes
Expansion time (interval between when the material starts and stops expanding).		10 minutes
Tack free time (Determine whether the material is tack free by touching lightly. Begin the time requirement for tack free time when the expansion time ends.)		10 minutes

b. Use material that meets the following requirements after curing:

Physical Property	Requirement
Weight per cubic foot (meter)	4lbs, ± 0.4 lbs. (64 kg, ± 6 kg)
Compression to 50% thickness	40 to 130 psi (275 to 895 kPa)
Recovery (compressed to 50% thickness, released, then tested 10 minutes later)	Min. 65%
Extrusion when compressed 50%	Max. 0.125 In. (3 mm)
Moisture absorption	Max. 0.10 lb./ft.^{2} (490 g/m^2) of exposed area

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Weight per cubic foot (meter)	AASHTO T 42 [omit drying at 220 °F (104 °C)]
Compression to 50% thickness	AASHTO T 42
Recovery after compression	AASHTO M 213
Extrusion	AASHTO T 42
Moisture absorption	AASHTO T 42 (calculate absorption based on exposed area)

D. Materials Warranty

General Provisions 101 through 150.

833.2.06 Silicone Sealants and Bond Breakers

Prepare and install silicone and bond breakers according to Section 461.

A. Requirements

1. Silicone

Furnish silicone sealant in a one-part or two part silicone formulation. Use sealant that is compatible with the surface to which it is applied. Do not use acid-cure sealants on Portland cement concrete.

a. Use silicone that meets the physical requirements in Table 1. For a list of silicone joint sealant sources, please see QPL 66. Identify silicones as the following types:

1) Type A—A one part, low modulus, non-sag silicone. Used to seal horizontal and vertical joints in Portland cement concrete pavements and bridges. Tooling is required.

2) Type B—A one part, very low modulus, self-leveling silicone. Used to seal horizontal joints in Portland cement concrete pavements and bridges. Tooling is not normally required.

3) Type C—A one part, ultra-low modulus, self-leveling silicone. Used to seal horizontal joints in Portland cement concrete pavements and bridges and joints between Portland cement concrete pavement and asphaltic concrete shoulders. Tooling is not normally required.

4) Type D—A two part, ultra-low modulus, self-leveling, rapid cure silicone. Used to seal horizontal joints in Portland cement concrete pavements and bridges and joints between Portland cement concrete pavement and asphaltic concrete shoulders. Tooling is not required.

b. Use silicone sealant evaluated by the National Transportation Product Evaluation Program (NTPEP).

c. Use sealant that is compatible with the surface to which it is applied. Do not use acid-cure sealants on Portland cement concrete.

d. Use silicone that meets the following physical requirements:

TABLE 1—PHYSICAL REQUIREMENTS FOR SILICONE SEALANTS

Type Silicone	A	B	C	D
Tensile Stress at 150% Strain, Max. psi (kPa) (Note 1)	45 (310)	40 (275)	15 (105)	25 (175)
Durometer Hardness, Shore [0 °F and 77 °F ± 3 °F (-18 °C and 25 °C ± 2 °C)] (Note 1)	"A" 10-25	"00" 40-80	"00" 20-80	"00" 40-80
Bond to Concrete Mortar, Min. psi (kPa) (Note 1) (Note 3)	50 (345)	40 (275)	35 (240)	35 (240)
Tack Free Time (Skin-over) (Max. Minutes) (Note 2)	90	90	90	30
Extrusion Rate (Min. Grams/Minute) (Note 4)	75	90	100	200-550
Non-volatile (Min. %)	90	90	90	90
Specific Gravity	1.1 - 1.5	1.1 - 1.5	1.1 - 1.5	1.2 - 1.5
Shelf Life (from date of shipment)	6 Months	6 Months	6 Months	6 Months
Movement Capability & Adhesion (Note 1)	No adhesive or cohesive failure after 10 cycles at 0 °F (-18 °C).			
Ozone and U.V. Resistance (Note 1)	No chalking, cracking or bond loss after 5,000 hours.			
Note 1: The cure time for these specimens shall be 21 days for Type A and 28 days for Type B, C and D. Specimens shall be cured at 77 °F ± 3 °F (25 °C ± 2 °C) and 50±5% relative humidity.				
Note 2: At conditions of 77 °F ± 3 °F (25 °C ± 2 °C) and 50±5% relative humidity.				
Note 3: Type C and D silicone shall also meet its bond strength requirement to asphalt concrete.				
Note 4: Type D extrusion rate shall be within the range specified.				

2. Bond Breakers

Bond breakers shall be chemically inert and resistant to oils, gasoline, solvents, and primer, if one is required. Install silicone sealants over a bond breaker to prevent the sealant from bonding to the bottom of the joint.

a. Use bond breakers that are chemically inert and resistant to oils, gasoline, solvents, and primer, if one is required.

b. Do not use bond breaker that will stain or adhere to the sealant.

c. Use either a backer rod or tape bond breaker.

1) Backer Rods

Type L	Closed-cell, expanded polyethylene foam
Type M	Closed-cell, polyolefin foam with a closed-cell skin over an open-cell core

Use backer rods that meet the following physical requirements:

Physical Property	Requirement
Density	2 lb./ft.^{3} (30 kg/m^3)min.
Tensile strength	25 psi (170 kPa) min.
Water absorption	0.02 g/cm^3 max.

2) Bond Breaking Tapes

Type N bond breaking tapes are made from extruded polyethylene with a pressure-sensitive adhesive on one side.

Bond breaking tapes may be used with all four types of silicone but is suitable for bridge joints only.

Bond breaking tapes shall have a minimum thickness of .005 in. (0.13 mm.).

3. Joint Sealant Certification

Submit, at no cost to the Department, a minimum of 30 gal (100 L) of material and certified test results on each lot of joint sealant furnished to a Project.

Submit a certification that verifies the sealant meets all the test requirements of this specification, except the Bond to Concrete Mortar and Shore Durometer Hardness at 0 °F (-18 °C).

B. Fabrication

Prepare and install silicone and bond breakers according to Section 461.

C. Acceptance

1. Silicone

Test the silicone as follows:

Test	Method
Tensile stress	ASTM D 412 (die C)
Durometer hardness	ASTM D 2240
Bond to concrete mortar	GDT 106
Tack free time (skin-over)	GDT 106*
Extrusion rate	GDT 106
Non-volatile	GDT 106
Specific gravity	ASTM D 792 (Method A)
Movement capability and adhesion	GDT 106
Ozone and UV resistance	ASTM C 793
*In cases of dispute, use ASTM C 679 as a referee test.	

2. Bond Breakers

Test the bond breaker backer rods as follows:

Test	Method
Density	ASTM D 1622
Tensile strength	ASTM D 1623
Water absorption	ASTM C 1016

3. Department Responsibility

The Department will:

a. Evaluate the sealant in the field before accepting any silicone sealants that meet the requirements of this specification.

b. Install the material submitted by the Contractor in roadway and/or bridge joints. The material shall be in place for two winters without failure before being accepted.

c. Reject any sealant or bond breaker that is evaluated and approved yet fails in actual use.

D. Materials Warranty

General Provisions 101 through 150.

833.2.07 Neoprene for Bridge Deck Joint Seals

A. Requirements

1. Type

Use a neoprene material for bridge deck joint seals that is a vulcanized elastomeric compound with polymerized chloroprene as the only basic elastomer.

a. Ensure the neoprene meets the physical requirements in Table 2.

TABLE 2—PHYSICAL REQUIREMENTS FOR NEOPRENE

Test	Requirements	Test Method
Tensile strength Before aging	1500 psi (10 MPa) min.	ASTM D 412
After oven-aging for 70 hrs. @ 212 °F (100 °C)	30% max. loss	ASTM D 573
Elongation at breaks Before aging	250% min.	ASTM D 412
After oven aging for 70 hrs. @ 212 °F (100 °C)	40% max.	ASTM D 573
Hardness Type A Durometer		
Before aging	63 ± 10 points	ASTM D 2240
After oven-aging for 70 hrs. @ 212 °F (100 °C)	0 to +15 points change	ASTM D 2240
After aging for 70 hrs. @ 14 °F (-10 °C)	0 to +15 points change	ASTM D 2240
Ozone Resistance: After 70 hrs. @ 104 °F (40 °C), under 20% strain in 300 ppm in air (Wipe specimens with toluene before test to remove surface contaminants)	No cracks	ASTM D 1149
Weight change in oil After 22 hrs. in oil No. 2 [ASTM D 471]	45% max.	AASHTO M 220
Recover under 50% deflection (type II only)		
After 70 hrs. @ 212 °F (100 °C)	85% min.	AASHTO M 220
After 72 hrs. @ 14 °F (-10 °C)	88% min.	AASHTO M 220
After 22 hrs. @ –22 °F (-30 °C)	85% min.	AASHTO M 220

2. Certification

Submit certified test results on the joint seal system according to Subsection 106.05, *Materials Certification.*

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test according to the methods indicated in Table 2.

D. Materials Warranty

General Provisions 101 through 150.

833.2.08 Ethylene Propylene Diene Monomer for Bridge Deck Joint Seals

A. Submittals

1. Type

Use an ethylene propylene diene monomer (EPDM) material for bridge deck joint seals that is 100 percent EPDM compound.

Ensure the compound shall meet the following physical requirements:

Physical Property	Requirement
Hardness, Type A Durometer	80 ± 5
Tensile strength	Min. 2,000 psi (14 MPa)
Elongation at break	Min. 200%
Low temperature	Not brittle at –67 °F (-55 °C)
Weather resistance	No cracks
Ozone resistance (70 hours, 100 °F (38 °C), under 20% strain, 100 ppm in air)	No cracks

2. Certification

   Submit certified test results of the joint seal system according to Subsection 106.05, *Materials Certification.*

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test the EPDM as follows:

Test	Method
Hardness, Type A Durometer	ASTM D 2240
Tensile strength	ASTM D 412
Elongation at break	ASTM D 412
Low temperature	ASTM D 746
Weather resistance	ASTM D 1171
Ozone resistance (70 hours, 100 °F (38 °C) under 20% strain, 100 ppm in air)	ASTM D 1149

D. Materials Warranty

General Provisions 101 through 150.

833.2.09 Sealant for Inductive Loops

A. Requirements

1. Type

   Use sealant that is a one component or two components, moisture-curing, flexible sealant formulated to encapsulate inductive detector loop wires and leads embedded in asphaltic or Portland cement concrete. The sealant shall be unaffected by freeze-thaw cycling, salts, gasoline, oil, sewerage and corrosive chemicals. It shall be proportioned and mixed per the manufacturer's instructions. For a list of sources, see QPL 75.
2. Submit, at no cost to the Department, at least 12, 29 oz. (857 mL) cartridges of the material and certified test results from an accredited laboratory.
3. Physical Characteristics

   Use a sealant that will:

   - Remain flexible to –20 °F (-30 °C) (necessary to protect the wire from the stress of pavement movement).
   - Fully encapsulate the wire but resist flowing out on inclined or crowned roads.

- Be compatible with asphaltic concrete.
- Not soften the asphaltic concrete to a degree that would cause widening of the joint, when installed in a simulated joint in the laboratory.
- Ensure one component sealant cures within 30 days to attain 95% of published properties for the cured material.
- Ensure two component sealant cures within 48 hours to attain 95% of published properties for the cured material.

4. Use a cured sealant that meets the following physical requirements:

Physical Property	Requirement
Hardness, Type A Durometer	35-85
Tensile strength	Min. 150 psi (1035 kPa)
Elongation at break	Min. 200%
Flexibility 20 °F (30 °C)	No cracks
Weathering resistance	Slight chalking

5. Furnish certified test results of the loop sealant according to Subsection 106.05, *Materials Certification.*

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Test the sealant for inductive loops as follows:

Test	Method
Hardness, Type A Durometer	ASTM D 2240
Tensile strength	ASTM D 412 [die C pulled at 20 in. (500 mm)/min]
Elongation at break	ASTM D 412 [die C pulled at 20 in. (500 mm)/min]
Flexibility –20 °F (-30 °C)	25 mil (0.64 mm) free film bend (180°) over a 1/2 in. (13 mm) mandrel
Weathering resistance	ASTM D 822; Weatherometer 350 hrs., cured 7 days, 77 °F (25 °C), 50% relative humidity

2. Department Responsibility

   The Department will:

   a. Evaluate the sealant for inductive loops in the field before approving it for use. The material also must meet the requirements of this specification.
   b. Install the material in asphaltic inductive loops. The material shall be in place for one winter without failure before being accepted.
   c. Reject any sealant that is evaluated and approved yet fails in actual use.

D. Materials Warranty

General Provisions 101 through 150.

833.2.10 Preformed Foam Joint Filler

A. Requirements

1. Type

Use a preformed foam joint filler consisting of polyethylene, polypropylene, polyurethane, neoprene, natural rubber, or isomeric polymer closed-cell foam and ultraviolet, stable resistant to oils, chemicals, ozone, and weathering. Ensure the joint filler conforms to the following physical requirements:

Physical Property	Requirement	Test Method
Cell Structure (Compression—Deflection to 50% of original thickness	Closed Cell 35 – 50 psi (250 – 350 kPa)	ASTM D545
Recovery (Compress the specimen to 50% of original thickness)	80% min.	ASTM D545
Water Absorption	1% volume max.	ASTM D545
Extrusion at 50% compression of original thickness	0.25 in. (6 mm) max.	ASTM D545
Density	3.5 lbs./ft^3 (56.1 kg/m^3) min	ASTM D545
Heat Resistance @ 392 °F ± 5 °F (200 ° C ± -15 ° C)	1% max	ASTM D5249
UV Weathering (1000 hrs., Cycle A – 340 nm)	No observation change or cracking	ASTM D4329
Freeze Thaw Resistance (300 cycles)	No visual change, <10% tensile strength change	ASTM C666

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test according to ASTM D 1752.

D. Materials Warranty

General Provisions 101 through 150.

Section 834—Masonry Materials

Replace Section 834 with the following:

834.1 General Description

This section includes the requirements for masonry materials, including brick; clay or shale brick; masonry stone; and mortar and grout.

