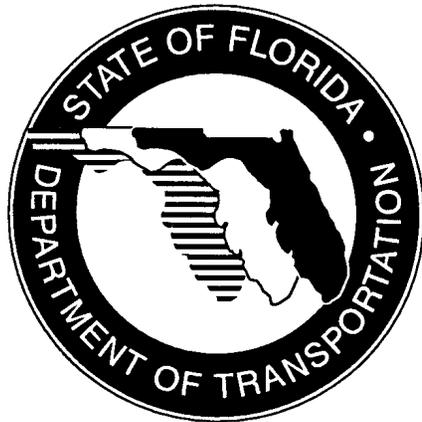


**FLORIDA
DEPARTMENT
OF
TRANSPORTATION**



**Supplemental Specifications
to the
1991 Standard Specifications
for
Road and Bridge
Construction**

1994

These Florida Department of Transportation Supplemental Specifications are hereby approved for application on highway and related construction contracts as referenced in the contract plans or special provisions, and they shall apply as noted and amended by those documents.

Approved

J. B. Lairscey, P. E.
Director, Office of Construction

I hereby certify that this Supplemental Specification book was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of Florida.

Ernest Garcia, P. E.
State Specifications Engineer

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SECTION 001

DEFINITIONS AND TERMS

1-2 ABBREVIATIONS is expanded by the following:

AIA American Institute of Architects.

1-9 CONSULTANT. The text of this Article is deleted and the following substituted:

The Professional Engineer or Engineering Firm, Architect or Architectural Firm registered in the State of Florida under contract to the Department to perform professional services for the Department, other than Department personnel. The Consultant may be the Engineer or Architect of Record or may provide services through and be subcontracted to the Engineer or Architect of Record.

1-19 ENGINEER OF RECORD is expanded as follows:

The Department's Engineer of Record shall not be employed as the Contractor's Specialty Engineer.

SECTION 1 is expanded by the following new Articles:

1-53 SPECIFICATIONS PACKAGE.

A compiled package of revisions to the Standard Specifications including Special Provisions, Supplemental Specifications, Technical Special Provisions and other attachments for a specific contract.

1-54 SUPPLEMENTAL SPECIAL PROVISIONS.

Additions and revisions to the Specifications Package.

1-55 ARCHITECT.

The Architect as defined in s.481.203(3) Florida Statutes.

1-56 ARCHITECT OF RECORD.

The Architect or Architectural Firm registered in the State of Florida who performs services for the Department in connection with the design and construction of buildings which have as their principal purpose human habitation or use.

1-57 ARCHITECTURE.

The practice of Architecture as defined in s.481.203(6) Florida Statutes.

1-58 DESIGNER OF RECORD.

The Architect of Record or the Engineer of Record.

SECTION 002
PROPOSAL REQUIREMENTS
AND CONDITIONS

2-2 PROPOSAL FORMS is modified as follows:

(a) The last sentence of the first paragraph is deleted.

(b) The first sentence of the second paragraph is deleted and the following substituted:

The plans, Standard Specifications, Specifications Package, Supplemental Special Provisions and other Documents designated in the proposal form shall be considered a part of the proposal, whether attached or not.

(c) The fifth paragraph is deleted and the following substituted:

Bid item sheets generated from the CEB program shall be printed on 8 1/2 x 11" paper. All computer generated sheets must be legible. Computer generated sheets utilizing type smaller than 17 characters per inch (9 point) will not be acceptable. Ten characters per inch (12 point) is desired. A minimum of 20 pound paper is recommended.

(d) The eighth paragraph is deleted and the following is substituted:

The diskette furnished by the Department or a copy thereof which is used to generate the official bid shall be returned with the proposal. The Department's furnished computer diskettes will be 3 1/2 inches, double-sided, high-density (DS, HD), and formatted at the standard MS-DOS/PC-DOS (DOS) capacity of 1.44 megabytes. Only 5 1/4 inch DSDD diskettes formatted at 360 kilobytes, 5 1/4 inch double-sided, high-density diskettes formatted at the standard DOS capacity of 1.2 megabytes, 3 1/2 inch low-density diskettes formatted at the standard DOS capacity of 720 kilobytes, or 3 1/2 inch high-density diskettes formatted at the standard DOS capacity of 1.44 megabytes will be accepted. Diskettes which have been physically altered to format at a higher capacity will not be acceptable. The computer-generated bid item sheets that are submitted must be printed from the diskette that is returned. When a diskette other than the one furnished by the Department is utilized to generate the official bid, the diskette submitted shall have a label attached indicating the Contractor's Name, Vendor Number, Letting Date, Revision Date (if applicable) and the State Project Number. Contractors are cautioned that failure on their part to follow proper diskette-handling and shipping procedures could result in the Department's being unable to process the diskette.

(e) The last paragraph, beginning with "Only computer generated" is deleted.

2-4 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS AND SITE OF WORK. The first sentence of the first paragraph is deleted and the following substituted:

The Bidder is expected to examine carefully the proposal, plans, Standard Specifications, Specifications Package, Supplemental Special Provisions, contract forms, and the site of the

proposed work before submitting a proposal for the work contemplated.

2-6 REJECTION OF IRREGULAR PROPOSALS is expanded as follows:

When alternate bids are indicated in the proposal form and the Bidder submits non-computer-generated bid item sheets, only one entry shall be made in each design group. The proposal shall be considered irregular if entries are made for more than one item in a designated alternate.

SECTION 004 SCOPE OF THE WORK

-3.2.3 Conditions Requiring Supplemental Agreement is expanded as follows:

Additional or unforeseen work of the type already provided by the contract for which there is a contract price will be paid for at such contract price in accordance with 4-3.2.1.

Additional or unforeseen work having no quantity or price provided in the contract will be paid at a negotiated price.

Where the cost is negotiated, the Contractor shall submit an estimate to the Department in terms of labor, materials, equipment, overhead, and other expenses incurred solely as a result of the additional or unforeseen work.

The portion of the cost for equipment shall be based on the Rental Rate Blue Book for Construction Equipment, published by Dataquest (version current at time of work) in accordance with the following:

- (a) Costs shall be provided on an hourly basis. Hourly rates, for equipment being operated or on standby, shall be established by dividing the Blue Book monthly rates by 176. The columns, itemizing rates, labeled "Weekly", "Daily", and "Hourly" shall not be used.
- (b) On all projects, the costs shall be adjusted by regional adjustments and by Rate Adjustment Tables according to the instructions in the Blue Book.
- (c) Reimbursement for the equipment being operated shall be at a rate of 75 percent of the Blue Book ownership cost plus 100 percent of the Blue Book operating costs.
- (d) Reimbursement for equipment, required to be idled and on standby, shall be at 50 percent of the Blue Book ownership cost, only. No more than eight hours of standby will be paid on a single day.
- (e) No additional overhead will be allowed on equipment costs.
- (f) Transportation to and from the location at which the equipment will be used will be allowed. If the equipment requires assembly or disassembly for transport, the time for this will be paid at the rate for standby equipment.

4-3.5.3(5) Data Requirements. The last sentence is deleted and the following substituted:

Any design changes which result from the VECP must be supported by prints of

drawings and computations signed and sealed by the Contractor's Specialty Engineer.

SECTION 005 **CONTROL OF THE WORK**

5-1.4.1 General. The text is deleted and the following is substituted:

The Contractor shall furnish such working, shop and erection drawings as may be required to complete the structure in compliance with the design shown on the plans. The drawings shall be prepared on reproducible permanent transparent material made for the purpose, such as tracing cloth or plastic. The size of the transparent sheets shall be no larger than 24 by 36 inches. Each sheet shall be numbered consecutively for the series and the sheet number shall indicate the total number in the series (VIZ. 1 of 12, 2 of 12,.....12 of 12). Each sheet shall have affixed thereon a title block indicating the name of the series, the subject of the sheet, the state job number designations and the name of the persons drawing and checking, together with dates on which the work was done.

Working, shop and erection drawings submitted for approval by the Contractor shall be directed as follows with the number of copies indicated:

1. Bridge, Bulkhead and Retaining Wall Structures and Lighting and Signing Structural Items: The number of and the submittal path to be followed shall be determined dependent upon the identity of the Engineer of Record. The identity of the Engineer of Record is shown adjacent to the title block on the structural plan sheets, and on the key sheets for roadway, signing, and pavement marking and lighting plans.

The following signing and lighting items are defined as Structural Items:

Lighting: poles, bracket arms, frangible bases and foundations.

Signing: Mounting brackets for bridge mounted signs, overhead cantilever structures and footings, overhead truss structures and footings, overhead sequential sign structures and footings and multiple post sign supports and footings.

(a) When the Engineer of Record is shown to be the Florida Department of Transportation, the Contractor shall submit one set of prints and one set of reproducible copies of each series of working, shop and erection drawings to the appropriate Shop Drawing Review Office with a copy of the letter of transmittal sent to the Resident Engineer. Work requiring catalog data, material certifications, material test results, procedure manuals, fabrication/welding procedures, and maintenance and operating procedures shall be submitted to the Department in sets of 11 of each series. The mailing address of the appropriate Shop Drawing Review Office will be furnished by the Department or will be shown on the plans.

(b) When the Engineer of Record is shown to be a Consulting Engineer or Firm the Contractor shall submit one set of prints and one set of sepias of each series of working, shop and erection drawings to the Consulting Engineer or Firm with a copy of the letter of transmittal sent to both the Resident Engineer and the appropriate Shop Drawing Review Office. Work requiring catalog data, material certifications, material tests,

procedure manuals, fabrication/welding procedures, and maintenance and operating manuals shall be submitted to the Consulting Engineer in sets of 11 of each series. The mailing address of the Consulting Engineer of Record and the appropriate Shop Drawing Review Office will be furnished by the Department or will be on the plans.

2. Signing, Lighting, Drainage Structures and Attenuators and other nonstructural items: The number of and the submittal path to be followed shall be determined dependent upon the identity of the Engineer of Record. The identity of the Engineer of Record is shown on the key sheets for roadway, signing and pavement marking and lighting plans.

(a) When the Engineer of Record is shown to be the Florida Department of Transportation, the Contractor shall submit seven sets of prints of each shop drawing to the Department for approval. All submittals and correspondence shall be addressed to the Engineer of Record as noted on the key sheet.

(b) When the Engineer of Record is shown to be a Consulting Engineer or Firm, the Contractor shall submit seven sets of prints of each shop drawing to the consulting firm listed as the Engineer of Record on the key sheet.

3. Rest Area Building Structures and Pavilions and Maintenance Warehouses: One set of prints and one set of sepias of each series of working, shop and erection drawings and all correspondence related to building structures, such as Rest Area Pavilions and Maintenance Warehouses shall be submitted to the Department with a copy of the letter of Transmittal to the Resident Engineer. All submittals and correspondence shall be addressed to:

Florida Department of Transportation
Attn: Special Facilities
Bureau of Structures Design
Mail Station 48
605 Suwannee St.
Tallahassee, Fl. 32399-0450
Telephone 904/487-4273

Prior to the submission of any working, shop or erection drawings, the Contractor shall prepare and submit to the Department, for approval, a schedule for all proposed working, shop and erection drawings. The Contractor shall coordinate, schedule and control all submittals of working, shop and erection drawings including those of his various subcontractors, suppliers and engineers to provide for an orderly and balanced distribution of the work.

Shop and erection drawing submittals required for the work will be identified in the Summary of Pay Items and shall be noted with a pound symbol. Those items so identified represent the minimum requirements and are not intended to represent all of the working, shop and erection drawings the Contractor may need to properly conduct his work.

For the following categories of working and shop drawings, the Contractor shall submit for approval permanent reproducible drawings with one print and four sets of applicable

computations. The print and the cover sheet of each set of applicable computations shall be signed and sealed by the Contractor's Specialty Engineer:

(a) Contractor originated redesign.

(b) Design and/or structural details furnished by the Contractor in compliance with the contract.

(c) For structures that may jeopardize public safety, such as structures spanning functioning vehicular roadways, pedestrian walkways, railroads and channels to navigable waterways and for unusual structures such as cable stayed bridges, post-tensioned concrete box girder bridges, movable bridges, bridges with clear spans in excess of 500 feet or bridges classified as major bridges; the Contractor shall submit to the Department's Review Office signed and sealed drawings and calculations of all special erection equipment. Additionally, prior to its use, the special erection equipment shall be personally inspected by the Specialty Engineer who shall certify to the Engineer in writing that the equipment has been fabricated and is being utilized in accordance with the submitted drawings and calculations. The Specialty Engineer shall also sign and seal the letter of certification.

(d) For the same structures defined in (c) above, the Contractor shall submit to the Engineer signed and sealed drawings and calculations of all falsework and/or temporary supports. Additionally, after its erection and/or installation, but prior to the application of any superimposed load, the falsework and/or temporary supports shall be personally inspected by the Specialty Engineer who shall certify to the Engineer in writing that the falsework and/or temporary supports have been constructed of materials and in accordance with the details shown on the submitted drawings and calculations. The Specialty Engineer shall also sign and seal the letter of certification.

5-1.4.4 Submission of Working, Shop and Erection Drawings. The second paragraph is expanded by the following:

Only Department approvals/stamps on shop drawings are valid and any work performed in advance of approval will be at the Contractor's risk.

SECTION 006

CONTROL OF MATERIALS

6-1.5 QUALIFIED PRODUCTS LIST. The text is deleted and the following substituted:

A Qualified Products List (QPL) is published and maintained by the Product Evaluation Section in the Office of Construction. The list provides assurance to contractors, consultants, designers and Department personnel that specific products and materials are approved for use on Department facilities. These items have basic approval but are subject

to additional testing of individual lots, batches or shipments.

Procurement and use of products and materials requiring pre-approval in the specifications will be limited to those items listed on the QPL effective at the time of usage. The QPL will be used with the Materials Sampling Manual, Standard Specifications, Supplemental Specifications, Technical Special Provisions, Special Provisions and Plans.

Manufacturers seeking approval and QPL listing of an item must submit a Product Evaluation Application to the Product Evaluation Section in Tallahassee.

-1 INFORMATION ON MATERIALS is expanded by the following new Subarticles:

6-1.6 Aggregate Source. A physical location including mines, recycled material processing sites and redistribution terminals.

6-1.7 Aggregate Point of Use. The point of incorporation into the project, such as the actual project site, asphalt plant or concrete plant.

6-3 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS.

6-3.1 Only Approved Materials to be Used is expanded as follows:

Materials containing asbestos will not be allowed.

6-3.3 Approval of Source of Supply is expanded by the following:

The production of mineral aggregates shall be under a Producer Quality Control Program (QC) as approved by the Department. The program shall be in accordance with the Department's requirements and procedures for obtaining and maintaining Department approval of developed and operational mineral aggregate sources (mines and redistribution terminals) and the Department's Mineral Aggregate Manual. Individual certification shall be furnished with each haul unit load of materials shipped attesting that those specific materials were produced under a Department approved Producer Quality Control Program and that they fully meet Department specifications.

6-5 CONTROL BY SAMPLES AND TESTS is expanded by the following Subarticle:

6-5.12 Materials Accepted Based on Producers' Certification.

Materials accepted based on producers' certification shall be identified by production lot or other acceptable means which shows a direct tie between the certification and the material being used. Such identification will be used by the Department when doing verification testing. The certification shall be signed by a legally responsible person from the producer on company letterhead.

6-7 DEFECTIVE MATERIALS is expanded by the following:

Any haul unit load of mineral aggregates received by the Contractor for a Department Project without an individual certification being made available to the Engineer as required by 6-3.3 will be considered defective.

6-8 QUALITY ASSURANCE (Hot Bituminous Mixture).

6-8.4 II.2 FUNCTIONS AND RESPONSIBILITIES. The first sentence is deleted and the following substituted:

The Contractor shall submit in writing his proposed Quality Control Plan for each asphalt plant to be approved by the District Bituminous Engineer.

The approved Quality Control Plan will remain in effect for the plant to which it is assigned until it is rejected in writing by the District Bituminous Engineer.

6-8.4 III.1 QUALITY CONTROL SYSTEM. The following new sentence is inserted ahead of the last sentence in this text:

The Contractor's person in responsible charge of the paving operations shall also be certified by the Department as an Asphalt Paving Technician and shall possess a valid certificate of qualification.

SECTION 007 **LEGAL REQUIREMENTS AND** **RESPONSIBILITY TO THE PUBLIC**

7-1 LAWS TO BE OBSERVED.

1.1 General. The first sentence of the third paragraph is deleted and the following substituted:

Contractors removing underground pollutant storage tanks must be certified by the Construction Industry Licensing Board as required by Part I, Chapter 489, Florida Statutes, regardless of exemptions allowed by Section 489.103.

7-1.2 Plant Quarantine Regulations. The text is deleted and the following substituted:

The U.S. Department of Agriculture and the Florida Department of Agriculture and Consumer Services have issued quarantine regulations pertaining to control of the nematodes of citrus, Rule 5B-44, Florida Administrative Code, and other plant pests.

It shall be the Contractor's responsibility to contact the local (or other available) representatives of the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture, and the Division of Plant Industry of the Florida Department of Agriculture and Consumer Services to ascertain any current restrictions regarding plant pests which may be imposed by these agencies. He shall also keep himself advised of current quarantine boundary lines throughout the construction period. These restrictions may affect the Contractor's operations in connection with such items as clearing and grubbing, earthwork, grassing and mulching, sodding, landscaping, and other items which might involve the movement of materials containing plant pests across quarantine lines.

Quarantine regulations and related information can be obtained from the following:

Animal and Plant Health Inspection Service
U.S. Department of Agriculture
3031 Lake Alfred Road
Winter Haven, Florida 33881

Director, Division of Plant Industry
Florida Department of Agriculture and Consumer Services
P.O. Box 147100
Gainesville, Florida 32614-7100

7-11 PRESERVATION OF PROPERTY.

7-11.1 General is expanded as follows:

The Contractor's special attention is directed to the protection of any geodetic monument, horizontal or vertical, located within the limits of construction.

7-16 WAGE RATES FOR FEDERAL-AID PROJECTS. The text is deleted and the following substituted:

For all projects which include Federal-Aid Participation, the Special Provisions contain requirements with regard to payment of predetermined minimum wages. Predetermined Wage Rate Decisions (Wage Rate Tables) exist for Heavy, Highway, and Building Construction Projects, and will be included in the Specifications Package as applicable. Other Specialty Decisions will be included when required. Heavy Decisions will be included in Contracts for bridge construction over commercially navigable waters. Highway Decisions will be included in Contracts for highway and/or bridge construction (other than over commercially navigable waters). Building Decisions will be included in Contracts for building construction.

The Contractor shall review Wage Rate Tables for completeness. If additional classifications are needed, they shall be requested by the Contractor. Requests for additional wage rate classifications may be initiated through the Resident Engineer's Office.