834.1.01 Related References

A. Standard Specifications

Section 801—Fine Aggregate

Section 830—Portland Cement

B. Referenced Documents

AASHTO M 240

AASHTO T 96

AASHTO T 104

ASTM C 5

ASTM C 32

ASTM C 55

ASTM C 91

ASTM C 109 (ASTM C 109M)

834.2 Materials

834.2.01 Brick

A. Requirements

1. Use bricks that are relatively straight, sound, and uniform in quality.
2. Clay or Shale Brick: Use clay or shale bricks that meet the requirements of ASTM C 32, Grade MS or MM.
3. Concrete Brick: Use concrete bricks that meet the requirements of ASTM C 55.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

834.2.02 Masonry Stone

A. Requirements

1. Type: Use stone for rubble masonry that is sound, durable, and does not contain segregations, seams, cracks, pyrite intrusions, or other structural defects or imperfections that affect weather resistance.

a. Do not use stone with rounded, worn, or weathered surfaces. Exposed faces cannot show scars caused by quarrying. Weathered stone will be rejected.

a. Ensure that the stone has no more than 65 percent wear and no more than 15 percent loss after the magnesium sulfate soundness test.

b. Use stone that can be wrought truly to lines and surfaces (curved or plain).

c. Ensure that each stone is at least 6 in. (150 mm) thick and 1 ft. (300 mm) wide, except for fill stones used in wall interiors.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Percent Wear	AASHTO T 96
Soundness	AASHTO T 104

D. Materials Warranty

General Provisions 101 through 150.

834.2.03 Mortar and Grout

A. Requirements

1. Use mortar and grout that consists of fresh mixtures of one-part Portland or masonry cement and three parts mortar sand and water.

   You may add hydrated lime when using Portland cement in amounts not exceeding 10 percent of the weight of cement.

   a. Cement: Use Portland cement that meets the requirements of Subsection 830.2.01 or masonry cement that meets the requirements of ASTM C 91.

   b. Mortar Sand: Use mortar sand that meets the requirements of Subsection 801.2.02.

   c. Mixing: Mix dry in a mixer or in a clean, tight box, until a uniform mixture is produced. Then add enough water to produce the desired consistency.

      Do not use mortar and grout that has been mixed for more than 45 minutes.

      Retempering of mortar is not permitted.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

Section 860—Lumber and Timber

Replace Section 860 with the following:

860.1 General Description

This section includes the requirements for lumber and timber.

860.1.01 Related References

A. Standard Specifications

Section 502—Timber structures

Section 863—Preservative Treatment of Timber Products

B. Referenced Documents

American Softwood Lumber Standard PS 20-70, US Department of Commerce or the National Hardwood Association

ASTM D 245

860.2 Materials

For the definition and limitations of defects, use the current manufacturing association grade rules applicable for the species specified.

860.2.01 Lumber and Timber

A. Requirements

1. Saw or finish all lumber and timber as specified from the plants listed in QPL 50.
2. Grades

   Use grade rules from an agency that follows the basic provisions of American Softwood Lumber Standard PS 20-70, US Department of Commerce or the National Hardwood Association.

   a. Furnish all structural timber in the grades, sizes, and finish shown in the plans and these specifications, or as directed by the Engineer.
   b. Unless otherwise specified, use No. 2 or higher grade Southern Pine to construct buildings, shelving, and forms.
   c. Mark the grade on the lumber or timber according to the current manufacturing grade rules for the species.

B. Fabrication

1. Seasoning and Preservation: Season and treat according to the requirements of Section 863.

C. Acceptance

The Department will accept the material based on inspection certification or on the results of tests conducted by the Department.

D. Materials Warranty

General Provisions 101 through 150.

Section 863—Preservative Treatment of Timber Products

Replace Section 863 with the following:

863.1 General Description

This section includes the requirements for treated timber and wood products used in Department work.

863.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

American Wood Protection Association (AWPA), U1-Use Category System (UCS) Standard: User Specifications for Treated Wood

AWPA T1 – Use Category System: Processing and Treatment Standard

AWPA M2 – Standard for the Inspection of Preservative Treated Products for Industrial Use

AWPA P – Preservative/Protectant Standards

AWPA M4 – Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products

SOP 31

AASHTO M 133

QPL 50

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

863.2 Materials

863.2.01 Conditioning and Preservative Treatment

A. Requirements

1. All treated timber and wood products shall be treated in accordance with the current AWPA or AASHTO Standards, using wood preservatives registered by the US Environmental Protection Agency under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA).
2. Treatment Plants

   All treatment plants supplying timber and wood products for Departmental work shall comply with Standard AWPA T1 and the following:

   a. To expedite the work, a third-party inspection agency accredited by the American Lumber Standard Committee (ALSC), or a commercial inspection agency approved by the Department will inspect and test all treated timber products, including any preservative treatment at the treatment plant before it is delivered to the project. The treatment plant shall bear all the cost associated with the inspection and testing.

b. Before requesting an inspection, the authorities of the treatment plant shall acquaint themselves with the timber specification requirements and shall segregate the material to be inspected for Department work from other stock.

3. Preservatives

All wood preservatives shall comply with AASHTO M 133 or AWPA P Preservative/Protectant Standards.

B. Fabrication

As practicable, cut, frame, and bore timber before treatment.

C. Acceptance

1. Inspection

The Department, an ALSC accredited third-party inspection agency, or an approved commercial inspection agency will inspect treated timber and wood products according to the procedures outlined in AWPA M2 and applicable AWPA U1/T1 Commodity Specification requirements, AASHTO M 133 and Standard Operating Procedure (SOP) 31.

NOTE: Check QPL 50 for pre-approved manufacturers that supply material compliant with this specification.

2. Marking

The Inspector will mark each acceptable piece with a hammer stamp before and after treatment.

a. Stamp only 25 percent of the offset blocks after treatment.

a. Ensure that both inspection stamps identify the Inspector. Ensure that the before-treatment stamp is clearly distinguished from the after-treatment stamp.

3. Reporting

The Inspector shall:

a. Prepare reports of the treating process and results of the inspection that confirm treatment was completed according to these specifications.

b. Furnish these reports to the Office of Materials and Testing.

c. Report according to AWPA M2.

d. Get a shipping report from the treatment plant showing the project number, purchaser, sizes and amounts of materials, and preservative type for each shipment.

e. Furnish the shipment report and the treatment report to the Office of Materials and Testing.

D. Materials Warranty

1. Retest treated material that has been in stock for two years before using.

2. The Department will reject any material that fails to meet specifications. Retreatment of material is allowed in order to meet all applicable requirements.

E. Field Treatment

Cuts or holes to the surface of treated timber or wood products, which occur after pressure-treatment, shall be field-treated in accordance with AWPA Standard M4.

Section 865—Manufacture of Prestressed Concrete Bridge Members

Replace Section 865 with the following:

865.1 General Description

This section includes the following requirements for precast-prestressed concrete bridge members and piling:

- Manufacturing
- Inspecting
- Testing
- Marking
- Painting
- Rubbing as specified
- Plant handling
- Storing
- Shipping

The term “precast-prestressed concrete” is referred to as “prestressed concrete” in the rest of this Section.

865.1.01 Related References

A. Standard Specifications

Section 106–Control of Materials

Section 152–Field Laboratory Building

Section 500–Concrete Structures

Section 511–Reinforcement Steel

Section 514–Epoxy Coated Steel Reinforcement

Section 801–Fine Aggregates

Section 830–Portland Cement

Section 831–Admixtures

Section 853–Reinforcement and Tensioning Steel

Section 857–Bronze Bushings, Bearings, and Expansion Plates

Section 870–Paint

Section 885–Elastomeric Bearing Pads

Section 886–Epoxy Resin Adhesives

B. Referenced Documents

AASHTO M 55

AASHTO M 85

AASHTO M 221

AASHTO T 22

AASHTO T 27

ASTM A 123/A 123M)

ASTM A 153/A 153M)

ASTM A 185

ASTM A 416

ASTM A 497

AASHTO LRFD Bridge Design Specification

Laboratory SOP-3, Standard Operating Procedures for Precast/Prestressed Concrete

QPL 9

GDT 35

865.2 Materials

Use materials that meet the specifications as follows:

Material	Section
Concrete, Class AAA (except as noted)	500
Steel Bars for Reinforcement	853.2.01
Pretensioning Steel Wire Strand	853.2.02
Post-Tensioning Steel Wire	853.2.03
Post-Tensioning Steel Bars	853.2.04
Plain Steel Bars—Threaded Ends	853.2.05
Portland Cement	830.2.01
Fine Aggregate for Mortar	801.2.02
Aluminum Powder	835.2.01
Self-Lubricating Bronze Bearing and Expansion Plates and Bushings	857.2.03
Primer Coats	870
Elastomeric Pads	885.2.01
Epoxy Resin Adhesive	886
Microsilica (Silica Fume)	831.2.03

NOTE: Do not use accelerators (24-hour accelerated strength concrete) that contain chlorides in any prestressed concrete.

865.2.01 Prestressed Concrete Bridge Members

A. Requirements

1. Portland Cement
2. Use Type I, Type II, Type III or Type IL cement that meets requirements of AASHTO M 85 and M 240 for low alkali cement.
   a. Use Type II cement in concrete to cast pile for specific locations noted on the plans.
3. Coarse Aggregate
   a. Use the size specified and approved for prestressed concrete products.
   b. Do not use unconsolidated limerock coarse aggregate in prestressed concrete piling or in any structure that has direct contact with water.
4. Microsilica (Silica Fume)

   The Department may approve silica fume as an additive to concrete. If approved, add the silica fume at a rate not to exceed 10 percent of the cement content.
5. Epoxy-coated Reinforcement Steel and Wire:

   If top steel mat of the bridge deck is epoxy-coated, the shear steel in the prestressed concrete beams will be epoxy-coated in accordance with Section 514.
6. Welded Wire Fabric

   Use welded wire fabric that meets the following requirements:
   a. Use smooth wire fabric that meets the material requirements of AASHTO M 55 (ASTM A 185) and this Section.
   b. Use deformed wire fabric that meets the requirements of AASHTO M 221 (ASTM A 497) and this Section.
7. Pretensioning Steel Wire Strand

   Use strands that meet all the requirements of ASTM A 416, Grade 270.
8. Slump Limitation

   Ensure the slump meets Subsection 500.1.03.A Table 1 – Concrete Mix Table , except when Type F high range water reducers (HRWR) are added. With HRWR, you may increase the slump value from 4 in. to 6 in. (100 mm to 150 mm) with a maximum slump value not to exceed 7 in. (175 mm), provided the concrete mix does not segregate.
9. Facilities and Equipment Plans

   Facilities are approved according to Laboratory SOP-3, Standard Operating Procedures for Precast/Prestressed Concrete. See QPL 9 for a list of approved facilities.

   Submit a complete set of plans and an itemized equipment list of the prestressing facilities to the Engineer.
   a. For established plants already approved by the Department, the Department will send a written notice about approval. The plant need not comply with the requirements concerning plans and equipment listing.
   b. The Department may withdraw the waiver at its discretion if the plant changes the facilities, equipment, production methods, types of products, or for any other reason.

B. Fabrication

1. General Plant Requirements

   Furnish erection drawings to the Engineer that show the placement of superstructure units, especially when the units are not interchangeable with respect to transverse placement within a span or with respect to the reversal of ends within a span.

2. Manufacturing Facilities and Equipment

   Ensure that the prestressed concrete bridge members are made at a plant that has as a minimum the facilities and equipment specified as follows:

   a. Do not start manufacturing until the Engineer approves the facilities and equipment.

NOTE: Regardless of approval, the Contractor is responsible for the facilities' performance and obtaining additional equipment as needed.

   b. Beds: Construct beds for casting prestressed concrete of concrete; these shall be level or on a grade acceptable to the Engineer.

   c. Anchorages: Design and construct anchorages so they will not yield under 150 percent of the maximum design load.

   d. Forms: Construct steel side and bottom forms unless the Department allows other materials.

      1) Design the forms so the bridge members will be well within the tolerances specified in Subsection 865.2.01.B.11.

      2) Anchor the forms to prevent movement.

   e. Stressing Equipment

      1) Jacks: Use jacks in good repair that do not leak. Calibrate them with the actual gauge or gauges that you will be using. You may use pressure gauges, load cells, or dynamometers.

         Ensure all jack systems have devices that prevent the gauge pointer from fluctuating.

      2) Calibration: Calibrate all devices to a reading accuracy of 2 percent within the proposed stressing range.

         Use an approved testing laboratory to calibrate the devices. Have the laboratory furnish at least five copies of the calibration chart for each device to the Engineer.

         Recalibrate all stressing systems at least every 6 months and as required by the Engineer. Use gauges that you can read from 6 ft. (1.8 m) and have a capacity of twice the maximum load.

   f. Elongation Measurement: Use a system approved by the Engineer and isolated from any movement in the bed or anchorages.

   g. Curing Systems Equipment: Use one of the curing methods listed below. Do not use curing compounds on prestressed concrete units unless the Engineer gives written permission.

      1) Water Curing: Use equipment that consists of a clean, non-deleterious water source, a method of application, and enough burlap or other means of moisture retention that will keep all surfaces of the concrete wet during the curing cycle, except those in contact with the forms.

      2) Steam Curing: Use the following minimum basic equipment:

         - An enclosure tight enough to maintain a uniform atmospheric temperature around the concrete units.
         - A steam system that distributes live steam uniformly through nozzles, capable of maintaining a temperature of at least 120 °F (50 °C) in all weather. Do not eject steam directly against concrete or forms.
         - A controlling device installed in the steam line that helps maintain a constant temperature.
         - A recording thermometer for each 200 ft. (60 m) of bed length.

3) Heated Forms: Uniformly heat the forms with a recirculating system that distributes the heat evenly. Use a system that includes:

- A means of retaining moisture on concrete surfaces, except those in contact with the forms.
- A recording thermometer for each 200 ft. (60 m) of bed length.
- A weathertight covering for each bed to ensure uniform heating throughout the bed.

h. Vibrators: Use internal vibrators with at least 4,500 impulses per minute. Ensure the vibrator heads are small enough to reach through the prestressing and reinforcing steel to all portions of the form.

1) Use enough vibrators to properly compact the concrete. Have an additional stand-by vibrator in good operating condition for each concrete placing operation.

2) Get the Engineer's approval of the vibration procedure and of the number and types of vibrators before pouring.