7-23 SUBMITTAL OF WAGE RATE SUMMARY. The text is deleted and the following substituted:

It shall be a condition of this Contract and shall be made a condition of all subcontracts entered into pursuant to this Contract, that the Contractor shall submit to the Resident Engineer's Office by the 10th of the month, the original Monthly Summary of Wage Rates, including those of all Subcontractors. The Contractor shall review Monthly Summaries of Wage Rates for completeness.

SECTION 008

PROSECUTION AND PROGRESS

8-4 LIMITATIONS OF OPERATIONS.

8-4.9 Hazardous or Toxic Waste is expanded as follows:

The Department may agree to hold harmless and indemnify the Contractor for damages when the Contractor discovers or encounters hazardous materials or pollutants during the performance of services for the Department when the presence of such materials or pollutants were unknown or not reasonably discoverable. Such indemnification agreements shall only be effective if the Contractor immediately stops work and notifies the Department of the hazardous material or pollutant problem.

Such indemnification agreement will not be valid for damages resulting from any willful, wanton, or intentional conduct of the Contractor nor operations of Hazardous Material Contractors.

8-4 LIMITATIONS OF OPERATIONS is expanded by the following new SUBARTICLE:

8-4.10 Milling. The Contractor shall provide positive drainage of the remaining pavement after milling. This operation shall be done during the same day as milling.

The Contractor shall provide suitable transitions between milled areas of varying thickness in order to create a reasonably smooth longitudinal riding surface.

The Contractor shall also restrict his milling operation such that any lane milled will be repaved no later than the day after the initial milling operation.

8-6.4 Contractor's Vacation.

8-6.4.1 Length of Vacation. The second sentence is deleted and the following substituted:

The 14 days annually allowed for the Contractor to suspend operations to provide vacation time for his employees shall include the two periods for automatic suspension, if used, and no more than two separate additional periods.

8-10 LIQUIDATED DAMAGES FOR FAILURE TO COMPLETE THE WORK.

8-10.1 Highway Code Requirements Pertaining to Liquidated Damages is revised as follows:

(a) In the first sentence, reference to "Florida Highway Code, Section 337.18, paragraph (2)" is deleted and "Section 337.18, paragraph (2) Florida Statutes" is substituted.

(b) The text is expanded by the following paragraph:

In accordance with Section 337.18, paragraph (3) Florida Statutes, an additional damage recovery/user cost equal to the daily liquidated damage amounts will be assessed for failure to complete work within the approved Contract time.

8-10.2 Amount of Liquidated Damages. The text is deleted and the following

substituted:

Such liquidated damages shall be the amounts established in the following schedule:

<u>Original Contract Amount</u>	<u>Daily Charge Per Calendar Day</u>
\$50,000 and under	\$ 450
Over \$50,000 but less than \$250,000	870
\$250,000 but less than \$500,000	920
\$500,000 but less than \$2,500,000	1,090
\$2,500,000 but less than \$5,000,000	1,320
\$5,000,000 but less than \$10,000,000	1,470
\$10,000,000 but less than \$15,000,000	1,500
\$15,000,000 but less than \$20,000,000	2,260
\$20,000,000 and over	2,260 plus 7/1000 of one percent per day for any amount over \$20 million

SECTION 009 MEASUREMENT AND PAYMENT

9-2 SCOPE OF PAYMENTS.

9-2.1.1 Bituminous Material. In subparagraph (e), factors 1.10 and 0.90 are changed to 1.05 and 0.95, respectively; and in Subparagraph (g), 10 percent is changed to 5 percent.

9-2.1.2 Natural Gas. In Subparagraph (e), 10 percent is changed to 5 percent; and in Subparagraph (f), the factors 1.10 and 0.90 are changed to 1.05 and 0.95, respectively.

9-2.1.3 Gasoline and Diesel Fuels. In Subparagraph (e), 10 percent is changed to 5 percent and in Subparagraph (f) the factors 1.10 and 0.90 are changed to 1.05 and 0.95, respectively.

9-3 COMPENSATION FOR ALTERED QUANTITIES.

9-3.2.1 Payment Based on Plan Quantity. The second sentence of the first paragraph is deleted and the following substituted:

An error shall be deemed substantial if the quantity will increase or decrease in excess of five percent of the original plan quantity for that item or the amount due for that item will

increase or decrease in excess of \$5,000 (whichever is smaller).

9-6PARTIAL PAYMENTS.

9-6.2 Unsatisfactory Payment Record. Reference to Section 255.05 of the Florida Statutes is changed to 255.052.

9-6.6 Substitution of Securities for Retainage. The text is deleted and the following substituted:

In accordance with Section 337.175, Florida Statutes, the Department will accept substitution of securities as provided by Section 255.052, Florida Statutes; or certificates of deposit or irrevocable letters of credit approved by the Department's Comptroller in lieu of retainage. Information concerning such substitution may be obtained from the Office of Comptroller of the Department of Transportation, Haydon Burns Building, 605 Suwannee Street, Tallahassee, Florida, 32399-0450.

9-6.7 Certification of Payment to Subcontractors. In the first sentence of the first paragraph, reference to Florida Transportation Code, Section 337.11 Subsection 8 is changed to Florida Statutes 337.11(10)(a).

9-6.7 Certification of Payment to Subcontractors. In the last paragraph, reference to "Florida Administrative Code 14-22.12" is changed to "Florida Administrative Code 14-22.012".

9-9(a) ACCEPTANCE AND FINAL PAYMENT is deleted and the following substituted:

(a) The Contractor has agreed in writing to accept the balance due, as determined by the Department, as full settlement of his account under contract and of all claims in connection therewith, or the Contractor has the option, through the use of the Qualified Acceptance Letter, of accepting the balance due, as determined by the Department, with the stipulation that acceptance of such payment shall not constitute any bar, admission or estoppel, or have any effect as to those payments in dispute or the subject of a pending claim between the Contractor and the Department. The dispute or pending claim must be defined in writing with full particular of all items of all issues in dispute, including itemized amounts claimed for all particulars of all items, and must accompany the Qualified Acceptance Letter before payment under this option will be allowed. The Contractor further agrees, through the use of this option, that any pending or future arbitration claim or suit must be limited to those particulars, including the itemized amounts, defined in the Qualified Acceptance Letter and must be commenced within 820 calendar days from and after the time of final acceptance of the work done and that failure to file a formal claim within this period constitutes full acceptance.

SECTION 101
MOBILIZATION

101-2BASIS OF PAYMENT.

101-2.2 Partial Payments is expanded as follows:

As an exception to partial payments being made based on Percent of Original Contract Amount Earned, the Contractor will be paid the invoice price of the Contract Bond when the Engineer has been furnished with a certified copy of the invoice from the Bonding Company. No other work will be required to receive payment for the Contract Bond included in the bid price for Item No. 101-1 -Mobilization.

SECTION 102
MAINTENANCE OF TRAFFIC

102-3TRAFFIC CONTROL.

102-3.1 Standards is expanded as follows:

Reflectorization of traffic cones used at night shall be by cone collars meeting the following requirements:

(a)Each collar shall be designed to properly fit the taper of the cone when installed.

The upper six-inch collar shall be a uniform 3 1/2-inch distance from the top of the cone and the lower four-inch collar shall be a uniform two-inch distance below the bottom of the upper six-inch collar. The collars shall be capable of being removed for temporary use or attached permanently to the cone in accordance to the manufacturer's recommendations. The sheeting shall consist of a white sheeting having a smooth outer surface and that essentially has the property of a retroreflector over its entire surface.

(b)The retroreflective sheeting for the collars shall meet the requirements of ASTM D 4956 Table 4, Type III and Table 9, Type VI; excluding 0.1 deg. observation angle and -4 deg., ± 30 deg. entrance angle.

The Contractor shall provide three certified copies of test reports and certification from the manufacturer that the material furnished meets all requirements of (b) above.

The reflective collars for cones shall be one of the products included on the Qualified Products List maintained by the Office of Construction, current at the time of the products proposal for use.

102-7 COMPENSATION.

102-7.2 Special Detours. The first paragraph is expanded as follows:

Unless otherwise indicated in the plans, traffic control devices, warning devices, barriers, signing and pavement markings for Special Detours will also be paid for separately.

SECTION 120
EXCAVATION AND EMBANKMENT

120-1 DESCRIPTION. The second paragraph is expanded as follows:

Unclassified material displaced by the storm sewer or drainage structure system is not included in the earthwork quantities shown on the plans.

120-5 DISPOSAL OF SURPLUS AND UNSUITABLE MATERIAL.

120-5.4 Disposal of Paving Materials. Reference to disposal of limerock outside of the right of way is deleted and the following substituted:

Existing limerock base that is removed may be incorporated in the stabilized portion of the subgrade. If the construction sequence will allow, all existing limerock base removed shall be incorporated in the project as allowed by the specifications.

120-6BORROW.

120-6.1 Authorization for Use of Borrow is expanded as follows:

The Contractor shall not provide borrow materials which are polluted as defined in Chapter 376, Florida Statutes (oil of any kind and in any form, gasoline, pesticides, ammonia, chlorine, and derivatives thereof, excluding liquified petroleum gas) in concentrations above any local, state, or federal standards.

If the Contractor proposes to use borrow material which is the product of soil incineration, he shall provide to the Engineer prior to placing any material, a copy of the Certificate of Materials Recycling and Post Burn Analysis showing that the material is below all allowable pollutant concentrations.

120-6.2 Furnishing of Borrow Areas. The first sentence of the first paragraph is deleted and the following substituted:

Borrow material, as required, shall be obtained from areas furnished by the Contractor, unless otherwise noted in the plans or special provisions.

120-13 BASIS OF PAYMENT.

120-13.3.1 General is expanded as follows:

Such price and payment for embankment shall also be full compensation for all material for constructing the embankment.

120-13.4 Final Dressing. The text is deleted and the following substituted:

No separate payment will be made for Final Dressing. All costs of such work shall be included in the item to which it is incidental.

120-13.5 Payment Items. Reference to Item No. 120-8 - Final Dressing - lump sum is deleted.

SECTION 125

EXCAVATION FOR STRUCTURES

125-1 DESCRIPTION is expanded by the following new SUBARTICLE:

125-1.1 Trench Excavation Safety System and Shoring, Special (Trench Excavation).

The Contractor(s) performing trench excavation on this Contract, in excess of five feet in depth, shall comply with the Occupational Safety and Health Administration's (OSHA) trench excavation safety standards, 29 C.F.R., s. 1926.650, Subpart P, including all subsequent revisions or updates to these standards as adopted by the Department of Labor and Employment Security (DLES).

By submission of his bid and subsequent execution of this Contract, the Contractor certifies that all trench excavation done within his control, including any subcontractors, in excess of five feet in depth shall be accomplished in strict adherence with OSHA trench safety standards contained in 29 C.F.R., s. 1926.650, Subpart P, including all subsequent revisions or updates to these standards as adopted by the Department of Labor and Employment Security.

The Contractor shall consider all available geotechnical information in his design of the trench excavation safety system.

The trench safety standards contained herein establish minimum requirements and are not meant to lessen more stringent requirements which may be contained elsewhere in this Specifications Package.

125-4 EXCAVATION.

125-4.1 Requirements for all Excavation is expanded as follows:

The Contractor(s) performing trench excavation shall adhere to OSHA trench excavation safety standards and special shoring requirements for trench excavation, if any, of the State or other political subdivisions. Inspections required by OSHA trench excavation safety standards shall be provided by the Contractor.

125-8 BACKFILLING.

125-8.1.3 Time of Placing Backfill. The text is deleted and the following

substituted:

No backfill shall be placed against any masonry or concrete abutment, wingwall or culvert until permission has been given by the Engineer, and in no case until the masonry or concrete has been in place seven days or until the specified 28-day compressive strength occurs.

125-8.3.2 Density Requirements. The text under the heading, "Height of Material Over Top of Pipe (Less Than Ten Feet)" is deleted and the following substituted:

All stages-To a firmness approximately equal to that of the soil adjacent to the pipe trench.

TOPSOIL

SECTION 162 (Pages 150-152) is deleted and the following substituted:

SECTION 162 **TOPSOIL**

162-1 DESCRIPTION.

The work specified in this Section consists of preparation of a layer of mixed material favorable to plant growth, over areas of the project which are to be grassed, grassed and mulched or sodded. This shall be accomplished by use of a six-inch muck blanket, commercially available supplements or topsoil.

162-2 MATERIALS.

Material in the specified layer shall be suitable for plant growth and free from appreciable quantities of hard clods, stiff clay, hardpan, gravel, brush, large roots, refuse, or other deleterious materials, and shall be of reasonably uniform quality.

The organic content of the specified layer after mixing (as determined in accordance with AASHTO T 194) shall be at least 1.0 percent and have a pH value (as determined in accordance with ASTM E 70) between 5.0 and 8.0.

If there is evidence of the specified layer being contaminated by other construction operations, the in-place topsoil will be sampled and tested for pH value and organic content.

Immediately after completion of the spreading and mixing as specified in 162-4.2, the top six inches of the mixed material shall be sampled and tested. The samples shall be taken at a minimum of four random samples per mile. On projects or areas less than 1/4 mile in length, one sample per 1/4 mile will be sufficient. When the source of topsoil changes, an additional sample will be required at the point of change.

Test results shall be averaged for each shoulder mile or increment thereof to determine specification compliance. Out of tolerance individual tests to a minimum of 0.5 percent organic content and minimum of 4.5 and maximum 8.5 pH values will be allowed.

Topsoil material may be obtained from either, or a combination, of the following sources:

- (a) Excavation within the limits of construction on the project. Such material may be stockpiled or windrowed on the project in areas approved by the Engineer.
- (b) Designated borrow pits for the project.
- (c) From other sources of topsoil provided by the Contractor.
- (d) By the addition of appropriate supplements mixed with the existing material in quantities sufficient to achieve the minimum organic levels and pH range as provided for in 162-2.

Supplements may be materials such as muck, commercial peat, dolomitic limestone, commercial sulfur, or any other material commonly accepted in the agricultural industry. Commercial fertilizer is not to be used for these adjustments.

The plans may contain data concerning texture, pH and organic content of the existing topsoil within the project limits. All muck excavated on the project may not be suitable for use in topsoil construction. The Contractor shall make his own determination as to the quantity and suitability of existing muck.

162-3 DISPOSITION OF EXCESS TOPSOIL.

Ownership of any stockpiled topsoil material excavated from within the limits of construction, which is not used in topsoil construction and which is suitable for use in topsoil construction, shall remain with the Department. This material shall be stockpiled in areas within the project right of way as designated by the Engineer or in Department owned sites as shown in the plans.

162-4 CONSTRUCTION METHODS.

162-4.1 Preparation of Areas. Prior to beginning of the work, the surface of the earthwork shall have been constructed to such lines and elevations as will provide a surface conforming to the plan lines and elevations upon completion of the topsoil operations. The surface of the earthwork shall be left in a roughened and loose condition.

The Contractor shall exercise care to prevent contamination of the mixed material by other construction operations. The Contractor shall correct the pH value of topsoil contaminated by his operation by application of appropriate supplements. The cost of any corrective work shall be at the Contractor's expense.

162-4.2 Spreading and Mixing. The necessary material shall be uniformly spread over areas to receive treatment. When supplements are furnished, sufficient quantities to meet the above stated specifications shall be applied.

After spreading, the material shall be mixed with the underlying soil to a combined depth of six inches. Mixing shall be done so as to provide a uniform blanket true to line and grade. Mixing will not be required if a six-inch layer of specified material is placed. Any slippage of this material shall be corrected by the Contractor at his expense.

162-5 METHOD OF MEASUREMENT.

The quantity to be paid for under this Section shall be the area in square yards for the topsoil layer meeting the requirements of 162-2, completed and accepted, determined as specified in 9-1.3.

162-6 BASIS OF PAYMENT.

The quantity determined as provided in 162-5 shall be paid for at the contract unit price per square yard for the topsoil layer six inches thick.

The above price and payment shall constitute full compensation for completing all work specified in this Section.

It includes the hauling of any material from the project right of way, designated borrow areas, other sources as may be provided by the Contractor, any combination of the above or the furnishing of any supplemental materials that may be required to meet the required organic levels and pH range. It also includes the mixing, grading, and/or leveling as required to provide a relatively uniform homogeneous topsoil mix throughout the six inches within the prescribed lines and grades.

Payment shall be made under:

Item No. 162-1 - Muck Blanket - per square yard.

Item No. 162-2 - Topsoil - per square yard.

SECTION 200
LIMEROCK BASE

200-2 MATERIALS is expanded by the following:

None of the existing limerock base that is removed is to be used in the construction of the new limerock base.

SECTION 250
SHELL BASE

250-2 MATERIALS - ROCK BASE is expanded as follows:

Shell-rock material shall meet the requirements of Section 913A.

PRIME AND TACK COATS FOR BASE COURSES.

Section 300 (Pages 205-210) is deleted and the following substituted:

SECTION 300

PRIME AND TACK COATS FOR BASE COURSES

300-1 DESCRIPTION.

The work specified in this Section consists of the application of bituminous prime coats on previously prepared bases and the application of bituminous tack coats on previously prepared bases and on existing pavement surfaces. All such work shall be accomplished in accordance with these specifications and in conformity with the lines, dimensions and notes shown in the plans.

300-2 MATERIALS.

300-2.1 Prime Coat. The material used for prime coat shall be cut-back Asphalt Grade RC-70 or RC-250 meeting the requirements of 916-3, Emulsified Asphalt Grades SS-1 or CSS-1, SS-1H or CSS-1H diluted in equal proportion with water; Emulsified Asphalt grade AE-60, AE-90, AE-150 or AE-200 diluted at the ratio of 6 parts emulsified asphalt to 4 parts water; Special MS-Emulsion diluted at the ratio of 6 parts emulsified asphalt to 4 parts water; Asphalt Emulsion Prime (AEP), Emulsion Prime (RS Type) or EPR-1 Prime, meeting the requirements of 916-4, or other types and grades of bituminous material which may be called for in the plans or Special Provisions.

Where the above materials for use as a prime coat are to be diluted, the Contractor shall certify that the dilution was done in accordance with this specification for each load of material used.

The Contractor may select any of the specified bituminous materials unless the plans or Special Provisions indicate the use of a specific material. Types and Grades of bituminous material other than those specified above may be allowed if it can be shown that the alternate material will properly perform the function of prime coat material.

300-2.2 Cover Material for Prime Coat. Primed base shall be uniformly covered by a light application of cover material. However, if EPR-1 prime material is used, the Engineer may waive the cover material requirement if the primed base is not exposed to general traffic and construction traffic does not mar the prime coat so as to expose the base. The cover material shall be sand or screenings, at the Contractor's option. The sand shall meet the requirements specified in 902-2 or 902-6 and the screenings shall meet the requirements specified in 902-5. When it is necessary to expose the primed base course to general traffic, the Contractor shall apply a cover material that has been coated with two to four percent asphalt cement. The application of the asphalt coated material shall be approximately ten pounds per square yard. The entire surface of asphalt coated prime material shall be rolled with a traffic roller as required to produce a reasonably dense mat.