3) You may use external vibration in conjunction with internal vibration when the Engineer so approves.

i. Grout Pump: Use grout pumps that can pump the fluid grout and maintain a uniform pressure of 75 lbs./in.^{2} (520 kPa) for at least 15 seconds.

j. Storage Areas: Use plant storage areas that have surfaces capable of supporting the prestressed concrete bridge members without settlement. Ensure the storage area has blocks to support the units properly at the required points.

3. Substitution of Reinforcement

You may substitute welded wire fabric for the bar reinforcement shown on the plans. The Department will not pay extra for the substitution.

The substitution is subject to the following:

a. Design Notes: Submit detailed shop drawings and design notes, including any changes, to the Engineer for approval before using welded wire fabric.

b. Indicate on the design notes that the welded wire fabric will provide the same or greater strength as that provided by the bar reinforcing shown on the plans.

c. Design fabric use according to the latest AASHTO LRFD Bridge Design Specification. Prepare the drawings on 11 x 17-in. (279 x 432 mm) sheets.

d. Have an Engineer registered in the State of Georgia stamp both drawings and notes.

e. Design the yield strength for the wire fabric not to exceed 60,000 psi (415 MPa) but not be less than 40,000 psi (275 MPa). Do not splice by welding or mechanical coupling.

f. If using welded wire fabric for stirrups of bar reinforcement, embed the wires perpendicular to the axis of the beam at least 6 in. (150 mm) into the slab. Leave at most a clearance of 4 in. (100 mm) from the top of slab to the welded wire fabric.

g. Embed at least two cross wires (wires parallel to the longitudinal axis of the beam) in the slab, with the closer cross wire clearing the top of the beam by at least 2 in. (50 mm).

h. You may use welded wire fabric in the anchorage zone at the ends of the beam to replace the stirrups that enclose the prestressing steel in the bottom flange, and the vertical stirrups that do not protrude beyond the top of the beam.

i. Ensure that the wires perpendicular to the longitudinal axis of the beam have the same steel area as that of the bar reinforcing.

j. Use either smooth or deformed wires for welded wire fabric. Use the AASHTO LRFD Bridge Design Specification for the proper methods to embed and splice the fabric.

4. Substitution of Strands

You may use strands of different arrangement, size, or arrangement and size. The Department will not pay extra for the substitution.

The substitution is subject to the following structural and physical requirements:

a. Ensure that the net prestressed force of the strands after losses equals that shown on the plans.

b. Ensure that the ultimate strength of the member meets the applicable requirements of AASHTO LRFD Bridge Design Specification.

c. Ensure that the eccentricity pattern of the substituted strands is about the same as the pattern shown on the plans.

d. Before substituting strands, submit to the Engineer all changes and detailed shop drawings, with design notes. Ensure that the design notes indicate compliance with the requirements. Prepare drawings on 11 x 17-in. (279 x 432 mm) sheets.

NOTE: If you propose to use strands that differ in size from those covered in ASTM A 416, submit complete data on the strands to the Engineer for approval.

Do not use individual strand couplings.

e. Have an Engineer registered in the State of Georgia stamp both drawings and notes.

5. Concrete Manufacture and Mixing

a. Manufacture and place concrete according to the requirements of Section 500.

b. Mix the concrete according to Subsection 500.3.04.E and Subsection 500.3.02.D.2 except when adding HRWR.

1) When adding HRWR, dose the HRWR at the casting yard under the direct supervision of the producer's Quality Control. Do not exceed the HRWR manufacturer's recommended dosage.

2) After dosing, mix the concrete at mixing speed for at least 70 revolutions.

NOTE: Do not exceed 360 total revolutions at mixing and agitating speeds.

3) After adding the plasticizer, no additional mixing water will be permitted.

6. Concrete Pouring

Fabricate the ends of all beams and girders to be vertical in the final erected position,.

a. Rough-float the tops of beams at approximately the initial set.

b. All nominal lengths shown on the plans are horizontal dimensions.

c. Ensure that the Fabricator adjusts the lengths, as necessary, to account for the final erected position of the member.

d. Slope bearing assemblies to accommodate the erected position of the member.

7. Methods of Prestressing

You may either pretension, post-tension, or combine these methods to prestress concrete bridge members.

a. Pretensioning: You may pretension with either the single-strand or the multi-strand jacking method.

NOTE: Do not use strands from more than one source in any one tensioning operation.

Ensure the method used meets these requirements:

1) Strand Splices: Get approval from the Engineer for splicing methods and devices.

Jacking Method	Action
Single-strand	Use only one splice per strand.
Multi-strand	Splice all strands or no more than 10% of the strands.

Ensure that the spliced strands have similar physical properties, are from the same source, and have the same "twist" or "lay." Locate splices outside the prestressed units.

2) Wire Failures: The Engineer may accept wire failures if the area of broken wires does not exceed 2 percent of the total area of the strands.

3) Stressing Preparations: Prepare the members as follows:

   a) Carefully place and thread all strands in the bed.

   b) Avoid contaminating the strand with oil, grease, or other bond breaking material. If any strand is contaminated, clean the strand with a suitable solvent or replace the strand.

   c) After final stressing, position all strands within the location tolerances specified in Subsection 865.2.01.B.11.

   d) Use strand vises designed for the size of pretensioning strand to anchor the strand.

   e) After anchoring, ensure that the vises sustain the pretensioning force without slipping until the release of stress. Ensure that the vise grips seat no more than 1/4 in. (6 mm) each.

   f) To prevent strands from bonding together, encase the strand in a conduit that can resist the pressure exerted by the concrete.

   g) Use conduit with an ID allowing free movement of the encased strand, but no greater than the diameter of the strand plus 1/8 in. (3 mm).

   h) Secure the conduit to prevent both longitudinal movement along the strand and bonding at the location shown on the plans, ± 1 in. (25 mm).

   i) Tape the conduit to keep concrete out. Use tape and conduit manufactured from a non-corrosive material compatible with both the concrete and steel. Do not debond the strand for the full length of members.

4) Pretensioning Operation: Use elongation to control this operation. Ensure that the hydraulic pressure gauge readings at the time of the measured net elongation are within 5 percent of the calculated gauge reading for that particular elongation.

   Ensure that the net elongation and final gauge measurements agree within ± 5 percent of their computed theoretical values.

   The measurements of force and elongation shall algebraically agree with each other within a 5% tolerance.

   If any measurement varies by more than 5 percent, the Department will stop all work. Correct the defect before proceeding.

   Pretension the members as follows:

   a) Initial Tension: After threading the strand in the bed, apply an initial tensioning force to each strand.

      Do not use elongation to measure the amount of initial tension, but use a dynamometer, hydraulic jack gauge, or dead weight.

b) Final Tension: Calculate the final stress from the final elongation measured between established reference points. Use points that are independent of any movement in the bed or anchorages that might occur during the pretensioning operation.

Calculate the design elongation as follows:

$$D = \frac{PL}{AE} \text{ where}$$

D = Design elongation in inches (millimeters).

P = Tensioning force, in pounds (kilonewtons); subtract the initial tensioning force from P.

L = Distance from dead end anchorage to reference point, measured in inches (millimeters)

A = Cross-sectional area of strand, in square inches (millimeters).

E = Modulus of elasticity of strand, in pounds per square inch (MPa).

c) Add correction factors to the design elongation for strand anchorage slip and temperature. Correct any movement in the anchorage abutments or in the overall anchorage system. Use the final elongation figure as the net elongation in jacking the strand.

d) Single-Strand Jacking: Do not let the jack ram rotate more than one revolution while stressing any strand.

e) Draped Strand Jacking: Partially jack draped strands from the end of the bed to add tension. Raise or lower the strands to their final position to get the final tension.

Ensure that the strands have no more than four points where the strand changes slope, two of which shall be at each anchorage.

Use approved, low friction devices at pick-up and hold-down points. Make the devices maintain the desired vertical and horizontal positioning of the strand.

After partial jacking, deflect the strands to their final position in a sequence approved by the Engineer.

f) Final Readings: After final stressing, position all strands within the location tolerances specified in Subsection 865.2.01.B.11.

g) Calculate the final elongation according to Subsection 865.2.01.B.7.a.4).b).

Uniformly distribute stress in the strands throughout the bed length.

5) Detensioning Operation: Before detensioning, submit the pattern and schedule for releasing the strands to the Engineer for advance approval.

Detension the members as follows:

a) Strip or loosen forms that tend to restrict the horizontal or vertical movement of the member prior to releasing the stress.

b) If curing with steam, carefully release the strand because of dimensional changes due to temperature and shrinkage changes. Where possible, release the pretensioned strand while the units are moist and warm.

c) In deflected strand construction, immediately release the hold down devices within the member or members after curing with steam.

6) Stress Release Strength: You may transfer stress to the concrete, unless otherwise specified on the plans or in the Special Provisions, based on the following requirements (minimum strength determined by cylinders cast of the same concrete):

Section	Minimum Strength	Age
Concrete I-beams, box beams, flat slab deck sections, or tee slab deck sections	4500psi (30 MPa)	18 hrs
Piling	4000 psi (28 MPa)	
Other members	As specified on the plans	

7) Strand Release: Use the following table for each type of strand:

Type of Strand	Release
Single strand	Heat each strand and allow it to pull itself apart in the sequence of the approved pattern and schedule of release. Do not cut the strands.
Multiple strand	Release either a symmetrical group of strands or all of the strands simultaneously. Remove the load on the strands from the anchorage and place it on the jacking system. Gradually release the jack or jacks until the strands are relaxed.
Draped strand	Release according to a method where the weight of the beam is compared with twice the total amount of the vertical components of the hold-down forces.*

*Use one of the following two methods:

Method	Release as follows:
Method I (beam weight less than twice the total amount and vertical restraints cannot counteract the vertical components of the hold-down forces)	Heat each draped strand at the end of each member to failure in the sequence of the approved pattern and schedule of release. Release hold-downs and remove hold-down bolts. Release straight strands as noted in Subsection 865.2.01.B.7.a.(7)
Method II (beam weight more than twice the total amount)	Release hold-down devices within the beam. Release the strands from the top to the bottom by either heating or jacking in the sequence of the approved pattern and schedule of release.

b. Post-tensioning: Use either the system required by the plans or an approved alternate system. Alternate systems may include the post-tensioning of both straight and draped tendons. Ensure that the system meets the appropriate requirements that follow:

1) Tendons: Do not splice post-tensioning tendons.

2) Ducts: Accurately position the ducts in which post-tensioning tendons are placed and securely fasten them to prevent movement during concrete placement. Use flexible metal conduit, metal tubing, or other acceptable material for the ducts.

3) Stressing Requirements: Prepare the members as follows:

a) Carefully thread tendons into the ducts.

b) Avoid contaminating the strand with oil, grease, or other bond breaking material. If any strand is contaminated, clean the strand with a suitable solvent or replace the strand.

c) Follow the stressing procedures and sequences approved by the Engineer.

d) After stressing, anchor the tendons against the ends of the members and fill the ducts with grout.

4) Concrete Strength: Stress the post-tensioning tendons after the concrete in the member has reached the minimum strength and age requirements, as follows:

Minimum Strength	Age
4500 psi (30 MPa)	3 days
4000 psi (28 MPa)	5 days

c. Post-tensioning Operation: In general, tension straight tendons from one end. Simultaneously tension draped tendons from each end.

Pretension the members as follows:

1) Initial Tension: After threading the tendon in the duct, apply an initial tensioning force of up to 5 percent of the final tensioning force with a jack.

Determine the initial tension by reading the gauge. Do not use elongation to measure the amount of initial tension.

2) Final Tension: Compute the final stress on tendons from the amount of the final elongation measurement, checked by the jack pressure gauge reading.

3) Gauge Reading: Ensure that the pressure gauge reading at the time of the measured elongation is within 5 percent of the calculated gauge reading for that particular elongation.

If the gauge pressure reading varies by more than 5 percent from the calculated reading, stop the stressing operation and correct the defect before proceeding.

4) Jacking: While jacking draped tendons, ensure that jack pressures and elongations are kept as near equal as is possible at each of the two jacks so the elongation measurements and jack pressures remain proportional.

5) Anchor Devices: Design anchor devices that secure the tendon for the size of post-tensioning tendon used.

After anchoring, ensure that the devices can maintain a prestressed load of 150 percent of the maximum design load and do not slip more than 1/8 in (3 mm) after anchoring.

Place anchor devices exactly at right angles to the axes of the post-tensioned tendons. Carefully note anchorage losses and take the proper corrective measures to ensure that the tendon has the final design stress.

8. Grouting

a. Time Limitations: Complete all grouting within 48 hours after post-tensioning.

b. Grout: Make grout to a consistency of thick paint.

1) Mix, by volume, 1 part Portland cement, 0.75 part (max.) sand passing a No. 30 (600 µm) sieve, and 0.75 part (max.) water.

2) Within the limit specified, vary the proportions of sand and water as required by the Engineer.

3) If you need to fill enclosures as hereinafter specified, you may eliminate sand and use a neat cement grout in the mix.

4) After adding all ingredients, mix the batch for three minutes.

5) Make batches of grout small enough so that the batch may all be used up in less than 45 minutes.

6) Immediately before grouting, blow out tendon ducts with compressed air. Ensure that the compressed air does not contain oil.

7) Vent each duct at each end. Ensure the vent has the means for positive closure when subjected to a minimum pressure of 75 psi (515 kPa).

8) Pump the grout into the duct towards an exit vent.

9) After the grout has expelled all entrapped air and is flowing in a solid stream, close the exit vent and build the pumping pressure to a minimum of 75 psi (515 kPa). Hold it at that level for a minimum of 15 seconds.

10) Close the grout entrance vent.

11) Do not move or disturb the member at all for at least 48 hours after grouting.

9. Concrete Finish

a. Beams

1) Finish the outside face of certain exterior beams specified in the Table of *Bridge Areas Requiring a Type III Finish* in Subsection 500.3.05.AB with the Type III Special Surface Coating Finish.

2) Finish all other beams with a steel form finish.

3) Score the surfaces of the top flanges of all beams with a stiff wire brush or equivalent. Score the beams transverse to the longitudinal axis of the beams.

4) Transversely scrub the entire beam top with a coarse brush to remove all laitance and to produce a roughened surface for bonding to the slab. Remove all concrete fins or projections to produce a vertical face at the edge of the beam.

5) If using prestressed concrete deck panels, finish both sides of the beam's top flange with a trowel for 2 in. (50 mm) from each panel edge to ensure a smooth and level bearing area.

b. Superstructure Deck Units: Finish the riding surface of superstructure deck units—flat slabs, channels, double tees, etc.—as specified in Subsection 500.3.05.T.9 and the plans.

Finish the traffic face and top face of curbs on exterior units and the outside face of certain exterior beams as specified in the Table of *Bridge Areas Requiring a Type III Finish* in Subsection 500.3.05.AB.

c. Substructure Units: Finish the top surfaces of caps and piling with the Type IV—Floated Surface Finish specified in Subsection 500.3.05.AB.5.

d. Patching: The Engineer will inspect all honeycombed areas. The Engineer may reject bridge members with extensive honeycombs within bearing areas.

1) Patch as directed by the Engineer, as soon as possible after form stripping.

2) The Engineer may require that you use an epoxy bonding compound.

3) Remove hold-down devices from the bottoms of the beams.

4) Coat the resulting holes with an epoxy bonding compound and plug them with grout.

10. Concrete Curing

Cure concrete with one of the methods listed below. Provide means for keeping the temperature of bridge members above the freezing point for 6 days after concrete placement, except for steam curing. The Department may reject bridge members based on improper curing.

a. Water Curing: Cover all concrete surfaces that are not in contact with the forms with wet burlap or other suitable material.

   Keep the member wet for 7 days or until the concrete has reached the stress release strength specified in Subsection 865.2.01.B.7.a.(6).

b. Steam Curing: Do not begin steam curing for at least four hours after final placement of concrete.

   1) The Engineer may delay the start longer if the concrete has not taken its initial set. You may use sufficient heat during the delay to maintain the temperature of the concrete between 50 ° and 70 °F (10 ° and 21 °C).

   2) Ensure the steam curing enclosures retain moisture and heat.

   3) After steaming begins, you may raise the enclosure temperature at a maximum rate of 80 °F (27 °C) per hour until the surface temperature of the concrete reaches an optimum temperature, not to exceed 190 °F (88 °C).

   4) Ensure that the differential surface temperature of the concrete within a member does not exceed 40 °F (4 °C) during the curing period.

   5) Continue steaming until reaching the stress release strength.

   6) Lower the enclosure temperature at a maximum rate of 40 °F (4 °C) per hour.

   7) Maintain a film of water on all exposed surfaces of the concrete during the steam curing cycle.

   8) Do not exceed the maximum temperatures.

   9) The Department may reject bridge members based on excessive temperature.

c. Heated Forms: When using approved heated forms, keep the exposed surfaces of the concrete wet at all times.

   1) Enclose the beds with a suitable weather-tight covering supported to uniformly heat throughout the bed.

   2) Apply the requirements stated in Subsection 865.2.01.B.10.b concerning the delay period, temperature control, curing duration, and basis of rejection.

11. Tolerances

a. Manufacture prestressed concrete bridge members within the dimensional tolerances listed in SOP-3, *Standard Operating Procedures for Precast/Prestressed Concrete.* These tolerances generally will be the maximum deviation allowed, although normal manufacturing tolerances will be well within those listed.

b. The Department may reject bridge members based on excessive deviations.

12. Galvanized Coatings

a. Before shipping beams, galvanize the exposed surfaces and edges of embedded structural steel bearing components and all exposed surfaces of attached structural steel bearing components according to ASTM A 123/ A 123M or A 153/ A 153M.

b. Touch up all areas to be welded after the welded area has cooled, and the weld is completed and cleaned.

c. Galvanize miscellaneous structural steel, hardware, bolts, and washers prior to storage at the casting yard or jobsite.

13. Marking

NOTE: This requirement does not apply to single point pick-up locations placed on piling.

a. With the exception of the Department's inspection stamp, the Contractor is responsible for the placement and accuracy of all markings on bridge members according to these specifications.

b. The Inspector will not act for the manufacturer with respect to marking, but will cooperate with the plant personnel to ensure that the work is properly done with respect to time of marking, accuracy of description, and accuracy of location of marks and lettering.

c. Locate the markings so they are hidden after completing Project construction.

d. Do not ship any unit from the plant until it carries the official GDT stamp and number assigned by the Department to the Inspector at the plant, nor until the Inspector checks and approves the markings required by these specifications.

e. Required Markings: Clearly mark bridge members to indicate the Project identification, date of manufacture, beam identification number (properly located to coordinate with the erection drawing), pile length, and location of pile single-point pick up.

f. Time of Marking

1) Before Stress Transfer: Immediately after forms are removed and before transferring stress, individually identify and date members. This helps keep accurate records on each member's bed location and date of concrete placement.

2) Before Shipping: Give the Inspector advance notice of shipping. After securing members for shipment, apply marking consisting of the Project identification to each member.

g. The Inspector will place the GDT stamp and number on each member. The Inspector will not use the GDT stamp until after the members have been satisfactorily finished and stored.

14. Handling and Storing

a. Prestressing Steel: Protect all prestressing steel from contact with dissimilar metals to prevent galvanic action and excessive rusting.

1) The Department will not consider light rust that does not visibly etch the steel as detrimental.

2) Keep prestressing steel free of harmful materials, such as grease, oil, wax, clay, dirt, paint, and loose rust.

3) Use special care to keep prestressing steel free of form oil and other bond-reducing material that may be used on the forms.

4) Handle prestressing steel at all times in such manner as to prevent kinks and nicks. The Department will not allow prestressing tendons that have kinks, nicks, bends, or other defects.

5) Do not use torches or welding equipment adjacent to tensioned strand unless the strand is insulated against heating or burning.

b. Reinforcement Steel: Handle, place, and support all reinforcement steel according to the requirements of Section 511.

c. Prestressed Concrete Bridge Members (other than Beams): Handle, store, and ship prestressed concrete bridge members in a way to eliminate the danger of cracks, fractures, and excessive bending stresses. Handle members by the two embedded pick-up points, unless the Engineer approves other methods.

1) Except for piling, handle members so their vertical axes remain plumb at all times.

2) Support members in storage on firm blocking located immediately below the two embedded pick up points. In multiple layer storage, support members in the stack with blocks of uniform thicknesses and in a vertical line.

3) Set all blocking at right angles to the longitudinal axis of the member, and the longitudinal axis of the blocking shall be horizontal. Do not ship members until the concrete reaches its ultimate design strength.

> **NOTE: Replace members that were damaged in handling or storage at no additional expense to the Department. However, the Engineer may determine that the damage is minor and may approve use of the member.**

d. Piling: Handle, store, and ship piling after stress release.
   1) The Department may reject any piling cracked in handling, storing, or loading if the crack warrants.
   2) The Department will reject any cracked piling destined for locations involving sea water or alkali soils.
   3) Mark rejected pile as rejected.
   4) Store piling in groups with the same length.
   5) Transport piling in a manner approved by the Engineer. Upon request, the Engineer will furnish drawings giving the limits of truck bolster spacing for various sizes and lengths of piling.

e. Beams: Handle or store fully pretensioned beams after stress release.
   1) Use pick-up and support points within 3 ft. (900 mm) of the beam ends, or as defined in the Plans.
   2) Support beams on firm blocking located within 3 ft. (900 mm) of the permanent bearing area of the beam. Placement of dunnage outside of this limit should be analysed and noted as a deviation on the shop drawings.
   3) You may handle or store fully post-tensioned beams 48 hours after the grout has been placed in the tendon ducts.
   4) For beams manufactured by the combined method of pretensioning and post-tensioning, you may handle and store them after the pretensioning phase is completed. Do not handle again until 48 hours after grout placement.
   5) Do not ship beams and other superstructure units until after their strength reaches the required minimum 28-day design strength.
   6) Store beams in single layers, not in stacks. Support beams so they meet the following requirements concerning warp and sweep:

Twist of vertical axes of the ends of beams due to misalignment of blocking	The maximum deviation between the vertical axes of the ends of beams shall be 1/4 in./ft. (20 mm/m) of beam height.
Tilt of vertical axis of an end of beam from the vertical due to deviation of blocking from the horizontal	The maximum deviation of the vertical axis of an end of a beam shall be 1/4 in./ft. (20 mm/m) of beam height.
Lateral sweep due to manner of storage	There shall be no discernible sweep induced by the manner in which a beam is stored.

C. Acceptance

1. Plant Inspection
   a. Give Notice to the Engineer: Give the Engineer ample notice before starting work so that the Engineer can inspect all plant facilities involved in the production. Do not manufacture anything until the Engineer approves all facilities.

b. Facilities for Inspection: Allow free access to the Inspector to all parts of the plant involved in the production process.

c. Inspector Authority: The Inspector has the authority to reject materials or quality of work that do not meet the specifications. In cases of dispute, the Contractor may appeal to the Engineer, whose decision will be final.

2. Rejections

If any material or finished members are defective, they will be rejected, even though the Inspector may have accepted them.

a. Promptly replace rejected material or quality of work or make it good at your own expense.

3. Provisions for Testing

Furnish and maintain sufficient testing equipment so that the Inspector can conduct the following tests at the casting yard:

Material	Test Method
Fine Aggregate	AASHTO T 27
Coarse Aggregate	AASHTO T 27
Hardened Concrete	GDT 35

a. Hardened Concrete: Make cylindrical molds available for use on each casting bed.

4. Provide and maintain a machine and other accessories, such as capping molds, heating pots, and capping compound, sufficient to test compression specimens according to AASHTO T 22.

5. Furnish all testing materials, without cost to the Department, well in advance of the anticipated time of use. The Department will not compensate the Contractor if the work is delayed waiting for approval of the materials furnished for testing.

4. Facilities for the Inspector: Furnish for the sole use of the Inspector a suitable field laboratory according to Subsection 106.04, Subsection 106.11, and Subsection 152.

D. Materials Warranty

General Provisions 101 through 150.

Section 920—Lighting Standards and Towers

Replace Section 920 with the following:

920.1 General Description

This section includes the requirements for the structural components of poles, towers, bases, anchor bolts, luminaires, and other attachments used for roadway, high mast, or other lighting.

In particular, the section covers the following:

- Steel lighting standards and towers
- Aluminum lighting standards
- Prestressed concrete standards
- Support and lowering assemblies
- Grounding

920.1.01 Related References

A. Standard Specifications

Section 105—Control of Work

Section 501—Steel Structures

Section 645—Repair of Galvanized Coatings

Section 682— Electrical Wire, Cable, and Conduit

Section 865—Manufacture of Prestressed Concrete Bridge Members

B. Referenced Documents

ASTM			AASHTO
A 27/A 27M	A 153/A 153M	A 709/A 709M	M 222/M 222M
A 53/A 53M	A 193/A 193M	B 108	M 314
A 123/A 123M	A 588/A 588M		

MIL-W-83420

AISI 304

AISI 1020

AASHTO Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, with Interims (SLTS)

ANSI C136.30, American National Standard for Roadway and Area Lighting Equipment-Pole Vibration

920.1.02 Submittals

Submit to the Engineer shop drawings and design calculations for each type of lighting standard, or tower to be used, for review and approval. Submission should be made electronically in a portable document format (pdf) and include an index. Format all drawings to fit 11 in. x 17 in. (279 mm x 432 mm) paper. Present calculations to fit 8.5 in. x 11 in. (216 mm x 297 mm) paper. The submission shall be prepared and stamped by the Design Engineer who shall be registered as a Professional Engineer in the State of Georgia.

The Engineer will distribute submitted documents to the Bridge Engineer (SLTS@dot.ga.gov) for review.

920.2 Materials

Design lighting assemblies consisting of standard, tower, bracket arms, lowering assembly, and luminaire support and assemblies according to AASHTO SLTS

920.2.01 Steel Lighting Standards and Towers

A. Requirements

1. Design

   Poles shall be designed to the following wind speeds using a 700 Mean Recurrence Interval (MRI) with Fatigue Category 1 for the listed counties:

   - 140 mph: Bryan, Camden, Chatham, Effingham, Glynn, Liberty, McIntosh
   - 130 mph: Brantley, Bulloch, Charlton, Evans, Long, Screven, Tattnall, Wayne
   - 120 mph: Appling, Bacon, Brooks, Burke, Candler, Clay, Clinch, Decatur, Early, Echols, Emanuel, Grady, Jeff Davis, Jenkins, Lowndes, Miller, Pierce, Seminole, Thomas, Toombs, Ware
   - 115 mph: For all counties not listed above

2. Include the following in the makeup of lighting standards and towers:
   - A pole and bracket arms as required on the Contract.
   - A steel base welded to the other end complete with bolts for use as an anchor base pole, or attached to an approved breakaway device, such as slip base, aluminum transformer base, breakaway couplings, etc., when so specified.

3. Steel Structures

   Use structural carbon or structural low alloy steel that meets the requirements of AASHTO SLTS. However, do not use ASTM A 588/A 588M steel.

4. Steel Pipe

   When steel pipe is used, use steel pipe complying with ASTM A 53/A 53M Grade B or approved equal. No hydrostatic test is required.

B. Fabrication

1. Roadway Standards

   Unless otherwise specified, do the following:

   a. Make the shaft or appropriate shape continuously tapered with a base welded to the lower end.

   b. The welds of the base flange to the shaft shall be configured such that the weld joints are loaded in shear, never in tension.

   c. Construct the standard of steel at least 11 gauge (3.1 mm) thick to the dimensions required for the specified mounting height. Form the standard from one piece with one electrically full penetration welded longitudinal joint and no intermediate horizontal joints.

   d. After forming and welding, cold-roll the shaft longitudinally under sufficient pressure to flatten the weld and increase the physical characteristics of the metal in the shaft.

- **e.** Ensure that the shaft has a reinforced handhole with a cover, except where a transformer base is specified.
  - **(1)** Provide a 0.5 in. (13 mm) approved grounding connector in the shaft or base.
  - **(2)** Equip the top of the shaft with a removable pole cap held securely in place.
  - **(3)** Galvanize the shaft, base plate, bracket arm(s), handhole cover, and all elements of the pole with the hot-dipped method in ASTM A 123/A 123M.
- **f.** Equip the top of the shaft with a removable pole cap held securely in place with set screws. Cap shall match material and meet the same requirements as the pole.