300-2.3 Tack Coat. Unless a specific type or grade of materials is called for in the plans or Special Provisions, the material used for tack coat shall be undiluted Emulsified Asphalt Grades RS-1 or RS-2 meeting the requirements of 916-4. RS-1 or RS-2 shall be heated to a temperature of 140°F to 180°F. RS-1 may be modified to include up to three percent naphtha to improve handling of the material during the winter months.

For night paving, the tack coat shall be AC-5 meeting the requirements of 916-1 heated to a temperature of 250°F to 300°F.

RS-1 or RS-2 may be approved by the Engineer for night paving if the Contractor demonstrates, at the time of use, that the emulsion will break to allow paving in a timely manner.

300-3 EQUIPMENT.

300-3.1 Pressure Distributor. The pressure distributor shall be equipped with pneumatic tires having a sufficient width of rubber in contact with the road surface to avoid breaking the bond or forming a rut in the surface. The distance between the centers of openings of the outside nozzles of the spray bar shall be equal to the width of the application required, within an allowable variation of two inches. The outside nozzle at each end of the spray bar shall have an area of opening not less than 25 percent nor more than 75 percent, in excess of the other nozzles. All other nozzles shall have uniform openings. When the application covers less than the full width, the normal opening of the end nozzle at the junction line may remain the same as those of the interior nozzles.

300-3.2 Sampling Device. All pressure distributors and transport tanks delivering bituminous materials for use on the Department's projects shall be equipped with an approved spigot-type sampling device.

300-3.3 Temperature Sensing Device on Transport Tanks. All pressure distributors and transport tanks delivering bituminous materials for use on the Department's projects shall be equipped with an approved dial type thermometer.

The thermometer shall have a temperature range from 50°F to 500°F in 25°F increments with a minimum dial diameter of two inches.

The thermometer shall be located near the midpoint in length and within the middle third of the height of the tank and be enclosed in a well with a protective window or by other means as necessary to keep the instrument clean and in the proper working condition.

300-4 CLEANING BASE AND PROTECTION OF ADJACENT WORK.

Before any bituminous material is applied, all loose material, dust, dirt, caked clay and other foreign material which might prevent proper bond with the existing surface shall be removed for the full width of the application. Particular care shall be taken in cleaning the outer edges of the strip to be treated, to insure that the prime or tack coat will adhere.

When the prime or tack coat is applied adjacent to curb and gutter, valley gutter or any other concrete surfaces, such concrete surfaces (except where they are to be covered with a bituminous wearing course) shall be covered with heavy paper, or otherwise protected as

approved by the Engineer, while the prime or tack coat is being applied. Any bituminous material deposited on such concrete surfaces shall be removed.

300-5 WEATHER LIMITATIONS.

Prime and tack coats shall be applied when the air temperature, in the shade, is above 40°F, and when all other weather conditions and the condition of the surface are suitable.

300-6 APPLICATION OF PRIME COAT.

300-6.1 General. The surface to be primed shall be clean and the moisture content of the base shall not exceed 90 percent of the optimum moisture. The temperature of the prime material shall be between 100°F and 150°F. The actual temperature shall be that which will insure uniform distribution, and will be designated by the Engineer. The material shall be applied by means of a pressure distributor. The amount to be applied will be dependent on the character of the surface and shall be sufficient to coat the surface thoroughly and uniformly, with no excess.

300-6.2 Rate of Application.

300-6.2.1 For Limerock, Limerock Stabilized, and Local Rock Bases. For these bases, the rate of application shall be not less than 0.10 gallon per square yard, unless a lower rate is directed by the Engineer.

300-6.2.2 Sand-Clay, Shell and Shell Stabilized Bases. The rate of application for these bases shall be not less than 0.15 gallon per square yard, unless a lower rate is directed by the Engineer.

300-6.3 Sprinkling. If so required by the Engineer the base shall be lightly sprinkled with water and rolled with a traffic roller, in advance of the application of the prime.

300-6.4 Partial Width of Application. If warranted by traffic conditions, the Engineer may require that the application be made on only one-half the width of the base at one time, in which case positive means shall be used to secure the correct amount of bituminous material at the joint.

300-7 APPLICATION OF TACK COAT.

300-7.1 General. Where a bituminous surface is to be laid and a tack coat is required, the tack coat shall be applied as specified hereinbelow.

300-7.2 Where Required. In general, a tack coat will not be required on primed bases except in areas that have become excessively dirty and cannot be cleaned, or in areas where the prime has cured to the extent that it has lost all bonding effect. Generally, a tack coat will be required on hot bituminous base courses before placing the surface course.

300-7.3 Method of Application. The tack coat shall be applied with a pressure distributor except that, on small jobs, if approved by the Engineer, application may be by other mechanical devices or by hand methods. The bituminous material shall be heated to a suitable temperature as designated by the Engineer and shall be applied in a thin, uniform layer.

300-7.4 Rate of Application. The rate of application shall be between 0.02 and 0.08 gallon per square yard. For tack coat applied on concrete pavement which is to be surfaced, the rate of application may exceed the upper limit, if directed by the Engineer.

300-7.5 Curing and Time of Application. The Engineer will designate the curing period for the tack coat. The tack coat shall be applied sufficiently in advance of the laying of the bituminous mix to permit drying but shall not be applied so far in advance that it might lose its adhesiveness as a result of being covered with dust or other foreign material.

300-7.6 Protection. The tack coat surface shall be kept free from traffic until the subsequent layer of bituminous hot mix has been laid.

300-8 METHOD OF MEASUREMENT.

300-8.1 General. The quantity to be paid for under this Section shall be the volume, in gallons, of bituminous material actually applied and accepted. This quantity shall be determined from measurements made by the Engineer based on tank calibrations, as specified in 300-8.2. Where it is specified that prime coat material or tack coat material is to be diluted with water, the quantity to be paid for shall be the volume after dilution.

300-8.2 Calibration of Tanks. All distributors used for applying tack or prime coats shall be calibrated prior to use. Calibrations may be performed by the State Materials Office or by a reliable and recognized firm engaged in calibrating tanks. All calibrations shall be reviewed and approved by the State Materials Office.

300-8.3 Temperature Correction. The measurement shall be based on a temperature of 60°F, and correction for temperature shall be made by increasing or decreasing the volume actually measured.

The correction for temperature shall be made by applying the applicable conversion factor (**K**), as shown below, as a multiplier for each degree Fahrenheit, above or below, the specified payment temperature of 60°F, for the adjustment from the volume as measured.

For petroleum oils having a specific gravity (60°F/60°F) above 0.966, **K** = 0.00035 per degree.

For petroleum oils having a specific gravity (60°F/60°F) of between 0.850 and 0.966, **K** = 0.00040 per degree.

For emulsified asphalt: **K** = 0.00025.

When volume-correction tables based on the above conversion factors are not available, the following formula will be used in computing the corrections for volumetric change:

$$V = V' / K(T-60) + 1$$

Where **V** =Volume of the bituminous material at 60°F (pay volume)

V' =Volume of bituminous material as measured

K =Correction factor (Coefficient of Expansion)

T =Temperature (in degrees F), of the bituminous material

when measured.

300-9 BASIS OF PAYMENT.

The quantity of bituminous material, both prime and tack materials, determined as provided in 300-8, shall be paid for at the contract unit price per gallon for Bituminous Material.

The price and payment for Bituminous Material shall be full compensation for all the work specified herein for prime and tack coats, including heating, hauling, and applying.

No separate payment will be made for cover material for prime coat (including hot-asphalt coated cover material and the bituminous material therein) but the costs of furnishing and applying such material shall be included in the contract unit price for Bituminous Material (Prime Coat).

Payment shall be made under:

Item No. 300-1 - Bituminous Material - per gallon.

BITUMINOUS CRACK RELIEF LAYER.

SECTION 312 (Pages 218-220) is deleted and the following substituted:

SECTION 312
BITUMINOUS CRACK RELIEF LAYER

312-1 DESCRIPTION.

The work specified in this Section consists of the construction of a crack relief layer composed of a separate application of bituminous material covered with a single application of aggregate.

312-2 COMPOSITION AND PROPORTIONING.

The composition and proportioning for the crack relief layer is shown in the table below. The range of bituminous material and cover material are approximate and may be increased or decreased as directed by the Engineer.

PROPORTIONS FOR CRACK RELIEF LAYER

Aggregate	Cover Material	Bituminous Material	
Grade	Cu. Ft. per Sq. Yd.	Gallons per Sq. Yd.	
67	0.32 - 0.38	Asphalt Cement	Emul. Asphalt
		0.20 - 0.30	0.29 - 0.43

312-3 MATERIALS.

The materials used shall conform with the requirements specified in Division III. Specific references are as follows:

- (1) Bituminous Material:
 - Asphalt Cement, Viscosity Grade AC-5.....916-1
 - Asphalt Cement, Viscosity Grade AC-10916-1
 - Emulsified Asphalt Grade RS-2916-4
- (2) Cover Material:
 - Stone, Slag or Crushed GravelSection 901

312-4 EQUIPMENT.

312-4.1 Pressure Distributor. The pressure distributor shall meet the requirements of 300-3.1.

312-4.2 Spreading Equipment. The spreading equipment shall meet the requirements of 310-4.2.

312-4.3 Rollers. The rollers shall be pneumatic-tired traffic type rollers equipped with at least seven smooth-tread, low-pressure tires and capable of carrying a gross load of at least eight tons. The inflation of the tires shall be maintained such that the pressure does not vary more than five pounds per square inch. The traffic roller shall be loaded as directed by the Engineer.

312-5 APPLICATION WIDTH.

The application of bituminous and cover material shall be confined to one lane at a time, leaving all additional lanes open to traffic.

312-6 PREPARATION OF ROAD SURFACE.

312-6.1 Cleaning. The surface to be covered shall be swept clean and free of sand, dirt, dust, and other deleterious material, by means of mechanical rotary sweepers, or other approved methods, and shall be free from moisture.

312-6.2 Condition of Underlying Surface. Crack relief layer shall not be constructed

over any loose or unstable pavement that will result in excessive penetration of the cover material during the rolling operations.

312-7 PROTECTION OF ADJACENT SURFACE.

Where a crack relief layer is constructed adjacent to curb and gutter, valley gutter, or any other concrete surface, the concrete surfaces shall be covered with heavy paper or other protection approved by the Engineer during application of bituminous material. Any bituminous material deposited on such concrete surfaces shall be immediately removed.

312-8 WEATHER LIMITATIONS.

No bituminous material shall be applied when the air temperature in the shade, away from artificial heat, is less than 40 degrees F at the location where the application is to be made, or when weather conditions are otherwise unfavorable.

312-9 APPLICATION OF BITUMINOUS MATERIAL.

312-9.1 Distributor Pressure. After the surface has been cleaned to the satisfaction of the Engineer, the bituminous material shall be sprayed uniformly over the surface by means of a pressure distributor. The distributor shall maintain a consistent pressure of at least 20 psi, but not more than 75 psi.

312-9.2 Application Temperatures. For asphalt cement, the application temperature shall be between 300 degrees F and 325 degrees F. For emulsified asphalt, the application temperature shall be between 140 degrees F and 180 degrees F.

312-9.3 Uniformity of Distribution. The distributor shall be so adjusted and operated as to maintain an even and uniform distribution of the bituminous material. Excessive deposits of bituminous material caused by stopping or starting the distributor, by leakage, or otherwise shall be immediately removed.

312-9.4 Limitations to Application. The area to be covered by any one application of bituminous material shall be no greater than can be covered with the aggregate without interruption due to limitations of hauling and spreading equipment or to any other cause.

312-10 SPREADING COVER MATERIAL.

312-10.1 Spreading. The spreading of the cover material shall follow immediately after the application of bituminous material. The cover material shall be distributed uniformly over the bituminous surface in one course. Trucks, spreaders or other vehicles shall not be driven on the uncovered bituminous material.

312-10.2 Dressing. Immediately after the application of cover material, the surface shall be checked by experienced and skilled workers to assure that uniform distribution of cover material and a smooth surface is obtained. Additional aggregate shall be placed by hand on any areas not properly covered. If deemed necessary by the Engineer, the surface shall then be dragged with a light drag broom or other dragging equipment that will not disturb the bonded aggregate. This operation shall be supplemented by additional hand brooming until a smooth and even surface is obtained. The dragging and brooming shall be

repeated, in conjunction with the rolling, for as long as required to insure a uniform surface.

312-11 ROLLING.

Immediately after the spreading and dragging of cover material, the entire surface shall be rolled. Rolling shall begin at the edge of pavement and progress toward the centerline, uniformly lapping each preceding pass and thoroughly covering the entire surface. During rolling, additional dragging and hand brooming shall be required as specified in 312-10.2.

312-12 SURFACE REQUIREMENT.

Any joints or portions of the completed surface which are defective, not properly finished, or not in conformance with these specifications shall be removed and replaced with a satisfactory surface. No compensation will be made for the removal work.

312-13 COVERING CRACK RELIEF LAYER.

The crack relief layer shall be covered with an asphaltic concrete layer prior to being opened to traffic.

312-14 METHOD OF MEASUREMENT.

312-14.1 General. The quantities to be paid for under this Section shall be the volume, in gallons, of bituminous material, and the area, in square yards, of cover material applied on the road and accepted.

312-14.2 Bituminous Material. The quantity of bituminous material shall be determined as provided in 300-8.

312-14.3 Cover Material. The quantity of cover material shall be determined by surface area in square yards.

312-15 BASIS OF PAYMENT.

312-15.1 Bituminous Material. The quantity of bituminous material, determined as provided above, shall be paid for at the contract unit price per gallon for Bituminous Material, which price and payment shall be full compensation for furnishing all the materials, and for heating, hauling, and applying.

312-15.2 Cover Material. The quantity of cover material, determined as provided above, shall be paid for at the contract unit price per square yard for Cover Material, which price and payment shall be full compensation for all the work described in this Section, except for the work paid for under the item of Bituminous Material.

312-15.3 Payment Items.

Payment shall be made under:

Item No. 300-1 - Bituminous Material - per gallon.

Item No. 312-70 - Cover Material for Crack Relief Layer - per square yard.

SECTION 320
HOT BITUMINOUS MIXTURES -
PLANT, METHODS AND EQUIPMENT

320-2.5 Equipment for Preparation of Bituminous Material. The last sentence is deleted.

320-6.1.1 General. The text is deleted and the following substituted:

The mechanical spreading and screeding equipment shall be of an approved type that is self-propelled and can be steered. It shall be equipped with a receiving and distribution hopper and a mechanical screed. The screed shall be capable of adjustment to regulate the depth of material spread and to produce the desired cross section.

320-6.1.4 Screed Width. The text is deleted and the following substituted:

Paving Machines used on full width lanes shall have a screed width greater than eight feet. Extendable screed strike-off devices which do not provide preliminary compaction of the mat shall not be used in place of fixed screed extensions. A strike-off device may be used on irregular areas that would normally be done by hand and on shoulders four feet or less in width. When the strike-off device is used on shoulders in lieu of an adjustable screed extension, the Contractor must demonstrate that an acceptable texture, density and thickness can be obtained.

SECTION 327
MILLING OF EXISTING ASPHALT PAVEMENT

327-3 CONSTRUCTION. The first two paragraphs are deleted and the following substituted:

The Contractor shall remove the existing raised reflective pavement markers prior to milling.

When milling to improve rideability or cross slope, the existing pavement shall be removed to the average depth specified in the plans, in a manner that will restore the pavement surface to a uniform cross section and longitudinal profile. The Project Engineer may require the use of a stringline to ensure maintaining the proper alignment.

The longitudinal profile of the milled surface shall be established on the side of the cut nearest the centerline of the road. Unless directed otherwise, the final cross slope of the

milled surface shall parallel the surface cross slope shown on the typical section or as directed by the Engineer. The cross slope of the milled surface shall be established by a second sensing device near the outside edge of the cut or by an automatic cross slope control mechanism. The plans may waive the requirement for automatic grade or cross slope controls where the situation warrants such action.

SECTION 330

HOT BITUMINOUS MIXTURES -

GENERAL CONSTRUCTION REQUIREMENTS

330-4 PREPARATION OF ASPHALT CEMENT. The text is deleted and the following substituted:

The asphalt cement shall be delivered to the asphalt plant at a temperature not to exceed 350 degrees F and the transport tanks shall be equipped with sampling and temperature sensing devices meeting the requirements of 300-3.2 and 300-3.3, respectively. The asphalt cement in storage shall be maintained within a range of 230 degrees F to 350 degrees F in advance of mixing operations. Heating within these limits shall be constant and wide fluctuations of temperature during a day's production will not be permitted.

330-5.2 Prevention of Segregation. The text is deleted and the following substituted:

Stockpiles shall be formed and maintained in a manner that will prevent segregation. If a stockpile is determined to have excessive segregation, the Engineer will disapprove the material for use on the project until the appropriate action has been taken to correct the problem.

330-6.3 Mixing Temperature. The last paragraph is deleted and the following substituted:

The mix temperature will be taken at the plant and the roadway for each day for each design mix on the first five loads and an average of once every five loads thereafter. The temperature measurements at the plant shall be taken and recorded by the Contractor's personnel for review by the Department. The temperature measurements at the roadway will be taken by the Department's Paving Inspector and be recorded on the backside of the delivery ticket. If the temperature exceeds the specified tolerance, the Contractor will be required to take immediate corrective action.

330-9.1.5 Number of Crews Required. The text is deleted and the following substituted:

For each paving machine operated, the Contractor will be required to use a separate crew, each crew operating as a full unit. The Contractor's Certified Paving Technician in

charge of the paving operations may be responsible for more than one crew but must be physically accessible to Project personnel at all times when mix is being placed.

330-9.1.6 Checking Depth of Layer. The text is deleted and the following substituted:

The depth of each layer shall be checked at frequent intervals and adjustments shall be made when the thickness exceeds the allowable tolerance. When an adjustment is made, the paving machine shall be allowed to travel a minimum distance of 32 feet to stabilize before the second check is made to determine the effects of the adjustment.

330-10.3.2 Control Strips. (a) The third paragraph is expanded by the following:

The lab density shall be calculated to the nearest 0.01 percent and rounded to the nearest 0.1 percent.

(b) The following paragraph is added ahead of Table 330-2:

In the event that a control strip meeting the requirements of Table 330-2 is not obtained and this particular mix, layer, etc. is completed on the project, density shall be evaluated in accordance with FM 5-543 (Determining Density of Asphalt Pavement Layers when a Valid Control strip is not obtained).