2. Lighting Towers

- **a.** Make the shaft to meet the requirements of the roadway standard (Subsection 920.2.1.B.1).
- **b.** Construct the standard to continuously taper 0.14 to 0.40 in./ft. (12 to 33 mm/m).
- **c.** Ensure that the standard has the necessary dimensions and metal quality to meet the requirements for the specified mounting height.
- **d.** The shaft may be formed in sections with each section having no more than two longitudinal welded seams. Sections shall be a minimum of 30 feet in length.
- **e.** Use intermediate horizontal welds only at section joints.
- **f.** Make telescoped joints overlap at least 1-1/2 pole diameters, measured at the minimum diameter of the inner telescoping section.
- **g.** Have field welding performed only by an approved certified welder who represents the manufacturer. Ensure the welding follows the requirements of Section 501.
- **h.** Repair any damage to galvanized coating according to Section 645.
- **i.** Match-mark all sections of the shaft so that the tapered sections are assembled properly.

3. Post Top or Other Standards for Special Installation

- **a.** Make the post top and other standards meet the requirements for roadway standards (Subsection 920.2.01.B.1).
- **b.** Make the top diameter of the shaft 2 in. (50 mm) or include a 2 in. (50 mm) tenon, unless otherwise specified, to insert the shaft or tenon into the luminaire.

4. Anchor Base

Do the following, unless otherwise specified:

- **a.** Secure a steel base to the lower end of the shaft with two continuous electric welds. Ensure that the base develops the full strength of the adjacent shaft section to resist bending.
- **b.** Provide removable cast or pressed steel covers with each base. Appropriately attach each cover to the base.

5. Steel Bracket Arms

Do the following, unless otherwise specified:

- **a.** Use the design dimensions from the Contract.
- **b.** Bracket arms shall be of the same material and meet the same requirements as the pole shaft.
- **c.** Ensure that the installed bracket connects securely with the shaft and has a smooth wiring raceway.
- **d.** Use stainless steel bolts and nuts that meet the requirements of ASTM A 193/A 193M, Type B8C or AISI 304 to attach the bracket arm assembly.

6. Transformer Bases

Do the following, unless otherwise specified:

- **a.** Use the dimensions on the Contract to build the bases.
  - **(1)** Make top and bottom plates that meet the requirements of ASTM A 709/A 709M, Grade 36 (250), and are fabricated to receive the shaft, anchor bolts, and the foundation bolts.
  - **(2)** Make the side panels meet the requirements of AISI 1020.

(3) Create a base thick enough for the height of the standard.

b. Fit the base with a handhole and cover that can be securely fastened.

7. Anchor Bolts

a. Provide bolts as follows:

Lighting standard	4 anchor bolts (minimum)
Lighting tower	8 anchor bolts (minimum)

b. Use the size indicated on the Contract or as required by the manufacturer's shop drawings.

c. Use anchor bolts, nuts, and washers that meet the requirements of AASHTO M 314, Grade 55(370). Supplementary requirement S 1 of AASHTO M 314 also applies.

NOTE: Do not use Grade 105 (724).

d. Install anchor bolts with a leveling nut and a flat washer between the leveling nut and the base plate.

(1) Use a template to install the bolts.

(2) Place a flat washer on top of the base plate.

(3) Use a lock washer on top of the flat washer and secure the nut.

(4) Fully grout the space between the shoe base and the top of the footing with non-shrink grout.

e. Galvanize threaded ends of anchor bolts, hexagonal nuts, flat washers, and lock washers according to ASTM A 153/A 153M and Contract details.

8. Finish

Unless otherwise specified, galvanize all steel lighting standards and towers, including pole, base, transformer base, and bracket arm assembly according to ASTM A 123/A 123M.

C. Acceptance

1. The Engineer reserves the right to inspect and run tests as necessary to ensure compliance with these specifications and to reject items that fail testing.

2. The Engineer will accept the steel lighting standards and towers based on:

- The results of physical and chemical tests made by the Department.
- The manufacturer's certification showing physical and chemical properties of the metal prior to forming.

D. Materials Warranty

General Provisions 101 through 150.

920.2.02 Aluminum Lighting Standards

A. Requirements

1. Design

Poles shall be designed to the following wind speeds using a 700 Mean Recurrence Interval (MRI) with Fatigue Category 1 for the listed counties:

- 140 mph: Bryan, Camden, Chatham, Effingham, Glynn, Liberty, McIntosh
- 130 mph: Brantley, Bulloch, Charlton, Evans, Long, Screven, Tattnall, Wayne
- 120 mph: Appling, Bacon, Brooks, Burke, Candler, Clay, Clinch, Decatur, Early, Echols, Emanuel, Grady, Jeff Davis, Jenkins, Lowndes, Miller, Pierce, Seminole, Thomas, Toombs, Ware
- 115 mph: For all counties not listed above

2. Include the following in making aluminum lighting standards:

a. A pole and bracket arm(s) as required on the Contract.

b. An aluminum base welded or bonded to the lower end, complete with bolts for use as an anchor base pole or attached to an approved breakaway device such as an aluminum transformer base, breakaway couplings, etc., when so specified.

B. Fabrication

Use aluminum materials that meet the requirements of AASHTO SLTS

3. Roadway Standards

   a. Make the shaft with a continuous taper formed from an extruded blank (preferably 6063-T6). Weld a base plate to the lower end.

   b. Give the shaft a reinforced handhole with a cover, except when a transformer base is specified.

   c. Provide a 0.5 in. (13 mm) approved grounding connection in the shaft or base.

   d. Equip the top of the shaft with a removable pole cap held securely in place with set screws. Cap shall match material and meet the same requirements as the pole.

4. For Post Top or Other Standards for Special Installation,

   Do the following, unless otherwise specified:

   a. Build the standard to meet the requirements for roadway standards (Subsection 920.2.01.B.1).

   b. Make the top diameter of the shaft 3 in. (75 mm) or include a 3 in. (75 mm) tenon to insert the shaft or tenon into the luminaire.

5. Anchor Base

   Do the following, unless otherwise specified:

   a. Secure the one-piece aluminum base to the lower end of the shaft by using two continuous welds.

   b. Ensure that the base develops the full strength of the adjacent shaft section to resist bending.

   c. When the Contract call for a frangible or breakaway base, attach the base to an approved breakaway device with an approved number and type of bolts, or use a base that is an approved breakaway type.

   d. Provide removable cast or pressed aluminum covers with each base. Appropriately attach each cover to the base.

6. Aluminum Bracket Arms

   a. Use the Contract design and dimensions.

   b. Ensure that the installed bracket arm connects securely with the shaft and has a smooth wiring raceway.

   c. Use stainless steel bolts and nuts that meet the requirements of ASTM A 193/A 193M, Type B8C or AISI 304, to attach the bracket arm assembly.

7. Transformer Bases

   a. Form the base of cast aluminum that meets the requirements of ASTM B 108, Alloy A03560, T6 to dimensions on the Contract.

   b. Make the top so it can receive the anchor base bolts and the bottom so it can receive the anchor bolts.

8. Anchor Bolts

   Use bolts as described in Subsection 920.2.01.B.7.

9. Finish all aluminum lighting standards, including pole, base, transformer base, and bracket arm assembly in a natural aluminum color, unless otherwise specified.

C. Acceptance

1. The Engineer reserves the right to inspect and run tests as necessary to ensure compliance with these specifications and to reject items that fail tests.

2. The Engineer will accept the aluminum lighting standards based on:

   a. The results of physical and chemical tests made by the Department

b. The manufacturer's certification showing physical and chemical properties of the metal prior to forming the standard

D. Materials Warranty

General Provisions 101 through 150.

920.2.03 Prestressed Concrete Lighting Standard

Concrete poles are only to be used where approved and as specified within the Contract.

A. Requirements

1. Design

   Poles shall be designed to the following wind speeds using a 700 Mean Recurrence Interval (MRI) with Fatigue Category 1 for the listed counties:

   - 140 mph: Bryan, Camden, Chatham, Effingham, Glynn, Liberty, McIntosh
   - 130 mph: Brantley, Bulloch, Charlton, Evans, Long, Screven, Tattnall, Wayne
   - 120 mph: Appling, Bacon, Brooks, Burke, Candler, Clay, Clinch, Decatur, Early, Echols, Emanuel, Grady, Jeff Davis, Jenkins, Lowndes, Miller, Pierce, Seminole, Thomas, Toombs, Ware
   - 115 mph: For all counties not listed above

2. Make the pre-stressed concrete lighting standard of the design and dimensions in the Contract. Make the standard with machines in steel forms by the centrifugal spinning process to ensure maximum density.
3. Use a manufacturing method that produces a smooth cable raceway throughout the length of the standard.

   Make the raceway between 1.5 to 2 in. (38 to 50 mm) in diameter when measured at the top of the standard.

B. Fabrication

1. Use materials and manufacturing methods according to Section 865 with the following exceptions:
   a. Concrete: Use Class AAA concrete with a maximum aggregate size of 3/8 in. (10 mm) and a maximum slump of 0.5 in. (15 mm) after the spinning process.
   b. De-tension: You may de-tension the standards after 24 hours under a low-temperature steam process.

      However, if the standard does not reach a compression strength of 3,500 psi (25 MPa) in this 24-hour period, the Inspector will reject the standard.
   c. Finish: Ensure that the standard has a smooth, uniform finish from a water carborundum mechanical process that removes the laitance and surface content revealing the aggregate.
2. Bases
   a. Furnish the standards with an anchor base or a precast butt base.

NOTE: If using the precast butt base, cast it as an integral part of the standard during the spinning process. Make a conduit entrance as shown on the Contract.

   b. Make the bolt-down anchor base have a cast steel anchor base that meets the requirements of ASTM A 27/A 27M, Grade 70-36 (485-250).
   c. Secure the base to the primary pole reinforcement so it is strong enough to transmit the required loads to the anchor bolts.
   d. Fit the base with a handhole and cover that can be securely fastened.

C. Acceptance

1. The Engineer reserves the right to make, inspect and run tests as necessary to ensure compliance with these specifications and to reject those items failing such tests.
2. The Engineer will accept these standards based on tests made by representatives of the Department during the manufacturing process.

3. Give sufficient notice to the Engineer prior to manufacture to arrange for the required inspection.

D. Materials Warranty

General Provisions 101 through 150.

920.2.04 High Mast Luminaire Support and Lowering Assembly

A. Requirements

1. This assembly shall be a mechanical device capable of supporting the luminaire assembly at the required operating position and raising the assembly to the operating height and lowering the assembly to ground level for servicing.
2. Furnish shop and working drawings or illustration sheets according to Section 105.
3. Transfer to the Engineer all guarantees on materials and equipment that the manufacturer normally furnishes, together with all operating instructions and service manuals.

   Include in the guarantees the provision that they are subject to such transfer.

B. Fabrication

1. Use AASHTO SLTS to build the assembly.
2. Support Head Frame

   Use a head frame with at least two supports for the suspension cables and a pulley for the power cable.

   a. Place the suspension supports 120 degrees apart. Place the power cable pulley midway between two suspension supports.

   b. Attach two pulleys to the inside of each support, one at each end. Construct the pulleys so that the suspension cables ride freely in the groove of the pulleys.

      Provide cable guides and retainers to keep the suspension cables and power cable inside the pulleys.

   c. Supply a hood for the support head frame to protect against weather for all working components at the pole top. Ensure that the hood adequately ventilates the pole.
3. Luminaire Mounting Ring

   a. Equip the inner portion of the ring with approved roller-contact, spring loaded centering arms. The arms should center the luminaire ring while ascending or descending the pole, protect the pole and luminaires, and prevent jamming during the raising and lowering operations.

      Make the rollers for the centering arms of a water-resistant, non-marking composition material.

   b. Design the mounting ring to symmetrically mount the number of luminaires indicated on the Contract.

      (1) Provide a weatherproof junction box and terminal board terminating the power cable and connecting the luminaire wiring.

      (2) Provide a weatherproof power receptacle to test the luminaires when the ring is in the lowered position.
4. Non-Latching Device Design

   a. If the design does not have a latching device at the top of the pole, position the luminaire mounting ring tightly against the support head frame.

NOTE: Use a positive, visible indication that the required force has been applied.

   b. Make sure the luminaire mounting ring and support head frame can hold the luminaire mounting ring in place and prevent rotation and unwanted movement while in the raised position.

   c. A spring-loaded arrangement is preferred to provide proper cable tension and hold the luminaire ring securely in place.
5. Latching Device Design

   a. Use a latching device at the top of the pole to latch all three suspension points and support the total weight of the ring including luminaires.

b. Place all moving parts of the latching device in the luminaire mounting ring.

NOTE: Use a positive, visible indication of the latching position.

6. Miscellaneous Hardware

   Use non-corrosive miscellaneous fittings, fasteners, and hardware for the support head frame and luminaire mounting ring. Use an approved means for locking nuts.

7. Hoisting Systems

   a. Ensure that each pole has three suspension cables and one hoisting cable.

   b. Use cables that have 7 strands of 19 wires each, made of stainless-steel aircraft cable according to MIL-W-83420, Type 1, Composition B.

   c. Use at least 0.2 in. (5 mm) diameter suspension cables and at least a 0.25 in. (6 mm) diameter hoisting cable.

   d. Anchor the ends of the pole's suspension cables to the top of the suspension cable bracket or transition plate assembly. Pass the other ends through the pulleys on the support head frame and attach to the luminaire mounting ring.

   e. Secure the hoisting cable at the bottom center of the suspension cable bracket assembly. Attach the other end to the drum of the motor-driven winch.

      Prevent future twisting and eliminate any tension developed during initial installation of the hoisting cable system.

   f. Use a worm-gear reducing winch with a reduction ratio that is self-locking in both raising and lowering operations.

      Completely enclose the worm-gear in a lubricating reservoir.

   g. Make the winch operable with either an electric drill motor or a NEMA frame motor as described in Lowering Device Power Supply Unit.

   h. Provide a hand crank for raising and lowering.

   i. Include a cable guard/retainer for the winch drum. This will force the cable away from the ends of the drum for spooling and prevent the cable from coming off the drum.

   j. Design the entire hoisting system so that power cable, suspension cables, and hoisting cable may be replaced from the ground.

8. Lowering Device Power Supply Unit

   a. Use a lowering device power supply unit that is either an electric drill motor or a NEMA frame motor.

      (1) Equip both motors with a factory-set torque limiter. Power each from a weatherproof outlet or receptacle located in the service area of the pole.

      (2) You may use a step-down transformer to supply the required motor voltage.

   b. Make the transformer an integral part of the power supply unit, when required.

   c. Attach and lock in place the drill or motor at the pole handhole. Provide a remote-control system that works from at least 20 ft. (6 m) away.

9. High Mast Power Cable

   a. Use extra heavy-duty power cable in a jacket that resists oil and sunlight. Include in the cable the number and size of copper insulated conductors required on the Contract.

   b. Securely connect the power cable to the luminaire mounting ring and the suspension cable bracket assembly so it will not damage the cable and supports only its own weight.

10. Pole Disconnect

    a. Furnish each pole with a molded case circuit breaker in a NEMA enclosure of the size and type specified on the Contract.

b. Make the breaker accessible through the pole handhole. Get the breaker from the manufacturer of the raising and lowering device.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Submit guarantees on materials and equipment.

920.2.05 Grounding

A. Requirements

General Provisions 101 through 150.

B. Fabrication and Construction

1. In accordance with AASHTO recommendations, pole must be grounded independently from power system ground using a ground rod.
2. Ground rod and equipment must meet provisions set forth within Section 682.6.01 P.
3. Include a grounding conductor with the high mast power cable and connect it to the luminaire mounting ring.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

Section 935—Fiber Optic System

Replace Section 935 with the following:

935.1 General Description

Furnish, install, test, and provide warranty and training for a fiber optic system comprised of equipment and materials as specified herein and shown in the Contract documents.

935.1.01 Definitions, Acronyms, and Abbreviations

A. Definitions

1. **Drop Fiber**: a smaller-strand count fiber optic cable that provides the interconnection of network equipment inside a field cabinet and/or a hub building to the trunk or backbone fiber optic cable.
2. **Encapsulate:** A resin or other material to prevent ingress of moisture into the fiber optic closure.
3. **Fiber Interconnect Cable**: a 12 or 24 fiber factory-connectorized cable from the splice tray to the back of the bulkhead connector panel.
4. **Fiber Pigtail Cable**: a single-fiber factory-connectorized cable from the splice tray or splice holder to the back of the bulkhead connector panel.
5. **FPP/FDU**: fiber termination at field cabinets and hub buildings to provide network connectivity for ITS devices. FPPs are defined as providing 6 to 36 connectors or ports, and FDUs are larger, providing 48 to 288 connectors or ports.
6. **Trunk Fiber**: a multi-fiber count fiber optic cable that provides the network interconnection and transport between field cabinets, hub buildings, the TMC, and other facilities.

B. Acronyms and Abbreviations

Refer to Sections 101.01 and 942.1.01.B for a list of acronyms, abbreviations, and terminology used in this section.

935.1.02 Related References

A. Standard Specifications

Section 631 – Dynamic Message Signs

Section 647 – Traffic Signal Installation

Section 682 – Electrical Wire, Cable, and Conduit

Section 694 – Weather Monitoring and Reporting System

Section 926 – Wireless Communications Equipment

Section 936 – Closed Circuit Television (CCTV)

Section 939 – Communications and Electronic Equipment

Section 942 – ITS General Requirements

B. Referenced Documents

Refer to Section 942.1.02.B for a list of standards and documents referenced in this section.

935.1.03 Submittals

Refer to Section 942.1.04 for submittal requirements. Requirements for fiber optic cables, components, and materials are specified herein.

935.2 Materials

935.2.01 Fiber Cable and Optical Requirements

A. General

1. Comply with ISO 9001 or Six Sigma quality manufacturing requirements.
2. Provide only fiber optic cables and components that are new (manufactured no more than one year prior to the Notice to Proceed) and provided by one manufacturer using the same model, part number, and revision. Provide the manufacturer date as part of the submittal process in Section 942.1.04.
3. Provide SM fiber optic cable that is splice-compatible with the Department's existing legacy G.652 SM fiber and requires no electronic equipment for dispersion compensation between new and existing fiber.
4. Provide fiber optic cables ranging from 6 strands to 288 strands as shown in the Contract documents.
5. Provide cables that comply with NFPA 70.
6. Provide cables that comply with RoHS Directive 2011/65/EU.

B. Fiber Optical

1. Provide fiber optic cables that comply with ICEA S-87-640.
2. Provide fiber optic cables that comply with Telcordia GR-20-CORE.
3. Provide fiber optic cables that comply with USDA RUS 7 CFR 1755.900, 901, and 902 (PE-90).
4. Provide SM fiber optic cables that comply with ITU-T G.652.D.
5. Provide SM fiber optic cables that comply with ITU-T G.657.A1.
6. Provide SM fiber optic cables that comply with TIA-492-CAAB (OS2).
7. Provide fibers that are 100% usable.
8. Provide SM fibers that meet the optical performance requirements when tested according to TIA-455:
   a. Provide a fiber section that has attenuation of ≤0.35 dB/km at 1,310 nm with a variability of ≤0.03 dB/km between 1,285 nm and 1,330 nm. Test according to FOTP-78-B.
   b. Provide a fiber section attenuation of ≤0.25 dB/km at 1,550 nm with a variability of ≤0.02 dB/km between 1,525 nm and 1,575 nm. Test according to FOTP-78-B.
   c. Provide fiber that has a mode field diameter of 9.2 μm ±0.4 μm at 1,310 nm and 10.4 μm ±0.5 μm at 1,550 nm. Test according to FOTP-191-B.
   d. Provide fiber that has uniform attenuation with no point discontinuities >0.05 dB at both 1,310 nm and 1,550 nm.
9. Provide a mechanically strippable, dual-layer, UV acrylate, color-coded protective coating.

C. Fiber Optic Cable Construction

1. Provide OSP fiber optic cables with the following characteristics:
   a. Provide cable suitable for underground (i.e., in conduit) and aerial installation.
   b. Provide cable with a single jacket that is unarmored.

c. Provide cable with an outside diameter of no greater than one inch.

d. Provide all-dielectric (no metal or electrically conductive) materials.

e. Provide water-blocking materials that are gel-free, dry-type, non-nutritive to fungus, electrically non-conductive, and homogenous.

f. Provide loose tube design that is SZ-stranded around an anti-buckling central strength member.

g. Provide buffer tubes that contain 12 optical fibers placed inside each tube for cables 24 count and higher.

h. Provide fibers and buffer tubes that are color coded according to TIA-598-D.

    i. Colors shall be stable during temperature cycling and aging.

    ii. Colors shall not fade or smear onto each other.

2. Provide cable outer jacket or sheath meeting the following minimum requirements:

    a. Provide a minimum medium-density polyethylene black outer jacket as defined by ASTM D1248, Type II, Class C, Category 4 or 5 and Grades J4, E7, and E8.

    b. Provide a track-resistant polyethylene black outer jacket if the fiber optic cable is installed in an aerial application and the space potential is >12 kV.

    c. Provide jacket that is smooth; concentric; free from holes; consistent thickness; free of splits, blisters, and any other surface flaws; and contains carbon black to provide UV protection and prevent the growth of fungus.

    d. Provide a method for removal of the sheath.

3. Provide labeling for the fiber optic cable meeting the following minimum requirements:

    a. Label fiber optic cables (trunk and drop) using the following template, unless otherwise listed in the Contract:

        i. Manufacturer's name – Optical Cable – Year – Telecommunication Handset Symbol – GA DOT (or as required by the AHJ) – Description (which consists of XX SM or MM, where XX denotes the fiber count).

        ii. Sequentially mark the cable length reflecting the distance from the cable origin point in English units every 2 ft (0.6 m). Cable length markings shall be within 1% of the actual length of the cable.

        iii. Provide cable marking that is contrasting in color to the cable jacket. Marking font height shall be no less than 0.10 in (2.5 mm).

    b. Use cable marking that meets the following minimum requirements:

        i. Use 2.5 in (64 mm) wide, 4 in (100 mm) long, wrap-around type cable markers suitable for underground and aerial use.

        ii. Use UV-stabilized marker material and printing inks to provide an aerial durability of at least five years.

        iii. Print text in bold black type on orange or yellow PVC markers.

        iv. Fabricate markers from PVC base material with a minimum thickness of 0.015 in (0.38 mm).

        v. Pre-print the following text, or alternate text shown in the Contract documents, legibly on markers used for the cables:

        Cable ID: XXXXXXX

        GA DOT

Optical Cable

Where XXXXXX is the cable ID as defined in the Contract documents.

vi. Print the text specified above twice on every cable marker with the text of the second image reversed and abutting the first image so that the text "reads right" when either short edge of the cable marker is held horizontally upright.

D. Cable Performance

Provide fiber optic cable that has been tested in accordance with TIA-455 as shown in Table 1, resulting in no permanent change in attenuation, no signs of water leakage, no mechanical damage to the cable, and no adverse effects to the jacket or fibers. Upon the request of the Department, provide certification from an independent testing laboratory certifying the cable conforms to the following specifications and test procedures.

ID	Parameter	Test Performed	Test Condition/ Specification
Testing requirements that apply to all fiber optic cable			
1	Bend Test (Low and High Temperature)	FOTP-37-A	Four full turns around mandrel of 20 times cable outer diameter at 4 hours of –22°F and +140°F (–30°C and +60°C)
2	Impact Resistance	FOTP-25-D	25 impact cycles (at 4.4 nm) at different points along the sample
3	Compressive Strength (Crush Resistance)	FOTP-41-A	125 lb/in (220 N/cm) (short)
4	Tensile and Fiber Strain (Macro-bending)	FOTP-33-B	Maximum 600 lb (2,700 N) – during tensile load, Maximum 180 lb (800 N) – without tensile load
5	Cable Twist-Bend	FOTP-85-A	10 cycles ±180 degrees of mechanical twisting
6	Cable Cyclic Flexing	FOTP-104-B	25 times mechanical flexing cycles around a sheave of 20 times cable outer diameter
7	Temperature-Humidity Cycling	FOTP-3-B	–40°F to +158°F (–40°C to +70°C)
8	Water (Fluid) Penetration	FOTP-82-B	1 m static head for 1 hour
9	Cable Freezing	FOTP-98	Frozen on ice
Testing requirements that apply to aerial fiber optic cable			
1	High Frequency (Aeolian) Vibration	IEEE P1222	100 million vibration cycles
2	Low Frequency (Galloping) Vibration	IEEE P1222	100 thousand vibration cycles

E. Fiber Patch Cord

1. Provide the same glass type and performance requirements as the manufacturer of the backbone and drop fiber optic cable provided in the Contract.
2. Provide factory pre-assembled, riser-rated, factory-tested, pre-terminated duplex patch cords with two fibers with connectors as described in Section 935.2.03.A on each end.
3. Provide patch cords that meet UL 94-V0 flammability requirements.
4. Provide lengths as listed in the Contract with a minimum of 1 ft (30 cm) slack between connected equipment.
5. Provide optical fiber within the body of fiber optic connectors that are mechanically isolated from cable tension, bending, and twisting.
6. Use yellow outer jackets for SM and orange for MM fiber optic cables.
7. Use connector boots of two colors for all duplex patch cords, zip cord, or round to distinguish between the two zip legs of the duplex cord.
8. Label duplex patch cords to distinguish between the two zip legs of the duplex cord. .

9. Provide protective dust caps on the connector ferrules.
10. No splices of any type shall be within a patch cord assembly.
11. Provide qualification or certification data from the manufacturer upon request by the Department.
12. Package each assembly individually within a plastic bag and clearly mark on the outside of that bag the submitted manufacturer's part number.

F. Environmental

Provide fiber optic cables, connectors, and splice trays that meet Telcordia GR-20-CORE and ICEA S-87-640 temperature and humidity requirements.

935.2.02 Fiber Optic Components Requirements

A. Fiber Optic Splice Closure

1. House optical fiber splices within a fiber optic splice closure, complete with fiber splice trays and expressed buffer tube organizer, dome, grommets, end plate, mounting hardware and bracket, cable restraint hardware, buffer tube storage, splice protection, sealant materials, and any other materials and components needed to provide a completely sealed fiber splice closure installation.
2. Provide splice closures, organizers, cable end preparation tools, and procedures that are compatible with the fiber optic cable.
3. Provide splice closures that are stand-alone.
4. Use splice closures that are either “cylindrical dome” or “rectangular dome” type with cable entries at one end only and sealed, one-piece, high-density black UV-resistant polyethylene (thermoplastic) dome bodies.
5. Provide splice closures that are designed and tested in accordance with Telcordia GR-771-CORE requirements.
6. Use only RUS-listed splice closures.
7. Provide splice closures consisting of three types depending on the number of splices required that meet the following requirements:
    a. Up to 48 fiber splice capacity (including both trunk and drop cable splices): determine the number and type of splice trays by the number of splices required in the Contract documents. Provide splice closures that support up to four cable entries of at least 0.75 in (19 mm) diameter. These splice closures shall have maximum dimensions of 10 in (254 mm) diameter and 22 in (580 mm) length (smaller physical size is preferred).
    b. Greater than 48 and up to 144 fiber splice capacity (including both trunk and drop cable splices): determine the number and type of splice trays by the number of splices required in the Contract documents. Provide splice closures that support up to four cable entries of at least 1.0 in (25 mm) and at least two additional cable entries of at least 0.75 in (19 mm) diameters. These splice closures shall have maximum dimensions of 10 in (254 mm) diameter and 22 in (580 mm) length (smaller physical size is preferred).
    c. Greater than 144 and up to 288 fiber splice capacity (including both trunk and drop cable splices): determine the number and type of splice trays shall by the number of splices required in the Contract documents. Provide splice closures that support up to four cable entries of at least 1.0 in (25 mm) and at least two additional cable entries of at least 0.75 in (19 mm) diameters. These splice closures shall have maximum dimensions of 10 in (254 mm) diameter and 28 in (711 mm) length (smaller physical size is preferred).