SECTION 331 TYPE S ASPHALTIC CONCRETE

331 TYPE S ASPHALTIC CONCRETE is deleted and the following substituted:

331-1 Description.

This Section specifies the materials, the composition, and physical test properties for Type S Asphaltic Concrete (Type S-I, Type S-II or Type S-III as specified by the contract or when offered as alternates, as selected by the Contractor). The composition and physical test properties for all mixes including Type S Asphaltic Concrete (S-I, S-II and S-III) are shown in the following Table 331-1 and Table 331-2.

Where Type S Asphaltic Concrete is specified in the contract, if approved by the Engineer, the Contractor may also select Type S-III Asphaltic Concrete as an alternate for the final surface (no friction course specified) and as the final layer of structural course only, prior to the friction course. Type S-II Asphaltic Concrete will not be permitted as the final layer prior to the friction course. Requirements for plant and equipment shall be as specified in Section 320. General construction requirements shall be as specified in Section 330.

Table 331-1
Bituminous Concrete Mixtures
(Gradation Design Range)

Percent by Weight Total Aggregate Passing Sieves *								
Type	3/4	1/2	3/8	No.4	No.10	No.40	No.80	No.200
S-I	100	88-100	75-93	47-75	31-53	19-35	7-21	2-6
S-II**	83-98	71-87	62-78	47-63	33-49	19-35	9-18	2-6
S-III		100	88-100	60-90	40-70	20-45	10-30	2-6
Type II		100	90-100	80-100	55-90			2-12
Type III	100	80-100	65-100	40-75	20-45	10-30	2-10	
SAHM		100						0-12
ABC-1		100						0-12
ABC-2		100		55-90				0-12
ABC-3***	70-100			30-70	20-60	10-40		2-10
FC-1		100		55-85				2-8
FC-2****		100	85-100	10-40	4-12			2-5
FC-4		100		75-90				2-6

* In inches, except where otherwise indicated. Number sieves are U.S. Standard sieve series.

** 100% passing 1 1/4-inch sieve and 94-100% passing 1-inch sieve.

*** 100% passing 1 1/2-inch sieve.

**** The design range for the No. 10 sieve may be increased for lightweight aggregates.

**Table 331-2
Marshall Design Properties For
Bituminous Concrete Mixes**

Mix Type	Minimum Marshall Stability (lbs.)	Flow* (0.01 in.)	Minimum VMA (%)	Air Voids (%)	Minimum Effective Asphalt Content (%)
S-I	1500	8-14	14	3-5	5.0
S-II	1500	8-14	13	3-5	5.0
S-III	1500	8-14	15	3-7	5.5
Type II	500-750	7-16	18	5-16	6.0
Type III	750-1000	7-16	15	5-12	5.5
SAHM	300-500	7-16	15	5-16	6.0
ABC-1	500	7-16	15	5-16	6.0
ABC-2	750	7-16	15	5-14	5.5
ABC-3	1000	8-14	14	3-7	5.0
FC-1	500	7-14	15	8-14	5.5
FC-2	—	—	—	—	—
FC-4	500	7-14	15	12-16	5.0

*The maximum Flow for the mix design shall be one point less than shown in the Table. The maximum Flow values shown apply only during production.

Work will be accepted on a LOT to LOT basis in accordance with the applicable requirements of Sections 5, 6, and 9. The size of the LOT will be as specified in 331-5 for the bituminous mixture produced at the plant and as stipulated in 330-10 and 330-12 for the material placed on the roadway.

331-2 MATERIALS.

331-2.1 General Specifications. The materials used shall conform with the requirements specified in Division III. Specific references are as follows:

- (1) Asphalt Cement Viscosity Grade AC-30..... 916-1
- (2) Mineral Filler 917-1 and 917-2
- (3) Coarse Aggregate, Stone, Slag or Crushed Gravel Section 901 *
- (4) Fine Aggregate Section 902

*Gravel for use in asphalt concrete mixtures shall be crushed. In addition, the asphalt concrete mixtures containing crushed gravel as the course aggregate component must show

no potential for stripping during laboratory testing, before approval of the mix design.

Reclaimed Portland Cement Concrete Pavement may be used as a coarse aggregate or screenings component subject to meeting all applicable specifications.

All materials shipped to the asphalt plant will be sampled at their destination.

331-2.2 Specific Requirements.

331-2.2.1 Condition of Aggregate. The aggregate shall be clean and shall contain no deleterious substances. Coarse or fine aggregate containing any appreciable amount of phosphate shall not be used.

331-2.2.2 Fine Aggregate and Mineral Filler. In laboratory tests, and for the purpose of proportioning the paving mixture, all material passing the No. 10 sieve and retained on the No. 200 sieve shall be considered as fine aggregate, and the material passing the No. 200 sieve shall be considered as mineral filler.

331-2.2.3 Screenings. Any screenings used in the combination of aggregates shall contain not more than 15 percent of material passing the No. 200 sieve. When two screenings are blended to produce the screening component of the aggregate, one of such screenings may contain up to 18 percent of material passing the No. 200 sieve, as long as the combination of the two does not contain over 15 percent material passing the No. 200 sieve. Screenings may be washed to meet these requirements.

331-2.2.4 Use of Reclaimed Asphalt Pavement. Reclaimed asphalt pavement may be used as a component material of the bituminous mixture subject to the following:

1. The Contractor shall be responsible for the design of asphalt mixes which incorporate reclaimed asphalt pavement as a component part.
2. Reclaimed asphalt pavement shall not exceed 60 percent by weight of total aggregates for Asphalt Base Courses nor more than 50 percent by weight of total aggregates for Structural and Leveling Courses. Reclaimed asphalt pavement shall not be used in Friction Courses.
3. A grizzly or grid with openings of a sufficient size to prevent clogging of the cold feed shall be mounted over the reclaimed asphalt pavement (RAP) cold bin.

A grizzly or grid over the RAP cold bin, in-line roller crusher, screen, or other suitable means shall be used to prevent oversized RAP material from showing up in the completed recycled mixture.

In the event that oversized RAP material appears in the completed recycled mix, plant operations shall cease and the appropriate corrective action shall be taken.

4. The reclaimed asphalt pavement material as stockpiled shall be reasonably uniform in characteristics and shall not contain aggregate particles which are soft or conglomerates of fines.

When milling is required on the project and a Composition of Existing Pavement is included in the plans or special provisions and the Contractor elects to use the milled material as a component of the asphalt mixture, the procedures for obtaining representative samples for the mix design shall be as follows:

1. The Contractor shall cut ten six-inch cores in area(s) approved by the Materials Office. The core holes shall be filled immediately prior to opening to traffic.

2. Representative samples may also be obtained by milling the existing pavement to the full depth shown on the plans for pavement removal for a length of approximately 200 feet. The pavement removed shall be immediately replaced with the specified mix in the contract and paid for at the contract unit price.
3. The Contractor will be required to submit a request in writing to the State Materials Engineer for any variance from the above outlined methods of obtaining samples for mix designs.

When the reclaimed asphalt pavement to be used as a component in a mix design is stockpiled from a previous DOT project and the Composition of Existing Pavement is known, the Contractor shall design the mix and submit to the Materials Office for approval.

When the composition of stockpiled reclaimed asphalt pavement to be used as a component in a mix design is not known, the procedures for design shall be as follows:

1. The Contractor shall submit a bag of reclaimed asphalt pavement, composed of samples from several locations in the stockpile(s), to the Materials Office at least four weeks prior to his planned start of mix design. The Department will run viscosities on the reclaimed asphalt pavement and furnish the information to the Contractor.
2. The Contractor shall run a minimum of six extraction gradation analyses of the reclaimed asphalt pavement. The samples shall be taken at random locations around the stockpile(s).
3. The Contractor shall request the District Bituminous Engineer to make a visual inspection of the stockpile(s) of reclaimed asphalt pavement. Based on visual inspection, the District Bituminous Engineer will determine the suitability of the stockpiled materials.
4. When the Contractor submits his proposed mix design to the Materials Office for approval, he shall submit the data from the extraction gradation analyses required above.

331-2.2.5 Recycling Agents. When reclaimed asphalt pavement is approved for use as a component material, a recycling agent meeting the requirements specified in 916-2 shall be used in the mix.

The State Materials Office will select the best formulation suited for the project and reserves the right to request reasonable changes throughout the construction duration.

331-3 PERMISSIBLE VARIATION FOR THE COARSE AGGREGATE.

The aggregate or aggregates shipped to the job shall be sized and uniformly graded or combined in such proportions that the resulting mixture meets the grading requirements of the mix design.

331-4 GENERAL COMPOSITION OF MIXTURE.

331-4.1 General. The bituminous mixture shall be composed of a combination of aggregate (coarse, fine or mixtures thereof), mineral filler, if required, and bituminous material. Not more than 20 percent by weight of the total aggregate used shall be silica sand or local materials as defined in Section 902. The silica sand and local materials contained in any reclaimed asphalt pavement material, if used in the mix, shall be considered in this limitation. The several aggregate fractions shall be sized, uniformly graded and combined in

such proportions that the resulting mixture will meet the grading and physical properties of the approved mix design.

Reclaimed asphalt pavement meeting the requirements of 331-2.2.4 may be approved as a substitution for a portion of the combination of aggregates, subject to all applicable specification requirements being met.

331-4.2 Grading Requirements. In all cases, the job mix formula shall be within the design ranges specified in Table 331-1.

331-4.3 Mix Design.

331-4.3.1 General. Prior to the production of any asphaltic paving mixture, the Contractor shall submit a mix design to the State Materials Office at least two weeks before the scheduled start of production. A copy of the proposed mix design shall be sent to the appropriate District Bituminous Engineer at the same time. (Open-graded mixes will be designed by the Department.) The following information shall be furnished:

1. The specific project on which the mixture will be used.
2. The source and description of the materials to be used.
3. The gradation and approximate proportions of the raw materials as intended to be combined in the paving mixture.
4. A single percentage of the combined mineral aggregate passing each specified sieve.
5. A single percentage of asphalt by weight of total mix intended to be incorporated in the completed mixture.
6. A single temperature at which the mixture is intended to be discharged from the plant.
7. The laboratory density of the asphalt mixture. For all mixes except Open-Graded Friction Courses.
8. Evidence that the completed mixture will conform to all specified physical requirements.
9. The name of the individual responsible for the Quality Control of the mixture during production.

In lieu of the above, when reclaimed asphalt pavement is approved for use as a component material, the Contractor shall submit to the Materials Office at least two weeks before the scheduled start of production in writing a proposed mix design and samples of all material components. A copy of the proposed mix design shall, at the same time, be sent to the appropriate District Bituminous Engineer.

The following information shall be furnished with the proposed mix design for mixes containing reclaimed asphalt pavement:

1. The specific project on which the mixture will be used.
2. The source and description of the materials to be used.
3. The gradation and approximate proportions of the raw materials as intended to be combined in the paving mixture.
4. A single percentage of the combined mineral aggregate passing each specified sieve.
5. A single temperature at which the mixture is intended to be discharged from the plant.
6. The name of the individual responsible for the Quality Control of the mixture during production.

331-4.3.2 Revision of Mix Design. The approved mix design shall remain in effect

until a change is authorized by the District Bituminous Engineer and the State Materials Office. A new design will be required for any change in source of aggregate.

331-4.3.3 Resistance to Plastic Flow. The submitted mix design shall include test data showing that the material as produced will meet the requirements specified in Table 331-2 when tested in accordance with FM 1-T245. Further, the bulk specific gravity of the laboratory compacted bituminous mixture shall be determined in accordance with FM 1-T166.

The percent of unfilled voids and the percent of aggregate voids filled with asphalt shall be based on the maximum specific gravity of the bituminous mixture and on the asphalt content of each group of specimens prepared from the same sample. Maximum specific gravity of the bituminous mixture shall be determined by FM 1-T-209.

331-4.4 Contractor's Quality Control.

331-4.4.1 Personnel. In accordance with the requirements of 6-8.4 Quality Control by the Contractor, the Contractor shall provide the necessary quality control personnel. The Contractor's Quality Control Technician shall be certified by the Department and shall possess a valid certificate of qualification. When it becomes evident to the Department that the Quality Control Technician cannot perform as required by the position, the Department will revoke the certification and require replacement with a certified technician.

331-4.4.2 Extraction Gradation Analysis. The bituminous mixture will be sampled at the plant in accordance with FM 1-T168. The percent bitumen content of the mixture will be determined in accordance with FM 5-544. The percent passing the standard sieves will be determined in accordance with FM 5-545. All test results will be shown to the nearest 0.01. All calculations will be carried to the 0.001 and rounded to the nearest 0.01, in accordance with the Department's rules of rounding.

The Contractor will run a minimum of one extraction gradation analysis of the mixture for each day's or part of a day's production and immediately following any change in the production process. The quality control sample of mixture for the extraction gradation analysis will be taken each day as soon as the plant operations have stabilized and the results will be obtained in a timely manner so that adjustments can be made if necessary.

Extraction gradation analysis will not be required on the days when mix production is less than 100 tons. However, when mix production is less than 100 tons per day on successive days, the test will be run when the accumulative tonnage on such days exceeds 100 tons.

The target gradation and asphalt content shall be as shown on the mix design. Any changes in target will require a change in the mix design in accordance with 331-4.3.2.

If the percentage of bitumen deviates from the optimum asphalt content by more than 0.55 percent, or the percentage passing any sieve falls outside the limits shown in Table 331-3, the Contractor will make the necessary correction. If the results for two consecutive tests deviate from the optimum asphalt content by more than 0.55 percent, or exceeds the limits as shown in Table 331-3 for any sieve, the plant operation shall be stopped until the problem has been corrected.

The Contractor will maintain control charts showing the results of the extraction

gradation analysis (bitumen content and sieve analysis).

**Table 331-3
Tolerances for Quality Control Tests
(Extraction Gradation Analysis)**

Sieve Size	Percent Passing
1"	7.0
3/4"	7.0
1/2"	7.0
3/8"	7.0
No. 4	7.0
No. 10	5.5
No. 40*	4.5
No. 80*	3.0
No. 200	2.0

*Does not apply to SAHM, ABC-1 or Type II.

331-4.4.3 Plant Calibration. At or before the start of mix production, a set of hot bin samples for batch or continuous mix plants or belt cut for drum mix plants will be wash graded to verify calibration of the plant. When approved by the District Bituminous Engineer, extraction gradation analysis of the mix may be used to verify calibration of the plant. This extraction gradation analysis may also be used to fulfill the quality control requirements for the first days production.

331-4.4.4 Viscosity of Asphalt in Mixes Containing Reclaimed Asphalt Pavement. When reclaimed asphalt pavement is a component material, the viscosity of the asphalt material in the bituminous mixture, determined by the Materials Office in accordance with FM 1-T 202, shall be 6000 ± 2000 poises. This determination shall be made on samples obtained by the Department on a random basis at a frequency of approximately one per 2000 tons of mix.

If the viscosity is determined to be out of the specified tolerance, the Contractor shall adjust the recycling agent formulation or blend of reclaimed asphalt material used in the mixture to bring the viscosity within tolerance.

331-5 ACCEPTANCE OF THE MIXTURE.

331-5.1 General. The bituminous mixture will be accepted at the plant, with respect to gradation and asphalt content, on a LOT to LOT basis. The material will be tested for acceptance in accordance with the provisions of 6-8.2 and the following requirements. However, any load or loads of mixture which, in the opinion of the Engineer, are

unacceptable for reason of being excessively segregated, aggregates improperly coated, or of excessively high or low temperature shall be rejected for use in the work.

A standard size LOT at the asphalt plant shall consist of 4000 tons with four equal sublots of 1000 tons each.

A partial LOT may occur due to the following:

- (1) the completion of a given mix type on a project.
- (2) an approved LOT termination by the District Bituminous Engineer due to a change in process, extended delay in production, or change in mix design.

If the partial LOT contains one or two sublots with their appropriate test results, then the previous full-size LOT will be redefined to include this partial LOT and the evaluation of the LOT will be based on either five or six subplot determinations. If the partial LOT contains three sublots with their appropriate test results, this partial LOT will be redefined to be a whole LOT and the evaluation of it will be based on three subplot determinations.

When the total quantity of any mix is less than 3000 tons, the partial LOT will be evaluated for the appropriate number of sublots from n=1 to n=3. When the total quantity of any mix type is less than 500 tons, the Department will accept the mix on the basis of visual inspection. The Department may run extraction and gradation analysis for information purposes; however, the provisions for partial payment will not apply.

On multiple project contracts, the LOT(s) at the asphalt plant will carry over from project to project.

331-5.2 Acceptance Procedures. The Contractor shall control all operations in the handling, preparation, and mixing of the asphalt mix so that the percent bitumen and the percents passing the No. 4, 10, 40 and 200 sieves will meet the approved job mix formula within the tolerance shown in Table 331-5.

**Table 331-5
Tolerances for Acceptance Tests**

Characteristic	Tolerance *
Asphalt Content (Extraction)	±0.55%
Asphalt Content (Printout)	±0.15%
Passing No. 4 Sieve	±7.00%
Passing No. 10 Sieve	±5.50%
Passing No. 40 Sieve **	±4.50%
Passing No. 200 Sieve	±2.00%

*Tolerances for sample size of n=1. See Table 331-6 for other sample sizes n=2 through n=6.

**Applies only to Type S-I, S-II, S-III, FC-1 and FC-4.

Acceptance of the mixture shall be on the basis of test results on consecutive random

samples from each LOT. One random sample shall be taken from each subplot. The bituminous mixture will be sampled at the plant in accordance with FM 1-T 168. The percent bitumen content of the mixture will be determined in accordance with FM 5-544. The percents passing the No. 4, No. 10, No. 40 and No. 200 sieves will be determined in accordance with FM 5-545.

Calculations for the acceptance test results for bitumen content and gradation (percent passing No. 4, No. 10, No. 40 and No. 200) shall be shown to the nearest 0.01. Calculations for arithmetic averages shall be carried to the 0.001 and rounded to the nearest 0.01 in accordance with the Department's rules of rounding.

When the Contractor or Producer chooses to use a storage bin for mix storage overnight or longer, the material processed in this manner will be handled as follows: The samples of mix taken for acceptance tests on asphalt content must be taken before the mix is placed into the storage bin. Samples of mix for acceptance tests on gradation shall be taken after the mix has been removed from the storage bin.

Payment will be made on the basis of Table 331-6 Acceptance Schedule of Payment. The process will be considered out of control when any individual test result from a LOT exceeds the 90 percent pay factor limit for the values in the "one test" column of Table 331-6. When this happens, the LOT will be automatically terminated and the percent of payment will be determined from Table 331-6.