8. Provide splice closures that are capable of storage and expressing through all unopened buffer tubes when configured for any number of splices as specified above.
9. Provide a flexible thermoplastic compression seal grommet for each end plate cable port that matches the required number and size of cables coming in and out of the splice closure without jeopardizing the weathertight characteristics of the splice closure.
10. Hermetically seal closures to protect fiber, splices, and internal components from water entry, including being submerged in standing water, without the use of an encapsulate material.
11. Provide splice closures that are sealed from insects, rodent proof, airtight, crush resistant, chemical-resistant, and corrosion resistant.
12. Provide an external pressurization air valve or port for flash testing the splice closure.
13. Provide fiber organizers that comply with Telcordia GR-769-CORE and splice trays that organize fiber buffers, protect fiber splices, and provide fiber and buffer slack storage.
14. Provide splice closures that can be re-entered and resealed using no special tools.
15. Provide reusable sealing materials (grommets, O-rings, etc.) that allow multiple re-entries and closures without removal of any component and without disruption to the surrounding cables.
16. Provide splice closures that are suitable for mounting on the inside wall of an underground buried ECB, pull box, or aerial messenger or strand as listed in the Contract documents.
17. Use corrosion-resistant aluminum, hot-dipped steel, or stainless steel mounting brackets and hardware.
18. For aerial installation, provide closure that also meets the following minimum requirements:
    a. Provide universal mounting bracket with features to permit aerial strand mounting with strand clamps or as approved by the Department.
    b. Provide a product that is designed to eliminate the need for drip collars and sealing collars.
    c. Package the closure with all hardware required for aerial mounting.

B. Fiber Splice Tray

1. Hold each fiber strand and buffer tube in the tray so that no stress or tensile force is placed on completed and finished fusion splices within the tray.
2. Loop individual fibers one full turn within the splice tray to avoid micro bending.
3. Maintain minimum bend radius of fiber at all times.
4. Provide slack storage for exposed fibers and buffer tubes to prevent damage to fibers.
5. Provide splice trays that include a cover with a locking mechanism to hold it in place.
6. Provide access to individual fibers without disrupting other fibers in the tray.
7. Provide fiber that is capable of being visually inspected.
8. Package and protect each fusion-spliced fiber housed within the splice tray with a minimum 1.5 in (40 mm) reinforced, heat shrink, and weathertight sleeve.

C. Fiber Optic Connector

1. Provide certified LC fiber optic connectors for SFP optical transceivers for network switches and for FPPs and FDUs with greater than 12-port terminations.
2. Provide only ST-compatible, ceramic-insert couplers where barrel couplers are used in passive termination applications such as FPPs and FDUs with 6 and 12-fiber port terminations.

3. Provide connectors that comply with TIA-568-B.3.
4. Provide connectors that comply with TIA-604-10B (Type LC) and TIA-604-2B (Type ST) intermateability requirements.
5. Test connectors according to Telcordia GR-326-CORE.
6. Provide ceramic ferrule UPCs that are polished.
7. Mechanically isolate the optical fiber within the body of connectors from cable tension, bending, and twisting.
8. Provide connectors that are factory-assembled and tested. No field installed connectors are permitted.
9. Provide unmated connectors with protective dust caps installed. Provide dust caps for both sides of couplers at all times until permanent connector installation.
10. Provide industry standard approved connector for optical fiber that meets or exceeds the applicable provisions of TIA-455-X related to fiber optic connectors and interfaces and meets the following requirements:
    a. Insertion loss of ≤0.25 dB (typical) and ≤0.5 dB (maximum).
    b. Return loss (back reflection) ≤–55 dB (UPC) for SM and ≤–25 dB (UPC) for MM, typical.
    c. Mating durability ≤0.2 dB (typical) change, 500 mating cycles.

D. FPP and FDU

1. Provide FPPs (6 to 36 connectors) and FDUs (48 to 288 connectors) that meet the requirements presented in this section.
2. Provide FPPs and FDUs that comply with TIA-310-D standard 19-in rack-mounted or wall or panel-mounted installation.
3. For 6 to 36 connectors, use FPP enclosures that integrate the splice trays and connector modules into one compartment within one enclosure. For 48 connectors and larger, use FDU enclosures as one integrated compartment or house the splice trays and connector modules in separate compartments integrated into one enclosure.
4. Provide splice trays for storing the number of fusion splices as listed in the Contract documents. For FPPs with 12 connectors or less, splice holders within the FPP compartment may be used in lieu of splice trays.
5. Provide FPPs and FDUs that meet UL 94-V0 flammability requirements.
6. Provide wire management system at every FPP and FDU location for fiber optic cables and patch cords.
7. Provide access to fiber splicing trays and fiber termination couplers meeting the following minimum requirements:
    a. Provide access from the front or rear with removable, fold-down or swing-out doors, drawers, and covers.
    b. Provide physical protection when doors, drawers, and covers are in the closed position that encloses the fiber splicing trays, fiber interconnection cables, fiber pigtail cables, and fiber termination couplers.
    c. Provide storage space to house and protect the number of splice trays required to splice and terminate the fibers.
    d. Provide rubber grommets or similar material to prevent the cable from coming in contact with bare metal.
    e. Provide radius guides and strain relief for the incoming fiber optic cable(s) to maintain bend radius and protect the fibers.
    f. Provide bulkhead-mounted, termination coupling connectors that include locknuts for mounting the connectors in predrilled or punched holes in the connector panel.

g. Provide bulkhead-mounted coupling connectors with dust caps.

8. Provide fiber interconnect cables and fiber pigtail cables meeting the following minimum requirements:

    a. Provide 12-fiber interconnect cables for FDUs with 12-splice capacity trays, and 24-fiber interconnect cables with FDUs with 24-splice capacity trays.

    b. Use only fiber-interconnect cables for FPPs and FDUs with 24 connectors or more.

    c. Provide single fiber pigtail cables or fiber interconnection cables for FPPs with less than 24 connectors.

    d. Provide cables with factory installed connectors in accordance with Section 935.2.03.A.

    e. Provide fiber pigtail cables with 900 micron tubing or 0.12 in (3 mm) fan out tubing as required for the application.

    f. Use fiber pigtail cables with 900 micron tubing only when fully enclosed within the FPP from splice tray to the back of the bulkhead connector panel.

E. Aerial Cable Lashing Materials

1. Provide minimum 0.038 in (0.96 mm) diameter lashing wire to attach aerial fiber optic cable to the messenger or strand.

2. Provide lashing wire, attachment, and mounting hardware with sufficient tensile strength for the application and meeting the requirements of ASTM F593/F594 for corrosion resistance.

3. Use Type 302 stainless steel lashing materials in non-coastal regions and Type 316 along coastal regions within 5 miles (8 km) of the coast line.

F. Aerial Snowshoe Storage

1. Provide a factory-manufactured, UV-stabilized, snowshoe fiber storage unit that is designed to store excess or slack fiber optic cable or fiber optic cable and a splice closure in the span.

2. Provide fiber optic snowshoe that is constructed with plastic or aluminum bodies that maintain the minimum cable bend radius and have integral cable lashing strap slots or holes to secure cable attachments to the storage bracket.

3. Provide galvanized or stainless steel hanging and attachment hardware (bolts, nuts, washers) and strand clamps for attachment to messenger or strand according to ASTM A135 and ASTM B695.

4. Provide cable protection bracket that minimizes cable abrasion and organizes cable against the pole.

5. Provide cable channel to secure the cable that minimizes ice and leaf loading.

6. Provide snowshoe design that minimizes the number of cable ties needed.

7. Provide weathertight, UV-resistant cable ties designed for continuous outdoor use.

G. Environmental

Provide fiber splice closures that meet Telcordia GR-771-CORE temperature and humidity requirements.

935.2.03 MM Fiber Optic Cable Requirements

A. General

1. Meet the fiber optic cable and environmental requirements as specified herein.

2. Provide fiber optic cable that is splice-compatible with the Department’s existing legacy 62.5/125 μm MM fiber optic cable as required.

B. Fiber Optical

1. Provide standard 62.5/125 µm graded index MM fiber optic cables that comply with TIA-492AAAA-A (OM1).
2. Comply with IEC EN 60793-2-10, Type A1b product specifications.
3. Provide MM fibers that meet the optical performance requirements when tested according to TIA-455:
   a. Provide a fiber section attenuation of ≤3.5 dB/km at 850 nm. Test according to FOTP-78-B.
   b. Provide a fiber section attenuation of ≤1.0 dB/km at 1,300 nm. Test according to FOTP-78-B.
   c. Provide fibers that have uniform attenuation with no point discontinuities >0.2 dB at both 850 nm and 1,300 nm.
4. Provide an OFL bandwidth ≥200 MHz/km at 850 nm and ≥500 MHz/km at 1,300 nm.

935.3 Construction

The construction and installation of fiber optic cabling and components as specified herein shall meet the requirements in this section and the cable manufacturers' installation requirements and recommendations.

935.3.01 Construction Requirements

A. General Construction

1. Fiber Optic Installation Plan
   a. Develop a fiber optic installation plan for review and approval by the Department prior to fiber optic cable installation, splicing, and termination work. Include at a minimum the following components:
      i. Fiber running path line (route). Where not specifically shown in the Contract documents, show proposed trunk fiber and existing fiber (if any) to identify trunk to trunk fiber splice points, coordination of fiber allocation and associated splice details, and as-built drawings of the complete fiber system.
      ii. Vendor and part numbers for proposed materials and equipment (i.e., fiber optic trunk and drop cables, splice closures and splice trays, splicer equipment, fiber patch panels, connectors and other materials required or needed).
      iii. Location of fiber drop cables and proposed splice locations.
      iv. Location of fiber terminations.
      v. Fiber splice details for each location, showing buffer/strand utilization and allocation plan.
2. Pack the cable and wrap in weathertight and temperature resistant covering to prevent damage during shipment, to facilitate unloading, and to allow for outdoor storage as approved by the Department.

B. Cable Installation Guidelines

1. Before installation begins, inspect the cable reels for imperfections such as nails that might cause damage to the cable as it is unreeled.
2. When unreeled cable is placed on the pavement or surface above a manhole, provide means of preventing vehicular or pedestrian traffic through the area in accordance with Section 150.
3. Comply with the manufacturer's recommended procedures and these specifications for cable handling.
4. Comply with the maximum recommended pulling tension during installation as specified by the cable manufacturer.

5. Comply with the minimum recommended bend radius during installation as specified by the cable manufacturer. Use large diameter wheels, pulling sheaves, and cable guides to maintain the bend radius. Provide tension monitoring at all times during the pulling operation.
6. Unless the manufacturer's recommendations are more stringent, use the following guidelines for minimum bend radius:
    a. 20 times the outside cable diameter during installation
    b. 10 times the outside cable diameter after installation
7. If a mechanical pulling machine is used, equip the machine with a monitored or recording tension meter. At no time shall the manufacturer's recommended maximum pulling tension be exceeded. Submit the method of monitoring cable stress during installation to the Department for review and approval. The allowable pulling tension shall be the lesser of either of the two values below:
    a. Cable manufacturer's recommended pulling tension from the outer jacket for the cable
    b. 80% of the cable manufacturer's maximum pulling tension from the outer jacket
8. When using lubricants, comply with the cable manufacturer's recommendations for type, amount, application tools and method, and removal of the lubricant from the exposed cable. Pre-lubrication of cable is acceptable to provide uniform lubrication.
9. Use rollers and sheaves for difficult pulls to eliminate damage when entering and existing the conduit system.
10. During the installation of the fiber optic cable, record as-built fiber optic cable footage at riser locations, hand-holes, and slack storage locations.
11. Where messenger cable is required, as shown in the Contract documents, lash aerial fiber optic cable to a steel strand wire messenger cable of the size specified in the Contract documents that conforms to Section 647.
12. Select fiber optic cable installation method that meets the following requirements:
    a. If pulling is utilized:
        i. Install the fiber optic cable by hand and/or by using a mechanical pulling machine.
        ii. Attach the central strength member and aramid yarn directly to the pulling eye during cable pulling. Use pulling attachments such as "basket grip" or "Chinese finger" type so that the optical and mechanical characteristics are not degraded during the fiber optic cable installation.
        iii. Coil excess cable in a figure eight and feed manually when pulling through pull boxes by hand.
        iv. Provide a continuous section of cable throughout the pull. Cable breaks are permitted only at designated splice points.
    b. If air assisted/blowing is utilized:
        i. Use either the HASB method or the Piston method.
        ii. When using the HASB method, the volume of air passing through the conduit shall not exceed 600 ft^3/min or the conduit manufacturer's recommended air volume, whichever is more restrictive.
        iii. In cold temperatures, an air dryer accessory is recommended to avoid introducing water condensation into the HASB air inlet chamber or conduit/duct system. Condensation may result in frost. In hot temperatures, an air cooler is recommended to avoid excessive temperatures at the conduit/duct and cable.
        iv. When using the Piston method, comply with the conduit manufacturer's recommended air volume or limit to 300 ft^3/min, whichever is less.

C. Cable End Sealing

1. Where a cable ends without termination in a fiber optic closure, seal the end of the cable by reusing a cable end cap shipped with a cable reel, or use a cap that is size-matched to the cable to be sealed.
2. Clean the end of the cable. Partly fill the cap with a weathertight silicone adhesive sealant and press the cap fully onto the cable end, rotating the cap to fully encapsulate the cable end with the sealant in the cap.
3. Apply a full sealant bead between the end of the cap and the cable jacket.