**Table 331-6
Acceptance Schedule of Payment
(Asphalt Plant Mix Characteristics)**

Average of Accumulated Deviations of the
Acceptance Tests from the Mix Design.

Pay Factor	1-Test	2-Tests	3-Tests	4-Tests	5-Tests	6-Tests
Asphalt Cement Content (Extraction)						
1.00	0.00-0.55	0.00-0.43	0.00-0.38	0.00-0.35	0.00-0.33	0.00-0.31
0.95	0.56-0.65	0.44-0.50	0.39-0.44	0.36-0.40	0.34-0.37	0.32-0.36
0.90	0.66-0.75	0.51-0.57	0.45-0.50	0.41-0.45	0.38-0.42	0.36-0.39
0.80*	over 0.75	over 0.57	over 0.50	over 0.45	over 0.42	over 0.39
Asphalt Cement Content (Printout)						
1.00	0.00-0.15	0.00-0.15	0.00-0.15	0.00-0.15	0.00-0.15	0.00-0.15
0.95	0.16-0.25	0.16-0.25	0.16-0.25	0.16-0.25	0.16-0.25	0.16-0.25
0.90	0.26-0.35	0.26-0.35	0.26-0.35	0.26-0.35	0.26-0.35	0.26-0.35
0.80*	over 0.35					

No. 4 Sieve **						
1.00	0.00-7.00	0.00-5.24	0.00-4.46	0.00-4.00	0.00-3.68	0.00-3.45
0.98	7.01-8.00	5.25-5.95	4.47-5.04	4.01-4.50	3.69-4.13	3.46-3.86
0.95	8.01-9.00	5.96-6.66	5.05-5.62	4.51-5.00	4.14-4.58	3.87-4.27
0.90	9.01-10.00	6.67-7.36	5.63-6.20	5.01-5.50	4.59-5.02	4.28-4.67
0.80*	over 10.00	over 7.36	over 6.20	over 5.50	over 5.02	over 4.67
No. 10 Sieve **						
1.00	0.00-5.50	0.00-4.33	0.00-3.81	0.00-3.50	0.00-3.29	0.00-3.13
0.98	5.51-6.50	4.34-5.04	3.82-4.39	3.51-4.00	3.30-3.74	3.14-3.54
0.95	6.51-7.50	5.05-5.74	4.40-4.96	4.01-4.50	3.75-4.18	3.55-3.95
0.90	7.51-8.50	5.75-6.45	4.97-5.54	4.51-5.00	4.19-4.63	3.96-4.36
0.80*	over 8.50	over 6.45	over 5.54	over 5.00	over 4.63	over 4.36
No. 40 Sieve **						
1.00	0.00-4.50	0.00-3.91	0.00-3.65	0.00-3.50	0.00-3.39	0.00-3.32
0.98	4.51-5.50	3.92-4.62	3.66-4.23	3.51-4.00	3.40-3.84	3.33-3.72
0.95	5.51-6.50	4.63-5.33	4.24-4.81	4.01-4.50	3.85-4.29	3.73-4.13
0.90	6.51-7.50	5.34-6.04	4.82-5.39	4.51-5.00	4.30-4.74	4.14-4.54
0.80*	over 7.50	over 6.04	over 5.39	over 5.00	over 4.74	over 4.54
No. 200 Sieve **						
1.00	0.00-2.00	0.00-1.71	0.00-1.58	0.00-1.50	0.00-1.45	0.00-1.41
0.95	2.01-2.40	1.72-1.99	1.59-1.81	1.51-1.70	1.46-1.63	1.42-1.57
0.90	2.41-2.80	2.00-2.27	1.82-2.04	1.71-1.90	1.64-1.80	1.58-1.73
0.80*	over 2.80	over 2.27	over 2.04	over 1.90	over 1.80	over 1.73

*If approved by the District Construction Engineer based on an engineering determination that the material is acceptable to remain in place, the Contractor may accept the indicated partial pay. Otherwise, the Department will require removal and replacement at no cost. The Contractor has the option to remove and replace at no cost to the Department at any time.

**When there are two or more reduced payments for these items in one LOT of material, only the greatest reduction in payment will be applied. CAUTION: This rule applies only to these four gradation test results.

Notes:

- (1) The No. 40 Sieve applies only to Type S-I, S-II, S-III, FC-1 and FC-4.
- (2) Deviations are absolute values with no plus or minus signs.

331-5.3 Automatic Batch Plant With Printout. Acceptance determinations for asphalt content for mixtures produced by automatic batch plants with printout will be based on the calculated bitumen content using the printout of the weights of asphalt actually used. Acceptance determinations for gradations (No. 4, No. 10, No. 40 and No. 200) will be based on the actual test results from extraction gradation analyses. Payment will be made based on

the provisions of Table 331-6.

331-5.4 Acceptance on the Roadway. The bituminous mixture will be accepted on the roadway with respect to compacted density and surface tolerance in accordance with the applicable requirements of 330-10 and 330-12.

331-5.5 Additional Tests. The Department reserves the right to run any test at any time for informational purposes and for determining the effectiveness of the Contractor's quality control. The Department will determine the Marshall properties, a minimum of one set per LOT, to determine whether or not the Contractor is meeting the specification requirements. Specimens will be prepared at the plant and transported to the District or Central Lab where they will be tested in accordance with FM 5-511 for Marshall stability and flow, FM 1-T 209 for maximum specific gravity, and FM 1-T 166 for density. When the average value of the specimens fails to meet specification requirements for stability or flow, or the air void content is below 3.0 percent (for structural mixes only), the Contractor's plant operations may be stopped until all specification requirements can be met or until another mix design has been approved (any revisions to a mix design shall be made in accordance with 331-4.3.2). When it is determined necessary to cease operations while the problem is being resolved, the approval of the District Bituminous Engineer will be required before resuming production of the mix. At this time the Marshall properties must be verified.

331-6 COMPENSATION.

331-6.1 Items for Which Payment Will Be Made. For the work specified under this Section (including the pertinent provisions of Sections 320 and 330), payment will be made for the area of the pavement, in square yards (after adjustment to the equivalent area of specified-thickness pavement), or, when so shown, the weight of the mixture, in tons.

331-6.2 Area of Pavement to be Paid for. When the pavement is to be paid for on an area basis, the area to be paid for shall be plan quantity subject to the provisions of 9-3.2, omitting any areas not allowed for payment under the provisions of 330-14.2 and adjusted as follows:

The volume of pavement represented by the difference between the average thickness, (determined as specified in 330-15); and the specified thickness, shall be converted into equivalent square yards of pavement of specified thickness, and the quantity thereby obtained shall be added to, or deducted from, the pay areas as appropriate. The maximum average thickness of pavement upon which payment will be made shall be limited as follows:

- (1) For pavement of a specified thickness less than 2½ inches: the specified thickness plus ¼ inch.
- (2) For pavement of 2½ inches up to 5 inches in specified thickness: the specified thickness plus ⅜ inch.
- (3) For pavement of 5 inches or, more in specified thickness: the specified thickness plus ½ inch.

331-6.3 Payment by Weight of Mixture. Where the pavement is to be paid for by weight, the weight shall be determined as provided in 320-2 (including the provisions for the automatic recordation system).

331-6.4 Bituminous Material. The bid price for the asphalt mix, whether by the square yard or by the ton, will include the cost of the liquid asphalt or the asphalt recycling agent. There will be no separate payment for the bituminous material in the asphalt mix. The bid price per square yard or per ton for asphalt mix shall be based on the following asphalt contents (by weight of total mix) in the mix designs:

Mix Type	Asphalt Content (%)
Type S-I, S-II, S-III and ABC-3.....	6.0
FC-2.....	6.3*
Type II, III, SAHM, ABC-1, ABC-2, FC-1 and FC-4.....	6.5

*12.5% for FC-2 with lightweight aggregate.

If the asphalt content in the mix design, as issued by the Materials Office increases or decreases from the foregoing percentages, the bid prices of the mix by the square yard or by the ton will be adjusted, based on the Asphalt Price Index (API) of the bituminous material plus ten percent of the index price.

$$Adjustment (\$/ton) = \frac{(AC_{Design} - AC_{Table})2000lb}{8.58lb/gal} (API)1.10$$

$$Adjustment (\$/sy) = t \frac{(AC_{Design} - AC_{Table})100lb/sy-in}{8.58lb/gal} (API)1.10$$

where

- AC_{Table} = Asphalt Content (%) from above table,
- AC_{Design} = Asphalt Content (%) in the mix design, as issued by the Materials Office,
- t = Design Thickness (inches).
- API = Asphalt Price Index, based on the month bid.

As an example where the asphalt content for a Type S-I mix design is determined to be 6.5 percent, the adjustment shall be calculated:

$$\$ \text{ Per ton} = (.005 \times 2000 \text{ lb.} / 8.58 \text{ lb/gal}) \times API \times 1.10$$

$$\$ \text{ Per square yard} = t \times (.005 \times 100 \text{ lb/sy-in} / 8.58 \text{ lb/gal}) \times API \times 1.10$$

where AC_{Design}-AC_{Table}=.065-.060=.005,

and other variables are defined above.

331-6.5 Work Included in Payment Items. The contract unit price per ton or per square yard, as applicable, shall be full compensation for all the work specified under this Section (including the applicable requirements of Sections 320 and 330).

Payment shall be made under:

Item No. 331-2 - Type S Asphaltic Concrete
- per ton.

Item No. 331-72 - Type S Asphaltic Concrete
- per square yard.

RUBBER MODIFIED ASPHALT BINDER.

PAGE 265. The following new Section is inserted after Section 335:

SECTION 336 **RUBBER MODIFIED ASPHALT BINDER**

336-1 DESCRIPTION.

This specification governs the production of rubber modified asphalt binder for use in Asphaltic Concrete Friction Courses and Rubber Modified Asphalt Membrane Interlayers.

336-2 MATERIALS.

336-2.1 Asphalt Cement. The particular grade of asphalt cement as specified in Table 336-1 for the respective uses shall meet the requirements of Section 916.

336-2.2 Ground Tire Rubber. The type of ground tire rubber shall meet the requirements of Section 919.

336-3 RUBBER MODIFIED ASPHALT BINDER.

The asphalt cement and ground tire rubber shall be thoroughly mixed and reacted in accordance with the requirements of Table 336-1. The rubber type shall be in accordance with the approved design mix. The blending unit may be a batch type or continuous type and shall provide for sampling of the blended and reacted rubber modified asphalt binder material during normal production. Blending of the asphalt cement and ground tire rubber may be accomplished either at the asphalt supplier's terminal or at the project site.

336-4 EQUIPMENT.

The meter for the rubber modified asphalt binder will be certified to meet the requirements for accuracy, condition, etc., of the Bureau of Weights and Measures of the

Florida Department of Agriculture and such fact shall be recertified every six months either by the Bureau of Weights and Measures or by a registered scale technician.

336-5 TESTING AND CERTIFICATION REQUIREMENTS.

336-5.1 Blending at Project Site. The ground tire rubber content in the rubber modified asphalt binder will be monitored by the Department on a daily basis based on the following: (1) the weight of the ground tire rubber used, and the gallons of rubber modified asphalt binder used (The weight per gallon for the various types of rubber modified asphalt binder shown in Table 336-1 are to be used for these calculations.) or (2) the weight of the ground tire rubber used and the number of gallons of asphalt cement used. The quantity of rubber modified asphalt binder used shall be determined by a certified meter meeting the requirements of 336-4 or from the printout of the weights of the binder for an automatic batch plant.

336-5.2 Blending at Asphalt Supplier's Terminal. Where the rubber modified asphalt binder is blended at the asphalt supplier's terminal, each load delivered to the project site shall be certified that the rubber modified asphalt binder has been produced in accordance with and meets the requirements of 336-3. In addition, the certification shall include the certification requirements for the asphalt cement, and ground tire rubber, as specified in 916-1.2 and 919-6, respectively.

336-5.3 Testing of Rubber Modified Asphalt Binder. The rubber modified asphalt binder will be tested for the viscosity requirement of Table 336-1 by the Department at the following frequencies and situations:

- (1) One per batch (for batch blending) or one per day (for continuous blending) during blending at the project site.
- (2) Each load delivered to the project site when blended at the asphalt supplier's terminal.
- (3) Beginning of each day from the storage tank when the asphalt-rubber binder is stored at the project site.

If the rubber modified asphalt binder does not meet the minimum viscosity requirement it will be rejected for use.

**Table 336-1
Rubber Modified Asphalt Binder**

Uses Modified	Dense-graded Friction Course	Open-graded Friction Course	Rubber Asphalt Membrane Interlayer
Rubber Type	Type A	Type B (or A)*	Type C (or B or A)*
% Ground Tire Rubber (by wt. of asphalt cement)	5	12	20
AC Grade	AC-30	AC-30	AC-20
Min. Temperature, (°F)	300	300	335
Max. Temperature, (°F)	335	350	375
Min. Reaction Time,(Minutes)	10	15 (for Type B)	30 (for Type C)
Unit Weight ** (lbs / gal)	8.6	8.7	8.8
Min. Viscosity, *** (Poises)	3.0 @ 325°F	6.0 @ 325°F	15.0 @ 350°F

*Use of finer rubber could result in the reduction of the minimum reaction time.

** Conversions to standard 60°F are not necessary.

*** FM 5-548, Viscosity of Rubber Modified Asphalt by use of the Rotational Viscometer.

NOTE: The minimum reaction time may be adjusted if approved by the State Materials Office depending upon the temperature, size of the ground tire rubber and viscosity measurement determined from the rubber modified asphalt binder material prior to or during production. The rubber modified asphalt binder for use in membrane interlayers shall be applied within a period of six hours

unless some form of corrective action such as cooling and reheating is approved by the State Materials Office.

ASPHALTIC CONCRETE FRICTION COURSES.

SECTION 337 (Pages 265-271) is deleted and the following substituted:

SECTION 337 **ASPHALTIC CONCRETE FRICTION COURSES** **(ASPHALT RUBBER BINDER)**

337-1 DESCRIPTION.

This Section specifies the materials, composition, mix design and compensation for Asphaltic Concrete Friction Courses containing asphalt rubber binder. The requirements for plant and equipment for this pavement are specified in Section 320. General construction requirements for all asphaltic concrete pavements as specified in Section 330 are applicable to this Section subject to any exceptions contained herein.

The work will be accepted on a LOT by LOT basis in accordance with the applicable requirements of Sections 5, 6, and 9. The size of the LOT for the bituminous mix accepted at the plant will be as specified in 331-5 and for the material accepted on the roadway as stipulated in 330-10 and 330-12.

The mixes covered by this Section are designated as Friction Course 2 (FC-2), and Friction Course 3 (FC-3).

337-2 MATERIALS.

337-2.1 General: The materials used shall conform with the requirements specified in Division III as modified herein.

337-2.2 Asphalt Rubber Binder: The asphalt rubber binder material shall meet the requirements of Section 336. In addition, the asphalt rubber binder shall contain 0.5 percent heat stable anti-stripping additive from an approved source. This amount may be varied based on tests performed by the State Materials Office. When the amount is varied in excess of the 0.5 percent, the Contractor will be compensated at the invoice price for the additive. When the amount is varied less than 0.5 percent, the Department shall be reimbursed at the invoice price of the additive.

The heat stable anti-stripping additive shall be introduced and mixed into the asphalt cement at the asphalt terminal during loading or by the Contractor at the asphalt plant in a manner satisfactory to the Engineer. Addition of the additive at the asphalt terminal shall be certified by the supplier.

337-2.3 Coarse Aggregate: Except as modified herein, all coarse aggregate shall meet the requirements of Section 901.

337-2.4 Fine Aggregate: Fine aggregates shall meet all applicable requirements of Section 902.

337-3 GENERAL COMPOSITION OF MIXES.

337-3.1 General: The bituminous mix shall be composed of a combination of aggregate (coarse, fine, or a mixture thereof), mineral filler if required, and asphalt rubber binder. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mix will meet the grading and physical properties of the approved job mix formula.

337-3.2 Aggregate Components: The aggregate components of the various mixes set out in this Section shall be as follows:

FC-2 -The coarse aggregate component of FC-2 shall be either crushed granite, crushed slag, or lightweight aggregates (that have been approved for this use). Crushed limestone from the Oolitic formation will also be permitted if the coarse aggregate contains a minimum of twelve percent non-carbonate material as determined by FM 5-510 and approval of the source is granted by the State Materials Office prior to its use. In addition, use of aggregates other than those listed above may be permitted if approved by the State Materials Office.

FC-3 - The coarse aggregate components of the FC-3 mixture shall be either crushed gravel, crushed granite, crushed slag, or crushed limestone from the Oolitic formation as specified for use in FC-2. In addition, use of aggregates other than these listed above may be permitted if approved by the State Materials Office.

The fine aggregate components shall consist of crushed screenings or a combination of crushed screenings and local materials. The crushed screenings shall be composed of hard, durable particles resulting from the crushing or processing of coarse aggregate as specified above. In addition, screenings from other approved sources may be used provided that the total of these screenings along with silica sand or local materials does not exceed 40 percent. The gradation requirements of the screenings shall be as specified in 902-5.1.

Not more than 20 percent by weight of the total aggregate used shall be silica sand or local materials as defined in Section 902.

Continuing approval of all sources of material for use in FC-2 and FC-3 will be based on field performance.

337-3.3 Grading Requirements: The job mix formula, as established by the

Contractor and approved by the Department, shall be within the design range specified in Table 331-1 for all friction courses.

337-3.4 Stability for FC-3: The constituents for FC-3 shall be combined in such proportions as to produce a mix having Marshall properties within the limits shown in Table 331-2.

337-4 MIX DESIGN.

The mix design shall conform to the requirements of 331-4.3 of these specifications except that Item No. 7 in 331-4.3.1 shall not apply to FC-2. For FC-3, data shall be submitted showing that the mix design meets the requirements of Table 331-2 using conventional AC-30. The asphalt rubber will then be substituted at the optimum conventional binder content for production and shall be shown as the optimum binder content on the approved mix design.

337-5 CONTRACTOR'S QUALITY CONTROL.

The Contractor shall provide the necessary quality control of the friction course mix and construction in accordance with the applicable provisions of 6-8.4 and 331-4.4. After the mix design has been approved, the Contractor shall furnish the material to meet the approved mix design in accordance with the provisions of 331-4.4.2 and Table 331-3. Plant calibration shall comply with the provisions of 331-4.4.3 and Table 331-3.

337-6 ACCEPTANCE OF MIX.

337-6.1 Acceptance at the Plant: The bituminous mix shall be accepted at the plant with respect to gradation in accordance with the applicable requirements of 331-5. Acceptance determinations for asphalt rubber binder content for mixtures produced by automatic batch plants with printout will be based on the calculated binder content using the printouts of the weights of asphalt rubber binder actually used. In all other cases, acceptance determinations for asphalt rubber binder content will be based on calculated binder content using a reading from the certified meter meeting the requirements of 336-4 and the quantity of mix produced. Payment will be made based on the provisions of Table 331-6. In this table, the asphalt cement content (Printout) shall be used for asphalt rubber binder.

337-6.2 Acceptance on the Roadway: The bituminous mix will be accepted on the roadway with respect to density and surface tolerance in accordance with the applicable provisions of 330-10 and 330-12. There will be no density requirements for FC-2.

337-6.3 Additional Tests: The provisions of 331-5.5 shall apply to the friction courses - FC-2 and FC-3.

337-7 SPECIAL CONSTRUCTION REQUIREMENTS.

337-7.1 Temperature Requirements for FC-2:

337-7.1.1 Air Temperature at Laydown: The mixture shall be spread only when the air temperature (the temperature in the shade away from artificial heat) is at or above 60°F.

337-7.1.2 Temperature of the Mix: The asphalt rubber binder and aggregates shall be heated and combined in such a manner as to produce a mix having a temperature, when discharged from the pugmill, of 290°F. The tolerance from this established temperature shall be as specified in Table 330-1. All other requirements of 330-6.3 shall apply to FC-2.

337-7.2 Temperature Requirements for FC-3:

337-7.2.1 Air Temperature at Laydown: The mixture shall be spread only when the air temperature (the temperature in the shade away from artificial heat) is at or above 45°F.

337-7.2.2 Temperature of the Mix: The asphalt rubber binder and aggregates shall be heated and combined in such a manner as to produce a mix having a temperature, when discharged from the pugmill, of 310°F. The tolerance from this established temperature shall be as specified in Table 330-1. All other requirements of 330-6.3 shall apply to FC-3.

337-7.3 Compaction of FC-2: Only seal rolling will be required; this rolling will be accomplished using a tandem steel-wheel roller. The weight of the steel-wheel roller shall not exceed 135 pounds per linear inch (PLI) of drum width.

$$PLI = \frac{\text{Total Weight of Roller (pounds)}}{\text{Total Width of Drums (inches)}}$$

A small amount of liquid detergent may be added to the water in the roller to reduce adhesion to the drum. Rolling shall be accomplished with a single coverage and with a nominal amount of overlap. Where the lane being placed is adjacent to a previously laid mat, the longitudinal joint will not be pinched in a manner with the roller on the cold mat. The longitudinal joint will be pinched with the roller on the mat being rolled, overlapping onto the cold mat by no more than three inches.

In no case shall a roller be allowed on the mat after the seal rolling has been completed.

337-7.4 Thickness of Friction Courses: The thickness of the friction course shall be designated in the plans. This is the minimum desirable thickness for FC-3, and the maximum desirable thickness for FC-2. The minimum spread rate for FC-2 shall be 25 pounds per square yard when lightweight aggregates are used and 40 pounds per square yard when conventional aggregates are used.

337-7.4.1 Thickness Requirements-Tonnage Payment: For FC-2 mixes where payment is on a tonnage basis, the rate of application shown on the plans shall be considered approximate. The intent is to achieve the maximum thickness of the friction course shown in the plans. Particular care must be exercised to avoid exceeding the

established rate of application for FC-2 mixes.

337-7.4.2 Thickness Requirements - Square Yard Payment: The thickness shall be determined in accordance with 330-15.1 except that the average thickness will not be calculated. Cores will not be taken in areas where the friction course is being transitioned in thickness to tie into an existing surface. The maximum allowable deficiency from the thickness specified in the plans shall be $\frac{1}{4}$ inch. If any area is deficient in thickness by more than the allowable tolerance, the Contractor shall correct the deficiency by removing and replacing the friction course at the proper thickness. Thickness deficiencies may be corrected by overlaying if approved by the Engineer. The overlay shall extend 50 feet either side of the deficient area and shall extend across the full width of the roadway.

As an exception to the foregoing, if the Engineer determines that the friction course will satisfactorily perform its intended function without corrective work, the friction course may be left in place without compensation. The area for which no payment will be made shall be the product of the total distance between cores indicating thickness within tolerances and the width of the lane which was laid in the particular pass in which the deficient thickness occurred. Additional cores will be taken as necessary to define the limits of a deficiency. Open-graded friction courses will not be cored for thickness determinations.

337-7.5 Hot Storage of FC-2 Mixes: When surge or storage bins are used in the normal production of FC-2, as with the drum mixer plants, the maximum time the mix is allowed to remain in the surge or storage bin shall not exceed one hour.

337-7.6 Longitudinal Grade Controls for Open-Graded Friction Courses: On open-graded friction courses, the use of the longitudinal grade control (skid, ski, or traveling stringline) is prohibited. The use of the joint matcher is required.

337-8 METHOD OF MEASUREMENT.

337-8.1 Payment Based on Area: When the plans indicate that the friction course is to be paid for on an area basis, the area to be paid for shall be plan quantity subject to 9-3.2. The pay area shall include entire areas of transitions to tie into existing pavement but excluding areas for which no payment is to be made due to deficient thickness as defined in 337-7.3. No adjustment to the area to be paid for will be made for extra thickness.

337-8.2 Payment Based on Weight: When the plans indicate that the friction course is to be paid for by weight, the weight shall be determined as provided in 320-2 (including provisions for the automatic recordation system).

For FC-2 mixes, in the event the actual rate of application exceeds the rate established by the DOT Lab (as provided in 337-7.3.1) by in excess of ten pounds per square yard, the weight to be paid for shall be reduced to a theoretical quantity computed as the product of the actual area covered by the friction course and the established rate of application plus ten pounds per square yard.

337-8.3 Bituminous Material: The provisions of 331-6.4 apply to bituminous materials used in friction course mixes.

337-9 Basis of Payment.

337-9.1 Asphalt Rubber Binder: The bid price for the friction course mix shall include the cost of the asphalt cement, ground tire rubber, anti-stripping agent and blending and handling of the asphalt rubber binder in the friction course mix. The bid price for the friction course shall be based on the following asphalt rubber binder contents:

<u>Mix Type</u>	<u>Asphalt Rubber Binder Content (%) by weight of total mix.</u>
FC-2	7.1 *
FC-3	6.5

*13.8 for FC-2 with lightweight aggregate.

If the asphalt rubber binder content in the approved mix design increases or decreases from the foregoing percentages, the bid price of the mix will be adjusted based on the invoice price of the asphalt rubber binder material plus ten percent of the invoice price. When the asphalt rubber binder is blended at the asphalt plant, the invoice price will be a combination of the invoice price for the asphalt cement, the ground tire rubber and the blending of the asphalt rubber binder.

$$Adjustment (\$/sy) = t \frac{(ARBC_{Design} - ARBC_{Table}) 100 lb/sy \cdot in}{8.6 lb/gal} (IP) 1.10$$

where

ARBC_{Table} = Asphalt Rubber Binder Content (%) from above table,

ARBC_{Design} = Asphalt Rubber Binder Content (%) in the mix design, as issued by the Materials Office,

t = Design Thickness (inches),

IP = Invoice Price.

As an example, when the asphalt rubber binder content for a FC-3 mix is determined to be 7.0 percent the adjustment shall be calculated as follows:

$$\begin{aligned} \$ \text{ Per square yard} &= t \times (.005 \times 100 \text{ lb/sy-in} / 8.6 \text{ lb/gal}) \\ &\times \text{ Invoice Price} \times 1.10 \end{aligned}$$

where ARBC_{Design} - ARBC_{Table} = .070 - .065 = .005,

and other variables are defined above.

*For FC-2 the lb/sy-inch will be based on the average spread rate for the project, and the

thickness will not be needed.

The contract unit price per square yard for Asphaltic Concrete Friction Course shall be full compensation for all the work specified under this Section.

Payment shall be made under:

Item No. 337-5 - Asphaltic Concrete Friction Course - per square yard.

ASPHALT RUBBER MEMBRANE INTERLAYER.

PAGE 272. The following new Section is inserted after Section 339:

SECTION 341 ASPHALT RUBBER MEMBRANE INTERLAYER

341-1 DESCRIPTION.

The work specified in this Section consists of the construction of an asphalt rubber membrane interlayer composed of a separate application of asphalt rubber binder covered with a single application of aggregate.

341-2 MATERIALS.

341-2.1 Asphalt Rubber Binder. The asphalt rubber binder shall conform to the requirements of Section 336.

341-2.2 Cover Material. The cover aggregate shall be Size No. 6 stone, slag or gravel meeting the requirements of Section 901.

341-3 EQUIPMENT.

341-3.1 Power Broom. The power broom for cleaning the existing pavement shall be capable of removing all loose material from the surface.

341-3.2 Spreading Equipment. The aggregate spreader shall be a self-propelled unit that can be adjusted to accurately apply the cover material at the specified rate and will spread the material uniformly.

341-3.3 Rollers. The rollers used shall be self-propelled, pneumatic-tired traffic type rollers equipped with at least seven smooth-tread, low-pressure tires and capable of carrying a gross load of at least eight tons. The inflation of the tires shall be 90 psi minimum and shall be maintained such that in no two tires shall the air pressure vary more than five psi. The traffic roller shall be loaded as directed by the Engineer.

341-3.4 Mixing Equipment. The mixing equipment for asphalt rubber binder shall be designed for that purpose and shall be capable of producing and maintaining a homogeneous mixture of rubber and asphalt cement at the specified temperature.

341-3.5 Pressure Distributor. The distributor used to apply asphalt rubber binder shall be a pressure type capable of maintaining a homogeneous mixture of rubber and asphalt cement at the specified temperature and consistently apply the material in a uniform manner.

341-4 PREPARATION OF ASPHALT RUBBER BINDER.

The materials shall be combined as rapidly as possible for such a time and at such a temperature that the consistency of the binder approaches that of a semi-fluid material. The time and temperature for blending of the asphalt rubber binder shall be as specified in Table 336-1. The Engineer shall be the sole judge of when the material has reached application consistency, and will determine if an extender oil or diluent is needed for that purpose. After reaching the proper consistency, application shall proceed immediately. In no case shall the mixture be held at temperatures over 350°F for more than six hours after reaching that point.

341-5 CONSTRUCTION PROCEDURE.

341-5.1 Preparation of Surface. Prior to application of the asphalt rubber binder, the existing pavement shall be cleaned as specified in 300-4.

341-5.2 Application of Asphalt Rubber Binder. The asphalt rubber binder shall be applied only under the following conditions:

- a) The air temperature is above 50°F and rising.
- b) The pavement is absolutely dry.
- c) The wind conditions are such that cooling of the asphalt rubber binder will not be so rapid as to prevent good bonding of the aggregate.

The asphalt rubber binder shall be uniformly applied, using a pressure distributor meeting the requirements of this specification, at the rate of 0.6 to 0.8 gallon per square yard as directed by the Engineer. The application rate is based on the unit weight as shown in Table 336-1. Conversions to standard 60°F are as specified in 300-8.7.

341-5.3 Application of Cover Material. Immediately after application of the asphalt rubber binder, cover material meeting the requirements set out herein shall be uniformly spread at a rate of between 0.26 and 0.33 cubic feet per square yard. The exact rate will be set by the Engineer.

The application of the asphalt rubber binder and the application of the cover material shall not be separated by more than 300 feet.

341-5.4 Rolling. In order to ensure maximum embedment of the aggregate, it is imperative that the entire width of the mat be covered immediately by traffic rollers meeting the requirements of this specification. For the first coverage, a minimum of three traffic rollers shall be provided in order to accomplish simultaneous rolling in echelon of the entire width of the spread.

Following the first coverage, coverage shall be made with additional traffic rollers as directed by the Engineer.

341-5.5 Traffic Control. The normal sequence of construction operations shall require the first course of asphalt concrete overlay to be placed over the membrane prior to opening

to traffic.

341-6 UNACCEPTABLE ASPHALT RUBBER MEMBRANE INTERLAYER.

If the asphalt rubber membrane interlayer is unacceptable due to incorrect blending, application rate, or not meeting the requirements of this Section, or damaged prior to placement of the asphaltic concrete layer, it shall be removed and replaced as directed by the Engineer. In no case shall excessive amounts of asphalt rubber binder be allowed.

341-7 METHOD OF MEASUREMENT.

The area of Asphalt Rubber Membrane Interlayer shall be determined as provided in 9-1.3.1. Separate measurement for payment will be made for the Bituminous Material (Asphalt Rubber Binder-Interlayer). The quantity of Bituminous Material (Asphalt Rubber Binder-Interlayer) will be determined as provided in 300-8.

341-8 BASIS OF PAYMENT.

341-8.1 Asphalt Rubber Membrane Interlayer.

The quantity of Asphalt Rubber Membrane Interlayer shall be paid for at the contract unit price for this item. Such price and payment shall constitute full compensation for all work specified in this Section including furnishing cover materials, handling, spreading, rolling, and other incidental work necessary to complete this item.

341-8.2 Bituminous Material (Asphalt Rubber Binder-Interlayer).

The quantity of bituminous material, determined as provided above, shall be paid for at the contract unit price per gallon for Bituminous Material. Such price and payment shall include all cost of furnishing asphalt cement, ground tire rubber, and blending and handling.

341-8.3 Payment Items.

Payment shall be made under:

Item No. 341-70 - Asphalt-Rubber Membrane Interlayer
- per square yard.

Item No. 300-1-19 - Bituminous Material (Asphalt Rubber
Binder-Interlayer) - per gallon.

PORTLAND CEMENT CONCRETE.

SECTION 345 is deleted and the following new Section is substituted:

SECTION 346
PORTLAND CEMENT CONCRETE

346-1 DESCRIPTION.

Concrete shall be composed of a mixture of portland cement, aggregate, water, and where specified, admixtures and pozzolan. It shall be delivered to the site of placement in a freshly mixed, unhardened state.

The production and quality control of concrete shall conform to the provisions of this section and the Florida Department of Transportation Standard Operating Procedures.

346-2 MATERIALS.

346-2.1 General.

The materials used in concrete must be certified from the source and shall conform to the requirements of Division III as follows:

- (a) Portland Cement..... Section 921
- (b) Fine Aggregate Section 902*
- (c) Coarse Aggregate..... Section 901
- (d) WaterSection 923
- (e) Admixtures..... Section 924
- (f) Fly Ash (Pozzolanic
Materials) Section 929

* Only Silica Sand will be permitted except as provided in 902-5.2.3

The materials used in concrete shall contain no hardened lumps, crusts, or frozen matter and shall not be contaminated with dissimilar material.

346-2.2 Types of Cement.

Unless a specific type of cement is designated elsewhere, cement used in all classes of concrete shall be Type I, Type IP, Type IS, Type IP(MS), Type II or Type III.

Types of cements to be used in structural concrete shall be as follows:

BRIDGE

SUPERSTRUCTURE

Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment
Precast Super-structure and Prestressed Elements	Type I, Type II, Type III, Type IP, Type IS, or Type IP (MS)	Type I, Type II, and Type III all with Fly Ash; Type IP, Type IS, or Type IP(MS)	Type II with Fly Ash or Type II with Slag
C.I.P. Super-structure Slabs and Barriers	Type I, Type II, Type IP, Type IS, or Type IP(MS)	Type I with Fly Ash, Type II, Type IP, Type IS, or Type IP(MS)	Type II with Fly Ash or Type II with Slag

BRIDGE SUBSTRUCTURE, DRAINAGE STRUCTURES AND OTHER STRUCTURES

Component	Slightly Aggressive Environment	Moderately Aggressive Environment	Extremely Aggressive Environment
C.I.P.	Type I, Type II, Type III, Type IP, Type IS, or Type IP (MS)	Type I Type II, Type IP, or Type IS, or Type IP(MS)	Type II with Fly Ash or Type II with Slag
Prestressed and Precast Units Drilled Shafts Seal Concrete	Type I, Type II, Type III, Type IS, Type IP, or Type IP (MS)	Type I with Fly Ash, Type II, Type IS, Type IP, or Type IP(MS)	Type II with Fly Ash or Type II with Slag

346-2.3 Use of Fly Ash, Slag and Other Pozzolanic Materials. Fly ash, slag, and other pozzolanic materials may be used as a cement replacement or as an admixture in all classes of concrete (when Type I, Type II or Type III cement is used) with the following limitations:

- (1) When fly ash or slag is used as a cement replacement, it shall be on a pound per pound basis.
- (2) The quantity of cementitious material replaced with fly ash in mass concrete must be greater than 18 percent and less than 50 percent by weight of the total cementitious content. The minimum cementitious content for each class of concrete is shown in the Master Proportion Table (Table 346-2) in 346-4.1.
- (3) For all other concrete uses not covered in (2) above, the quantity of cementitious material replaced with fly ash shall be greater than 18 percent and less than 22 percent by weight of the total cementitious content.
- (4) The pozzolan constituent of Type IP(MS) shall be in the range of 15 to 40 percent by weight of the portland-pozzolan cementitious material.
- (5) Use of pozzolanic materials other than Class F fly ash must be approved by the State Materials Engineer.
- (6) The quantity of cementitious material replaced with slag shall not be less than 50 percent nor greater than 70 percent of the total cementitious content.

346-2.4 Coarse Aggregate Gradation. All concrete shall be produced using Grade No. 57 or Grade No. 67 coarse aggregate except as follows:

(1) When approved by the State Materials Engineer, Grade No. 8 or Grade No. 89 may be used either alone or blended with Grade No. 57 or Grade No. 67 for concrete construction which is heavily reinforced or for barrier wall or curb construction where slip forms are used.

(2) When shown to be in the interest of the Department, other gradations of aggregates may be approved by the State Materials Engineer. Requests for approval of other gradations will be considered individually and will require submission of sufficient statistical data to establish production quality and uniformity of the subject aggregates and to establish the quality and uniformity of the resultant concrete. Aggregate gradations sized larger than nominal maximum size of 1 1/2-inch shall be furnished as two components.

(3) The maximum coarse aggregate size shall be selected so as not to violate the reinforcement spacing provisions given for reinforced concrete in the AASHTO Standard Specifications for Highway Bridges.

346-2.5 Admixture Requirements.

346-2.5.1 Chemical Admixtures. Concrete shall contain a water-reducing admixture (Type A) or water-reducing and retarding admixture (Type D). Dosage rate shall generally be in accordance with the manufacturer's recommended dosage rate and when necessary the dosage rate may be adjusted.

Other admixtures may be permitted when approved by the State Materials Engineer. Such approvals shall require submission of statistical evidence supporting successful laboratory and field trial mixes which demonstrate improved concrete quality or handling characteristics.

Chemical admixtures or additives containing Calcium Chloride (either in the raw materials or introduced during the manufacturing process) shall not be permitted in reinforced concrete.

346-2.5.2 Air Entrainment Admixtures. All concrete except counterweight concrete shall contain an air entraining admixture. Dosage rates shall be established by trial mixes and may be adjusted to meet field conditions.