D. Cable Slack Storage

1. For aerial installations, meet the following requirements.
   a. Where messenger strand or cable is required, as shown in the Contract documents, lash aerial fiber optic cable to a steel strand wire messenger cable of the size specified in the Contract documents that conforms to Section 647.
   b. Store the excess or slack cable at storage loops in a “bow tie” configuration on the messenger strand using two fiber optic snowshoes (aerial fiber optic cable storage brackets) that maintain the proper bend radius in the fiber optic cable.
   c. Install one fiber optic snowshoe for drop cable and trunk cable storage at aerial splice closures to maintain the bend radius in the fiber optic cable.
2. For underground applications, meet the following requirements.
   a. Pull Box Types 4, 4S, 5, 5S, 6, and 7: Apply the following storage requirements for the indicated cable/splice closure situations.
      i. Drop cable with no splice closure: 10 ft (3 m).
      ii. One or more trunk cables with no splice closure: 110 ft (34 m) of each cable.
      iii. Two or more trunk cables with one splice closure: Store 55 ft (17 m) of each trunk cable so that the splice closure can be removed from the pull box 55 ft (17 m). If a drop cable is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.
      iv. One trunk cable with one splice closure: 110 ft (34 m). Install splice closure in the center of the 110 ft (34 m) cable loop so that the splice closure can be removed from the ECB 55 ft (17 m). If a drop cable is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.
      v. One trunk cable with one splice closure and trunk cable ends: 95 ft (30 m). Install splice closure on the trunk cable at 55 ft (17 m) from the pull box. If a drop cable is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.
      vi. Trunk cable ends with no closure: 95 ft (30 m).
   b. Hub Building (interior): Do not store slack cable inside the hub building.
   c. Hub Building (exterior adjacent ECBs): 180 ft (55 m).
   d. Traffic Control Center and TMC (OSP splice vault): 180 ft (55 m).
   e. Traffic Control Center and TMC (Inside plant at equipment room): Cable entrance to distribution panel bay plus 20 ft (6 m).
   f. ECB Types 3, 4, 5, and 6: Apply the following storage requirements for the indicated cable/closure situations. More than one situation may occur in a single ECB, in which case apply each requirement.
      i. Trunk cable with no splice closure: 110 ft (34 m).

ii. Trunk cable with one splice closure: 110 ft (34 m). Measure the storage amount from the top of the ECB manhole opening. Install closure in the center of the 110 ft (34 m) cable loop so that the splice closure can be removed from the ECB 55 ft (17 m). If a drop cable(s) is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.

iii. Trunk cable with one splice closure and trunk cable ends: 95 ft (30 m). Install closure at 55 ft (17 m) from the ECB on the trunk cable. If a drop cable(s) is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.

iv. Trunk cable ends with no closure: 95 ft (30 m).

3. Unless otherwise noted in the Contract documents, the following are the minimum requirements for cable storage for aerial applications.

   a. Install a minimum 150 ft (45 m) storage loop one-half the distance between every equipment drop or as shown in the Contract documents.

   b. Where equipment drops are >1,000 ft (300 m) apart, install a minimum 150 ft (45 m) storage loop for every 1,000 ft (300 m) of uninterrupted cable length.

   c. At aerial splice closures, install 75 ft (23 m) of drop cable storage and 150 ft (45 m) of trunk cable storage, unless otherwise noted in the Contract documents, to allow the fully assembled splice closure, including the trunk cable and drop cable, to be lowered to ground level for maintenance purposes.

E. Cable Splicing

1. Splice together each individual reel of fiber optic cable to provide a continuous length of installed cable.
2. Splice cable only at splice points shown in the Contract documents.
3. Make no splices within a fiber patch cord assembly or fiber drop cable.
4. Use the fusion technique for splices and terminations. Use a fusion splicing machine (fusion splicer) to splice optical fiber. Mechanical splicing is not permitted.
5. Provide fusion splicing equipment supported by calibration records indicating a factory calibration within three months preceding their use.
6. Clean and calibrate fusion splicing equipment per the manufacturer's specifications, and specifically adjust the fiber and environmental conditions at the start of each splicing shift.
7. Comply with the cable manufacturer's and fusion splicer's procedures, accepted standards, codes, and practices. Do not install mechanical splices.
8. To prevent splice loss, meet the following requirements.

   a. Splice SM optical fibers using the fusion splice method. The mean (average) splice loss shall not exceed 0.1 dB for new fiber to new fiber and 0.3 dB (per TIA-568.3-D) for new fiber to existing (legacy) fiber.

   b. Splice MM optical fibers using the fusion splice method. The mean (average) splice loss shall not exceed 0.3 dB for new fiber to new fiber and for new fiber to existing (legacy) fiber.

   c. Obtain the mean splice loss by measuring the loss through the splice in both directions and then averaging the resultant values.

9. To protect splices, meet the following requirements.

   a. Protect fusion splices in splice trays or organizers in a splice closure.

   b. Provide the splice with strain relief and protection of the stripped fiber splice in a manner recommended by the splice tray or organizer manufacturer. Use splice types compatible with the tray design.

   c. Protect fusion splices with heat shrink tubing that protects the splice and extends over the fiber coating.

d. Do not leave bare fiber exposed.

e. Do not use silicone in any splice tray.

F. Mid Span/Drop Access

1. At points where mid span/drop access is required, keep fibers intact except those being accessed for the equipment drop.
2. Use a suitable tool for removing fibers from the buffer tube to prevent damage to the fibers remaining intact.

G. Connector Termination Procedures

Comply with procedures for the termination of the connectors as required by the connector manufacturer's fiber optic installation standard operating procedure for the field installation.

H. Cable Marking Installation

1. Clean the installed cable of dirt and grease before applying any marker.
2. Follow the marker manufacturer's recommended procedure for applying cable markers.
3. Mark cables in or at every hub building, ECB, pull box, hand-hole, field cabinet, aerial or underground splice closure, pole attachment, aerial storage bracket, and pole conduit riser entrance.
4. At every trunk cable termination, reel end-to-reel end splice, ECB, pull box, hand-hole, field cabinet, aerial splice closure, and aerial storage bracket, record the cable distance markings from the print-line for the cable entry and exit, along with the exact location by station number or location name.
5. Record the cable distance markings in a tabular format approved by the Department or on a documentation form provided by the Department.
6. Place cable markers in the following locations:
   a. Within 18 in (450 mm) of every cable entry to a pull box, hand-hole, ECB, and hub building
   b. Within 6 in (150 mm) of every cable entry or termination in a field cabinet
   c. Within 18 in (450 mm) of every splice closure at cable entry points
   d. Within 6 in (150 mm) of every FPP/FDU or splice cabinet in a hub building in which a cable terminates or enters
   e. Every 20 ft (6 m) for the length of a cable in maintenance coils in ECBs or pull boxes
   f. Within 12 in (300 mm) of every pole attachment, aerial storage bracket, and pole conduit riser entrance
7. Use orange markers at all locations, except as noted below:
   a. Where a trunk cable enters and leaves a closure (mid-span cable entry or end-to-end splice), use orange markers for one leg of the trunk cable and yellow for the other leg, placing corresponding color labels at the closure end of a leg and at the conduit entrance (underground installation) or span attachment (aerial installation).
   b. Where two drop cables terminate in a closure, use orange markers for one drop cable and yellow markers for the other drop cable throughout the drop cable's length to its other termination.

I. Splice Closures

1. Install splice closures according to manufacturer's recommendations.
2. Install splice closures where shown in the Contract documents. and in the approximate center of fiber optic cable storage coils.
3. Mount splice closures in ECBs or pull boxes to cable rack hooks or mounting brackets.

J. FPP/FDU

1. Do not install mechanical splices or field installed connectors.
2. Equip unused panel slots with blank panels.
3. Provide inter-cabinet and inter-bay bend radius and jumper management on each side of the FDU.
4. Install hardware according to the manufacturer's recommended procedures and approved by the Department.
5. Determine specific hardware sizing from the Contract documents.
6. For rack-mount and wall-mount FPPs/FDUs, array connectors with fiber number one being at the top left or leftmost position.
7. Route and secure the drop cable beside or behind the field cabinet side panel such that it is fully strain-relieved, does not violate the manufacturer's recommended bending radius, and does not interfere with the operation of or access to any field cabinet equipment or electrical components.

935.3.02 Equipment Configuration and Integration Requirements

Not Applicable

935.3.03 Testing Requirements

Refer to Section 942.3.04 for testing requirements.

935.3.04 Training Requirements

Refer to Section 942.3.05 for training requirements.

935.3.05 Warranty and Maintenance Support Services

A. Warranty Requirements

1. Provide a minimum warranty length of two years for fiber optic cable and associated components. If the manufacturer's warranties for the components are for a longer period, those longer period warranties shall apply.
2. Refer to Section 942.3.02 for general warranty requirements.

B. Maintenance Support Services

Refer to Section 942.3.02 for maintenance support services requirements.

935.4 Measurement

The fiber optic system and training that are complete, in place, accepted, and of the kind, size, and type specified will be measured as follows:

A. Outside Plant Fiber Optic Cable, Loose Tube, Single Mode, No. Fibers

OSP fiber optic cable, loose tube, SM fiber will be measured in units of actual linear feet and paid for at the Contract price per linear feet, including cable slack. The price bid will include the length in feet of actual cable installed and tested as measured from the cable sequential length markings, cable print-lines, aerial snowshoes for storage (aerial segments), ancillary and incidental materials, documentation, and labor and equipment necessary to complete the work. No measurement for payment will be made for cable storage amounts in excess of that required in the Contract documents.

B. Fiber Optic Closure, Underground or Aerial, No. Splices

Underground and aerial sealed fiber optic splice closures will be measured for payment by the number of units installed, complete, functional, tested and accepted. Fiber optic closures will be measured in units of each and paid for at the Contract unit price each, which will include, but not be limited to, splice closure, splice trays, splices, splice protection, organizer, dome, end plate, cable port sealing grommets, sealant material, cable end preparation tools, mounting hardware within the pull box or on the messenger strand, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

C. Fiber Patch Panel or Fiber Distribution Unit, Rack or Wall Mount, No. Ports

FPPs and FDUs will be measured for payment by the number of units installed, complete, functional, tested and accepted. The number of ports is equal to the number of fibers. FPPs and FDUs will be measured in units of each and paid for at the Contract price each, which will include, but not be limited to, housing, splice trays or splice holders, fiber interconnect cables, fiber pigtail cables, splices between the incoming cable fibers and fiber interconnect/pigtail cables, splice protection, connector modules, connectors, wire management, mounting hardware within field cabinet/hub rack and wall mounting hardware, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

D. Fiber Optic Splice, Fusion

Fiber optic fusion splices will be measured for payment by the number of splices made, complete, tested and accepted. Fiber optic fusion splices will be measured in units of each and paid for at the Contract unit price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work. Fiber optic splices associated with the use of fiber interconnector cables and fiber pigtail cables, in accordance with Section 935.2.03, will not be measured separately for payment. The price bid

E. Fiber Optic Patch Cord, SM

Fiber optic patch cord, SM will be measured for payment by the number of patch cords provided, installed, tested and accepted. Patch cords will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

F. Fiber Pigtail Cable, SM

Fiber pigtail cables, SM will be measured for payment by the number of pigtails provided, installed, tested and accepted, and only when separately denoted by pay item in the Contract. Fiber pigtail cables will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

G. Fiber Interconnect Cable, SM

Fiber interconnect cable, SM will be measured for payment by the number of interconnect cables provided, installed, tested and accepted, and only when separately denoted by pay item in the Contract. Fiber interconnect cables will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

H. Fiber Optic Connectors, SM

Fiber optic connectors, SM will be measured for payment by the number of connectors provided, installed, tested and accepted. Fiber connectors will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

I. Outside Plant Fiber Optic Cable, Loose Tube, Multimode, No. of Fibers

OSP fiber optic cable, loose tube, MM fiber will be measured in units of actual linear feet and paid for at the Contract price per linear feet, including cable slack. The price bid will include the length in feet of actual cable installed and tested as measured from the cable sequential length markings, cable print-lines, aerial snowshoes for storage (aerial segments), ancillary and incidental materials, documentation, and labor and equipment necessary to complete the work. No measurement for payment will be made for cable storage amounts in excess of that required in the Contract documents.

J. Fiber Optic Patch Cord, MM

Fiber optic patch cord, MM will be measured for payment by the number of patch cords provided, installed, tested and accepted. Patch cords will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

K. Fiber Pigtail Cable, MM

Fiber pigtail cables, MM will be measured for payment by the number of pigtails provided, installed, tested and accepted, and only when separately denoted by pay item in the Contract. Fiber pigtail cables will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

L. Fiber Interconnect Cable, MM

Fiber interconnect cable, MM will be measured for payment by the number of interconnect cables provided, installed, tested and accepted, and only when separately denoted by pay item in the Contract. Fiber interconnect cables will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

M. Fiber Optic Connectors, MM

Fiber optic connectors, MM will be measured for payment by the number of connectors provided, installed, tested and accepted. Fiber connectors will be measured in units of each and paid for at the Contract price per each, which will include, but not be limited to, ancillary and incidental materials, testing, documentation, and labor and equipment necessary to complete the work.

N. Training

Training will be measured as a lump sum for supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

935.5 Payment

935.5.01 Fiber Optic System

Fiber optic cable, splice closures, fiber splices, interconnect cables, pigtails, fiber patch cords, and fiber optic connectors will be paid for at the Contract unit price. This price will include full compensation for labor, materials, equipment, tools, test equipment, incidentals, installation, testing, and providing warranty necessary to complete the fiber optic system.

<u>Payment Notes</u>:

Submittal

> Submittal requirements are included in Section 942.1.04 and will not be paid for separately. It will be considered incidental to the fiber optic system pay item.

Testing

> Testing is defined in Section 942.3.04 and will not be paid for separately. It will be considered incidental to the fiber optic system pay item.

Payment for the fiber optic system will be made under:

Item No. 935	Outside Plant Fiber Optic Cable, Loose Tube, Single Mode, __ Fiber	Linear feet
Item No. 935	Fiber Optic Connectors, SM	Per each
Item No. 935	Fiber Optic Patch Cord, SM	Per each
Item No. 935	Fiber Interconnect Cable, SM	Per each
Item No. 935	Fiber Pigtail Cable, SM	Per each
Item No. 935	Fiber Optic Splice, Fusion	Per each
Item No. 935	Fiber Optic Closure, Underground, __ Splice	Per each
Item No. 935	Fiber Optic Closure, Aerial, __ Splice	Per each
Item No. 935	Fiber Patch Panel, Rack Mount, __ Port	Per each
Item No. 935	Fiber Patch Panel, Wall Mount, __ Port	Per each
Item No. 935	Fiber Distribution Unit, Rack Mount, __ Port	Per each
Item No. 935	Fiber Distribution Unit, Wall Mount, __ Port	Per each

The following pay items are eligible for use to maintain a legacy communication network that has existing multi mode fiber-optic cable. The pay items shall be used only when required and approved by the Department.

Item No. 935	Outside Plant Fiber Optic Cable, Loose Tube, Multi Mode, __ Fiber	Linear feet
Item No. 935	Fiber Optic Connectors, MM	Per each
Item No. 935	Fiber Optic Patch Cord, MM	Per each
Item No. 935	Fiber Interconnect Cable, MM	Per each
Item No. 935	Fiber Pigtail Cable, MM	Per each

935.5.02 Training

Payment for training will be made under:

Item No. 935	Training	Lump sum

Section 940—NaviGator Advanced Transportation Management System Integration

Delete Section 940