346-2.5.3 High Range Water Reducer Admixtures. The Contractor may propose the use of an approved High Range Water Reducer (HRWR) admixture, either Type F or Type G. The proposal to use HRWR for precast items shall include a list of precast items for which it is proposed. The Contractor may also propose the use of HRWR for cast-in-place concrete, except for concrete used in drilled shafts. The proposal to use HRWR shall include a detailed listing of the areas, locations, elements, etc. for which its use is proposed and the anticipated benefits to be derived from the use of HRWR in each instance.

All testing for plastic concrete properties shall be performed after the HRWR has been added to the concrete mix.

Value Engineering credits or other price adjustments will not be considered for proposals to utilize HRWR in order to reduce the specified minimum cementitious requirements for the various classes of concrete.

The Contractor's proposal to use HRWR in concrete shall include the following:

A certification from the HRWR supplier that the HRWR admixture proposed meets

the requirements of ASTM C 494, Type F or G. The certificate shall state that the one year tests representing the admixture to be supplied have been performed by an independent laboratory approved by the Cement and Concrete Reference Laboratory and records of such tests will be furnished to the Department on request. The certification shall also include an additional statement from the HRWR supplier or an approved independent testing laboratory that the proposed HRWR admixture is compatible with all other admixtures to be included in the concrete design mix.

When a HRWR admixture is proposed for use in the design mix, the Contractor shall propose a target slump value. The target slump shall not exceed 7 inches. Other control requirements and ranges shall be as specified herein.

Confirming data shall include all details of the design mix ingredients, all required certificates from the supplier and independent testing laboratory, and a certificate from the Witnessing Department Engineer. The Witnessing Department Engineer is an individual designated by the District Materials Engineer. The certificate shall state that the Contractor has demonstrated through production and placement of the required number of batches that concrete containing HRWR has been produced meeting all test requirements, that the HRWR concrete has been satisfactorily mixed in accordance with the Contractor's proposed methods and sequences, and that the concrete was acceptably placed, consolidated and cured.

Before any design mix is approved by the Department, the Contractor shall demonstrate through production of at least three batches (three cubic yard minimum size each) of concrete containing the HRWR that his concrete plant can produce concrete consistently meeting specified slump, air content, and compressive strength requirements.

At the discretion of the District Materials Engineer, proposed HRWR mixes for concrete, centrally mixed at the placement site, may be approved without the production of demonstration batches provided that the requirements of 346-6.2 are met, and:

(1) A previously approved HRWR mix of the same class shall have demonstrated satisfactory performance under the proposed job placing conditions with a minimum of fifteen consecutive Department acceptance tests which met all plastic and hardened concrete test requirements.

(2) The cement and water reducing admixtures used in the proposed mix shall be the same materials from the same source used in the previously approved mix (item 1 above), and the other materials and mix proportions shall be approved as similar by the District Materials Engineer.

The District Materials Engineer shall submit supporting test data and District approvals to the State Materials Engineer with the request for mix approval.

Disposal, and the cost thereof, of concrete produced for demonstration purposes is the Contractor's obligation. Subject to approval of the Engineer, this concrete may be incorporated into unreinforced concrete items. The Contractor shall also demonstrate to the Witnessing Department Engineer that the concrete containing the HRWR admixture in accordance with his proposed design mixes can be placed, consolidated and finished under conditions existing for the proposed uses. The State Materials Engineer will approve

HRWR concrete design mixes for the Department.

The design mixes shall each include a description of methods, sequences, times, and places that the HRWR will be introduced into the concrete mix for each proposed use. Methods, sequences, times, and places for introduction of the HRWR shall be adjusted to suit the requirements for each proposed use and condition. Design mixes including a HRWR may be transferable based on demonstrated ability of the mix to perform its intended function.

Consideration of submitted design mixes for approval will begin when the State Materials Engineer has received certification from the Witnessing Department Engineer that the Contractor has demonstrated that he can produce concrete containing a HRWR admixture in conformance with his proposed design mixes meeting minimum strength requirements within specified ranges for slump and air, and that they can be placed, consolidated, and finished under conditions existing for the uses proposed. In addition, the certification shall include the test values of the slump, air, and 28-day strength tests for all demonstration batches of concrete, and an evaluation and description of the Contractor's actual sequences, methods, and time required for the placement and consolidation of each batch of concrete. The certification shall also include the Witnessing Department Engineer's evaluation of the appearance, apparent consolidation, and finish texture after form removal of each item cast.

Except for casting unreinforced concrete items as approved by the Engineer, no demonstration concrete containing a HRWR admixture shall be produced and placed for payment under contract pay items until design mixes containing the HRWR have been approved. To qualify for payment under contract pay items, unreinforced demonstration concrete cast with the approval of the Engineer shall meet minimum strength and entrained air requirements contained in these specifications, and the slump shall be within 1 1/2 inches of the target slump proposed by the Contractor.

346-2.6 Mixing Different Coarse Aggregates. Substitution of coarse aggregate of the same type from a different source in an approved concrete mix may be permitted at the discretion of the District Materials Engineer when the aggregate to be substituted is also from an approved source and has similar physical and chemical properties. If unsatisfactory results are obtained with the different source aggregate, the Contractor shall return to the aggregate from the originally approved aggregate source for his supply.

346-3 CLASSIFICATION, USE, STRENGTH, SLUMP AND AIR CONTENT.

346-3.1 General. The separate classifications of concrete covered by this specification are designated as Class I, Class II, Class III, Class IV and Class V in accordance with the intended use. Strength, slump, air content and the intended use of each class are specified in the following (Table 346-1):

TABLE 346-1

Class of (a) Concrete	Minimum(g) 28-day Strength (psi)	Target (f) Slump (inches)	Target Air Content (percent)
NON-STRUCTURAL CONCRETE			
I(Nonstructural)(b)	-	-	-
STRUCTURAL CONCRETE			
I(Pavement) (d)	3000	2	4
I(Special) (c)	3000	3	4
II(c)	3400	3 (e)	4
II(Bridge Deck)	4500	3	4
III	5000	3 (e)	4
III (Seal)	3000	8	4
III (Drilled *Shaft)	3400	8	4
IV	5500	3 (e)	4
IV (Drilled Shaft)	4000	8	4
V (Special)	6000	3 (e)	3
V	6500	3 (e)	3

(a) Generally the various classes of Concrete shall be used as follows except that the specific use may be designated in the plans and/or special provisions:

Class I(Pavement)(3000 psi) - Cement concrete pavement (Plain and reinforced) in all environmental classifications.

Class I(Special)(3000 psi) - Special applications shown in the plans or special provisions in all environmental classifications.

Class II(3400 psi) - Cast-in-place items including box culverts, headwalls, barrier walls, bridge concrete as shown in the plans etc. in slightly aggressive environments.

Class II (Bridge(3400 psi) - Bridge counterweight concrete

Counterweight)-Air content requirements shall not apply.

Class II(Bridge Deck)(4500 psi) - Bridge decks and floor slabs in slightly aggressive environments.

Class III(5000 psi) - Prestress members and other uses specified in the Contract.

Class III(Seal)(3000 psi) - Cofferdam seal concrete.

Class III (Drilled)(3400 psi) - Drilled shaft concrete in Shaft)slightly aggressive environments.

Class IV(5500 psi) - Prestressed concrete (except piling) and cast-in-place concrete in moderately and extremely aggressive environments.

Class IV(Drilled)(4000 psi) - Drilled shaft concrete in Shaft)moderately and extremely aggressive environments.

Class V (Special)(6000 psi) - For concrete structural elements requiring high strength in all environmental classifications and for all prestressed concrete piles.

Class V(6500 psi) - For concrete structural elements requiring higher strength in all environmental classifications.

(b) See Class I Nonstructural Concrete Specification Section 347.

(c) Concrete meeting the requirements of ASTM C 478 (4000 psi) may be used in lieu of Class I and Class II concrete in precast items manufactured in plants which are under the Department's Standard Operating Procedure for Precast Drainage products. The chloride content limits set in 346-4.2 shall apply to all precast or cast-in-place box culverts.

(d) Consistency of the concrete shall be such that the edges of the pavement surface will consistently meet the surface requirements set out in 350-15.2.

(e) Higher target slump may be allowed when a high range water reducer is used.

(f) Variations from the target slump may be indicated in the Plans or Special Provisions. The target slump may be reduced for slipformed or prestressed elements when approved.

(g) Specified Minimum Strength (psi).

346-3.2 Drilled Shaft Concrete. When drilled shaft concrete is called for in the contract documents and is to be placed in any wet shaft, the Contractor shall provide concrete in accordance with the following specified slump loss requirements as well as all other requirements of this specification. Concrete placed in a dry excavation is exempt from test for slump loss.

Drilled shaft concrete shall have a slump between seven and nine inches when placed and

shall maintain a slump of four inches or more throughout the drilled shaft concrete placement time. The slump loss shall be gradual as evidenced by slump loss tests described below. The concrete placement time shall be defined as the elapsed time between beginning of placement to completion of placement which shall include the removal of any temporary casings which require the concrete to flow into space previously occupied by the temporary casing.

Slump Loss Tests: The Contractor shall provide slump loss tests before drilled shaft operations begin, demonstrating that the drilled shaft concrete will maintain a slump of at least four inches throughout the concrete placement operations. The Contractor shall inform the District Materials Engineer at least 48 hours prior to performing such tests in order to allow arrangements to be made for a Department representative to witness the mixing and testing required. Slump loss testing of the drilled shaft mix shall be performed by a laboratory acceptable to the State Materials Engineer. The laboratory shall also be inspected by Cement and Concrete Reference Laboratory (CCRL) on a regular basis with all deficiencies corrected and under the supervision of a Professional Engineer registered in the State of Florida, or meet all the requirements of ASTM C 1077.

The following procedures for slump loss tests shall be followed:

- (1) Duplicate tests shall be provided.
- (2) The mix for the slump loss tests shall be prepared at a temperature consistent with the highest ambient and concrete temperatures expected during actual concrete placement. The test temperature shall be formally approved by the District Materials Engineer.
- (3) The mix shall be at least three cubic yards and shall be mixed in a mixer truck.
- (4) After initial mixing, the slump, concrete temperature, ambient temperature, and air percent shall be determined. The properties of the concrete shall be within the specification allowable limits.
- (5) The concrete shall be mixed intermittently for 30 seconds every five minutes at the agitation speed of the mixer.
- (6) Slump, concrete temperature, ambient temperature and air percent shall be determined at 30 minute intervals until the slump is two inches or less. The trial mix shall be remixed for one minute at the agitation speed of the mixer before these tests are run.
- (7) All elapsed times shall begin when water is initially introduced into the mix.
- (8) The concrete shall maintain a slump of at least four inches for the estimated mixing and transit time plus anticipated placement time. Necessary adjustments shall be made to meet this requirement.

346-3.3 Mass Concrete. When mass concrete is designated in the contract documents, the Contractor shall provide an analysis of the anticipated thermal developments in the mass concrete elements for all expected project temperature ranges using his proposed mix design, casting procedures, and materials. Additionally, the Contractor shall describe the measures and procedures he intends to use to maintain a temperature differential of 35 F Degrees or less between the interior and exterior portions of the designated mass concrete elements during curing. The mass concrete mix design and the proposed plan to monitor and control the temperature differential shall be submitted concurrently to the State

Materials Engineer for approval. A copy of the temperature monitoring and control plan shall also be submitted to the Engineer. The Contractor shall provide temperature monitoring devices approved by the Engineer to record temperature development between the interior and exterior portions of the elements at points approved by the Engineer. The monitoring devices shall be read by the Contractor and readings recorded at not greater than six-hour intervals, as approved by the Engineer, beginning when casting is complete and continuing until the maximum temperature differential is reached and begins dropping. If monitoring indicates the 35 F Degrees differential has been exceeded, the Contractor shall take immediate action to retard further growth in the temperature differential and shall make the necessary revisions to the approved plan to maintain the 35 F Degrees or less differential on any remaining placements. Revisions to the approved plan must be approved by the District Materials Engineer prior to implementation.

346-3.4 Special Purpose Concrete for Repair Work. Where special requirements are contained in the Special Provisions, the requirements of this Specification may be waived or altered in part to allow the use of alternate admixtures and production procedures.

346-4 COMPOSITION OF CONCRETE.

346-4.1 Master Proportion Table. The proportions of materials used to produce the various classes of concrete shall be in accordance with the following (Table 346-2):

TABLE 346-2

Class of Concrete	Minimum Cementitious Content lbs./c.y.	*Maximum Water Cementitious Ratio lbs./lb.	
I (Pavement & Special)	508	0.50	
II	564	0.49	
II (Counterweight)	564	0.49	
II (Bridge Deck)	611	0.44	
III		611	0.44
III (Seal)	611	0.52	
III (Drilled Shaft)	611	0.50	
IV	658	0.41	
IV (Drilled Shaft)	658	0.48	
V	752	0.37	
V (Special)	752	0.37	

*Water cementitious ratios represent maximum values at which mix designs will be

approved. Water cement ratio (W/C) will be calculated based on the total cementitious material including fly ash or slag.

346-4.2 Chloride Content Limits for Concrete Construction:

346-4.2.1 General: The maximum chloride content limits for the following concrete applications shall be as follows:

<u>Application</u>	<u>Maximum Chloride Content lb/yd³</u>
Non Reinforced	N/A
Reinforced	0.70
All applications that require Type II cement plus pozzolans.	0.40
Prestress	0.40

The chloride content shall be determined as the average of three tests on samples taken from the concrete. The range of results of the three tests shall not exceed 0.08 pound of chloride per cubic yard of concrete for a valid determination of chloride content. When test results are outside of the 0.08 pound of chloride per cubic yard allowable range, an additional three tests shall be run until the test results are within the allowable range. Samples may be obtained from representative concrete cylinders or cores tested for compressive strength. If the cylinders or cores have been exposed to salt or aggressive environment, the outer one-inch surface of the sample shall be discarded.

346-4.2.2 Sampling and Testing: Chloride content shall be determined in accordance with Florida Test Method FM 5-516.

(1) The frequency of chloride content determinations for all concrete requiring Type II cement with pozzolan(s) and prestress concrete shall be in accordance with these specifications, and the approved procedures shall be as follows:

(a) When the chloride content is 0.25 pound of chloride per cubic yard or less, subsequent tests shall be made on a frequency of not less than one for every four weeks of production as long as the test results remain at or below 0.25 pound of chloride per cubic yard. When eight consecutive tests are below 0.25 pound of chloride per cubic yard, the frequency of testing may be reduced at the discretion of the State Materials Engineer.

(b) When the chloride content is in the range from 0.25 to 0.33 pound of chloride per cubic yard, subsequent tests shall be made at the frequency of not less than one for every two weeks of production as long as the values remain at or below 0.33 pound of chloride per cubic yard.

(c) When chloride content is greater than 0.33 pound per cubic yard, subsequent

chloride content tests shall be made for each day's production.

(2) For all reinforced concrete other than concrete requiring Type II cement with pozzolan(s) and prestress concrete, the frequency of chloride content determinations shall be not less than one test every four weeks. When eight consecutive chloride content determinations are below 0.40 pound of chloride per cubic yard of concrete, the frequency of testing may be decreased at the discretion of the State Materials Engineer.

For any case listed above, when the source of any component material, including admixtures, for the concrete is changed, a chloride content determination shall be made immediately.

Test results obtained at the frequency provided above shall represent the amount of chloride per cubic yard in all concrete placed subsequent to the immediate preceding test for the determination of chloride content.

346-4.2.3 Certification. Chloride content determinations shall be made and the test results of chloride determinations shall be certified to the Department. The certification must show all pertinent data as required by the Department. Properly executed certifications showing the chloride content within the required limits will be required for acceptance for all concrete controlled under these specifications. The Department will monitor the chloride content through comparison samples obtained by the District Independent Assurance personnel at a minimum frequency of one sample for each plant per independent laboratory each twelve months. The producer shall assist Department personnel in obtaining the samples.

346-4.2.4 Control Level for Corrective Action. If the test results indicate that the chloride level is within 0.05 pound per cubic yard of the applicable maximum, concrete production shall be suspended until corrective measures are implemented. When tests indicate that the applicable maximum has been exceeded, the concrete exceeding the maximum will be rejected.

346-5 SAMPLING AND TESTING METHODS.

Sampling and testing of the concrete shall be performed in accordance with the following standard methods:

(a) Slump	FM 1-T 119
(b) Air Content ***	
Pressure Type meter	FM 1-T 152
Volumetric Type meter	FM 1-T 196
Chace *	FM 1-T 199
(c) Making and Curing Test	
Cylinders**	FM 1-T 023
(d) Testing Cylinders	FM 1-T 022
(e) Taking and Testing Drilled	
Core Samples	FM 1-T 024
(f) Early sampling of	

fresh concrete from revolving drum truck mixers or agitators	FM 5-501
(g) Low Levels of Chloride in Concrete and Raw Materials	FM 5-516
(h) Yield Test	FM 1-T 121
(i) Temperature	ASTM 1064
(j) Sampling Fresh Cement Concrete	FM 1-T 141

* The Chace Air Indicator method shall be used for estimates only, and not for acceptance measurements.

** A strength test to determine when a precast member or a structure may be put into service, when a prestress force may be transferred, or when forms may be removed shall be the average of the compressive strengths of two test cylinders cast from concrete sampled from the LOT representing that member or structure. The cylinders shall be cured by methods identical to those used in curing the concrete member or structure.

*** The Contractor shall supply the same type of meter for his Quality Control tests as is used by the Department for Quality Assurance testing. Where pressure type meters are selected, an aggregate correction factor shall be determined for each mix design to be tested. The aggregate correction factor shall be determined by the concrete producer. Test results for correction factors for each type of aggregate shall be recorded and certified at the plant.

346-6 CONTROL OF QUALITY.

346-6.1 General. All concrete produced for incorporation into the work shall be produced by a concrete plant approved by the Department for such production. If plant approval is withdrawn by the Department during production for a construction project, it is the Contractor's sole responsibility to (a) obtain another approved concrete plant to produce the concrete, or (b) await re-approval of the concrete plant. Such actions shall occur prior to any further production and placement of concrete on the construction project. No changes in contract time or completion dates will be allowed. Delay costs or other costs associated with plant approval or disapproval shall be borne by the Contractor.

In addition to plant approval, two levels of concrete quality control shall be exercised by the Contractor and/or his concrete supplier.

The first level of quality control shall be exercised in accordance with the approved Level I Quality Control Plan requirements in the Standard Operating Procedures. The Level I Quality Control Plan shall include all control activities for the production of concrete and its transport to the point of delivery at the site.

The second level of concrete quality control shall be exercised in accordance with the

approved Level II Quality Control Plan requirements in the Standard Operating Procedures. The Level II Quality Control Plan shall consist of that necessary to control the quality of the concrete between the point of delivery at the site and the final placement location and other requirements contained in the Standard Operating Procedures.

All concrete shall be produced in accordance with an approved Quality Control Plan (including Level I and Level II) which has been developed and implemented by the Contractor and/or his concrete supplier in accordance with the Department's Standard Operating Procedures. In general, these procedures require, in addition to a written Quality Control Plan, certified personnel and assurances that materials, plant, production, delivery, and use of concrete comply with this specification.

All concrete produced in accordance with this specification shall be cured and tested in accordance with the procedures specified in the appropriate Sections of the Specifications covering the applications for which the concrete is required.

346-6.2 Concrete Design Mix. The Contractor shall furnish concrete in accordance with the following requirements or he shall order the concrete from a plant approved by the Department which has appropriate approved mix designs.

Prior to production of any concrete, a proposed mix design shall be submitted to the District Materials Engineer for the District in which the plant is located with a copy to the Office of Materials. A separate submittal shall be made for each class of concrete and each particular combination of component materials to be used at trial mix temperatures of 70-85 degrees F and for hot weather mixes as described in 346-6.2(5) at a minimum temperature of 94 degrees F. Only design mixes approved by the State Materials Office shall be used. The approved concrete mix design will remain in effect until a change is authorized in writing by the State Materials Engineer.

The mix design submittal shall include:

(1) The FDOT approved source identification number for coarse and fine aggregates, along with the grade of coarse aggregate and target Fineness Modulus for fine aggregate. Other component materials shall be identified by manufacturer, brand name, and type.

(2) The actual proportions of raw materials intended to be combined to produce the concrete.

(3) Mix Data:

(a) Historical data from a minimum of 15 consecutive Department acceptance tests of production concrete made in accordance with the proposed mix design that demonstrates that the proposed mix has met all applicable plastic and hardened concrete specification criteria herein without failure. For drilled shaft concrete to be placed in a wet shaft, acceptable slump loss test results must also be provided. Hot weather mixes will not be approved based on historical data. When required, the plant standard deviation and overdesign requirements will be established as described below.

(b) Alternatively, test data from a single trial mix shall demonstrate that concrete produced using the proposed mix, designated ingredients, and designated water-cement ratio will have the properties of slump (target $\pm 1/2$ " or for mixes utilizing HRWR target ± 1 "), air content (target $\pm 1\%$), and strength required to meet an overdesign which shall

be the minimum required strength plus 1.6 standard deviations.

(4) The chloride content of the proposed design mix shall be determined and submitted to the Department with the mix design submittal. Mix designs will not be approved when the chloride content of the trial mix exceeds the limits shown in 346-4.2.1.

(5) Design mixes developed for use under hot weather concreting conditions shall meet the following additional special conditions:

(a) The trial mix prepared at a minimum temperature of 94 degrees F shall be held in the mixer for 90 minutes after completion of initial mixing. Extended mixing is not required for precast/prestressed concrete when centrally mixed at the placement site.

On completion of the extended mixing period, the trial mix concrete shall have a slump within $\pm 3/4$ inch of the target value (± 1 inch for mixes utilizing HRWR), and an air content within $\pm 1.0\%$ of the target value listed in Table 346-1.

The mix temperature at the end of the extended mixing period shall not be less than 94 degrees F.

During the extended mixing period, the drum shall be turned intermittently for 30 seconds every five minutes. The drum shall be covered with wet burlap or an impermeable cover material during the rest periods.

At the end of the 90-minute period the trial mix shall be remixed for a minimum of one minute and a slump test made to verify that the concrete is within the specified range for slump. If below the target range, the slump may be adjusted by a water addition. After the water addition, the concrete shall be remixed for a minimum of two minutes.

The total water used in initial mixing and the final slump adjustment, if applicable, constitutes the design mix water content. It shall not exceed the maximum water cement ratio of Table 346-2 for the respective class of concrete.

(b) The heat of hydration of the cement shall not exceed 80 cal/g at seven days measured as the average of three samples, and no individual measurement shall exceed 90 cal/g.

Where fly ash is 18 to 22 percent of the total cementitious material, the heat of hydration of the cement shall not exceed 88 cal/g at seven days measured as the average of three samples, and no individual measurement shall exceed 96 cal/g.

These requirements do not apply to Type III cement, as allowed in 346-2.2, when used for precast and prestressed superstructures, nor do they apply to cements used for steam cured concrete, unless specified in the Special Provisions.

(c) The Contractor shall supplement standard curing practices with additional methods, supplies, and/or equipment which will further reduce moisture loss from exposed surfaces during the required 72-hour curing period. These methods may include but are not limited to the following examples:

- (1) Continuous or intermittent regular water fogging.
- (2) Insulated curing blankets approved by the Engineer.
- (3) Curing compound applied at a rate of 1 1/4 times the minimum rate required in 400-16.1.2.

(6) Proposed mixes for use in wet drilled shafts must demonstrate the additional requirements given in 346-3.2.

Strength test data for establishing the standard deviation of the plant proposed for use shall represent concrete produced to meet a specified strength(s) within 1000 psi of that specified for the mix submitted for approval. The strength test data shall represent either a group of at least 30 consecutive tests or a statistical average for two groups totaling 30 or more tests. When the District Materials Engineer cannot determine the plant standard deviation from historical data, the overdesign requirement, based on a singular trial mix, shall be the minimum required strength plus 1200 psi for minimum required concrete strengths of 5000 psi or less. For minimum required concrete strengths above 5000 psi, an overdesign of 1400 psi shall be required.

The production and testing of the trial mix concrete shall be demonstrated in the presence of the District Materials Engineer or his designated representative. If desired by the producer, and in addition to the above requirements, a proposed mix design may also be demonstrated at a water-cement ratio exceeding that proposed to meet the slump, air, and strength requirements above (but not to exceed the maximum water-cement ratio given in Table 346-1). The highest water-cement ratio so demonstrated to provide the required overdesign strength requirements will be allowed as an adjustment during production to maintain both plastic and strength requirements of delivered concrete.

Preparation and testing of the trial mixes shall be performed by a laboratory acceptable to the State Materials Engineer and (1) a laboratory inspected by the Cement and Concrete Reference Laboratory (CCRL) on a regular basis, with all deficiencies corrected, and under the supervision of a Professional Engineer registered in the State of Florida, or (2) a laboratory meeting all the requirements of ASTM C 1077. The 28-day strength (or strength at any other designated age) of trial mixes shall meet the requirements of the above stated overdesign to assure that substantially all produced concrete sampled and tested at the point of placement will have a strength exceeding the minimum strength specified in Table 346-1.

346-6.3 Delivery Certification. A certification shall be furnished to the Department with each batch of concrete before unloading at the site, a delivery ticket on which is printed, stamped, or written the information required in the Standard Operating Procedure, Attachment E.

346-6.4 Tolerance - The Properties of Production Concrete. The properties of the plastic concrete as specified in 346-3.1 shall be subject to the following tolerances from target values:

<u>Property</u>	<u>Tolerance</u>
Slump (Non-Drilled Shaft Concrete)	± 1 1/2"
Slump (Drilled Shaft Concrete)	± 1"
Air Content	± 1.6%

Concrete with slump or air content values exceeding the above tolerances will be rejected. Concrete will not be permitted to remain in a transporting vehicle to reduce slump. Concrete delivered to the site which is within the target range for slump (target value $\pm 3/4$ inch) shall not have any water added.

If the slump varies from the target value in excess of $3/4$ inch (1 inch for concrete containing HRWR) or the air content varies from the target value in excess of 1.3 percent, immediate adjustments to the concrete mixture shall be made to correct these properties for succeeding batches. For concrete used in slipforms, adjustments shall be made when the slump exceeds the target value by $3/4$ inch or is 1 $1/2$ inches below the target value, or when the air content varies from the target value in excess of 1.3 percent. A reasonable time will be allowed for adjustment, considering trucks already in route from the concrete plant. Failure to implement adjustments at the earliest possible time will be cause for rejection of the concrete and termination of further production until corrections are made.

346-7 CONCRETE PLANT REQUIREMENTS.

346-7.1 General. Concrete shall be produced at plants that qualify as approved sources in accordance with the Standard Operating Procedures for concrete quality control.

Equipment used for handling elements, mixing concrete, handling the mixed concrete, transporting, and depositing the mixed concrete shall have no detrimental effect on the hardened concrete. Equipment surfaces which are in physical contact with the elements of concrete or mixed product shall not be made of aluminum.

346-7.2 Measuring Materials.

346-7.2.1 Water. Water may be measured by volume or weight. Whichever method is used, the equipment shall be constructed so that the accuracy of measurement will not be affected by variations in pressure in the water supply line. The meter or weighing device shall be capable of being set to deliver the required quantity and to automatically cut off the flow when the required quantity has been discharged. The measuring equipment shall have an accuracy, under all operating conditions, within one percent of the quantity of water required for the batch. The accuracy of measuring devices shall be verified at the request of the Department or at least quarterly.

Design mix water-cement ratios may be exceeded at the job site only if each mix has been verified to meet the minimum required overdesign compressive strength requirements specified herein at the higher water-cement ratio. Adjustment to mix consistency, within the allowable limit for the addition of water, is the Contractor's responsibility at the job site, and shall be made upon initial arrival and not thereafter.

346-7.2.2 Admixtures. Admixtures shall be measured by weight or volume. The measuring equipment shall have an accuracy, under all operating conditions, within three percent of the quantity of admixture required for the batch. The accuracy of measuring devices shall be certified by the admixture supplier. Each admixture shall be measured separately and added to the mixing water in a separate sequence as the mixing water is introduced into the mix.

Exceptions to the above method of admixture addition may be made by the District

Materials Engineer provided accuracy of measurement is not sacrificed and the desired goals of each admixture are achieved.

346-7.2.3 Cement, Fly Ash and Slag. Cement, fly ash, and slag shall be measured by weight within an accuracy of one percent of the required total amount, except that for concrete batches of three cubic yards or less, a required accuracy of two percent will be permitted. Cement, fly ash, and slag shall be weighed separately from other materials. When cement, fly ash, and slag are weighed in a cumulative weigh hopper, the cement shall be weighed first.

If bag cement is permitted, the batch shall be so proportioned that only whole bags are used.

346-7.2.4 Fine and Coarse Aggregates. Aggregates shall be measured by weight or volume within an accuracy of one percent of the required amount. Proper aggregate surface moisture corrections shall be applied.

346-7.3 Batching Plants.

346-7.3.1 Bins. All bins shall be of adequate capacity for the concrete production required. They shall be supported upon a rigid framework founded upon a stable foundation capable of holding them in a safe and secure position. Each compartment shall be designed to discharge efficiently and freely into the weigh hopper. Positive means of control shall be provided so that as the quantity desired in the weigh hopper is approached, the material can be added slowly and shut off precisely. The discharging mechanism shall not permit loss of material when it is closed. Aggregate storage bins shall be constructed sufficiently tight to prevent leakage of material and they shall be divided into at least one compartment for the fine aggregate and one compartment for each size of coarse aggregate to be used. The compartment partitions shall be sufficiently tight and high enough to prevent the intermingling of the several materials. Cement bins shall be constructed leak-proof and moisture-proof, and shall be provided with vibrators or other means to aid the flow of cement from the bin.

346-7.3.2 Weigh Hoppers. Weigh hoppers shall consist of suitable containers freely suspended from scales and protected from the elements so that accuracy is not adversely affected. The hoppers shall be equipped with a discharge mechanism which prevents leakage or loss of material when closed. Hoppers shall be vented to permit air to escape and be equipped with vibrators or other equipment that ensures complete and efficient discharge of materials.

346-7.3.3 Scales. Scales shall be either beam type, or springless dial type, or electronic devices such as load cells, and the product of a recognized scale manufacturer. Where beam type scales are used, suitable means shall be provided to hold poises securely in position after they are set. Scales shall be kept clean and in good operating condition. Where necessary, the scale operator shall have an unobstructed view of all indicating devices and convenient access to all controls. The weigh beam, or dials, shall be graduated to permit reading to one tenth of one percent of the capacity of the scales.

Prior to beginning any work, all scales and other weighing devices used in batching shall be checked for accuracy by a qualified representative of a scale company registered with

the Bureau of Weights and Measures of the Florida Department of Agriculture.

Scales shall be rechecked once every three months or more often if deemed necessary. Scales shall be checked up to at least the maximum load normally handled on each respective scale.

Cement scales, fly ash scales, and coarse and fine aggregate scales shall be maintained to an accuracy of one half of one percent of the maximum load normally handled.

A certificate of inspection bearing the date of the certification and signed by the scale company representative shall be affixed to each weighing device. A copy of the scale company's report corresponding with the current certificate of inspection showing the date of inspection, signature of the scale company representative, the observed scale deviations for the loads checked, and a statement that the scale conforms to the requirements of Chapter 531 Florida Statutes pertaining to specifications, tolerances, and regulations, as administered by the Bureau of Weights and Measures of the Florida Department of Agriculture, shall be available at the plant.

346-7.4 Mixers.

346-7.4.1 General Requirements. All mixers shall be of an approved type and shall be capable of combining the components of the concrete into a thoroughly mixed and uniform mass, and shall be capable of discharging the concrete with a satisfactory degree of uniformity.

346-7.4.2 Design. Mixers may be truck mixers of the inclined axis revolving drum type, or concrete plant central mixers of the non-tilting, tilting, vertical shaft or horizontal shaft types.

A copy of the manufacturer's design, showing dimensions and arrangement of blades, shall be available at the batching plant at all times. The use of mixers that have been altered from such design in respect to blade design and arrangement, or to drum volume, may be permitted when recommended by the manufacturer and approved by the Department.

Metal rating plates shall be attached to each mixer specifying its mixing speed, agitating speed, rated capacity, and unit serial number.

346-7.4.3 Truck Mixers. The drum of truck mixers may be actuated by a power source independent of the truck engine or by a suitable power take-off. Either system used shall provide control of the rotation of the drum within the limits specified on the manufacturer's rating plate, regardless of the speed of the truck. Truck mixers of the revolving drum type shall be equipped with a hatch in the periphery of the drum shell which permits access to the inside of the drum for inspection, cleaning, and repair of the blades.

Truck mixers shall be equipped with revolution counters of approved type and mounting, by which the number of revolutions of the drum may be readily verified.

The water supply system mounted on truck mixers shall be equipped with a volumetric water gauge or approved water meter in operating condition.

346-7.4.4 Timers. Stationary type mixers shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum is charged and release it at the end of the mixing period. In the event of failure of the timing device, the Engineer may allow operations to continue as may be necessary to avoid critical or

uneconomical conditions. Such operations, however, shall not extend beyond the end of that working day.

346-7.4.5 Cleaning and Maintenance of Mixers. Mixer blades of revolving drum type mixers shall be repaired or replaced when the radial height at point of maximum drum diameter is less than 90 percent of the design radial height. Mixers of other designs shall be repaired or adjusted per instructions of the manufacturer. Questions of performance shall be resolved through mixer uniformity tests as described in ASTM C 94.

346-7.5 Trucks for Transporting Wet Batches. Wet batches of concrete may be transported in either agitating or nonagitating trucks. Bodies of nonagitating trucks shall be smooth, mortar tight containers with round internal corners, and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. Covers shall be provided for nonagitating trucks for protection from the elements.

346-8 MIXING AND DELIVERING CONCRETE.

346-8.1 General Requirements. Truck mixers shall be operated at mixing speeds of 6 to 18 rpm and agitating speeds of 2 to 6 rpm (of the drum). Concrete plant mixers shall be operated at speeds per the manufacturer's design or recommendation. The volume of material mixed per batch shall not exceed the manufacturer's rated mixing capacity.

346-8.2 Central Mixing. All concrete shall be mixed a minimum of two minutes or manufacturer's recommended minimum, whichever is longer, after all materials are in the mixer, unless a reduced mixing time is authorized by the Department.

346-8.3 Transit Mixing. Each batch shall initially be mixed between 70 and 100 revolutions of the drum at mixing speed. When water is added at the job site, the concrete shall be mixed 30 additional mixing revolutions. Mixing for the purpose of adjusting consistency shall not cause the total number of revolutions at mixing speed to exceed 160. All concrete shall be discharged from truck mixers before total drum revolutions exceed 300.

Mixer trucks shall not haul more than the rated capacity in cubic yards shown on their attached plates.

346-8.4 Mixing at the Site. Concrete mixing at the job site shall be by a mixer of sufficient capacity to prevent delays that may be detrimental to the quality of the work. The accuracy of batching equipment shall be in accordance with requirements of this Section.

346-8.5 Charging the Mixer. Each batch shall be charged into the drum so that some water will enter both in advance of and after the cementitious material and aggregates. If fly ash is used in the mix, it shall be charged into the drum over approximately the same interval as the cement. Other time intervals may be used for the introduction of fly ash into the mix when the Contractor demonstrates that uniformity of the concrete mix can be achieved using test requirements specified in ASTM C 94.

346-8.6 Mixing for Concreting in Cold Weather. No concrete shall be mixed when the air temperature is 45 degrees F and falling. Concrete may be mixed and placed when air temperature in the shade, and away from artificial heat, is 40 degrees F and rising. Heating of aggregates, or use of salts to reduce the freezing temperature, will not be permitted. The

Contractor must use extreme caution to protect the fresh concrete from freezing until the concrete reaches a minimum compressive strength of 1500 psi. This requirement does not apply where concrete is to be heat cured.

346-8.7 Mixing for Concreting in Hot Weather. Hot weather concreting is defined as the production, placing, and curing of concrete when the concrete temperature at placing exceeds 85 degrees F but is less than 100 degrees F.

Unless the specified hot weather concreting special measures are in effect, including a design mix complying with 346-6.2, concrete exceeding 85 degrees F at times of placement shall be rejected. Regardless of special measures taken, concrete exceeding 100 degrees F will be rejected. It is the Contractor's responsibility to predict the concrete temperatures at placement and to implement hot weather measures in a timely manner to avoid production shutdown.

346-8.8 Transit Time. When nonagitator trucks are used, the elapsed time between the addition of water to the mix and depositing the concrete in place shall not exceed 45 minutes, except that when a water reducing and retarding admixture (Type D or Type G) is used, such elapsed time shall not exceed 75 minutes. When the hauling is done in agitator trucks, such elapsed time shall not exceed 60 minutes, except that when a water reducing and retarding admixture (Type D or Type G) is used, a maximum elapsed time of 90 minutes will be permitted.

All such time limits are subject to the ability of the Contractor to properly place and consolidate the concrete. Inability to place and consolidate concrete within the time limits specified above shall be cause to reduce the time limits to those limits which will result in acceptable placement and consolidation.

346-9 PLASTIC CONCRETE VERIFICATION SAMPLING AND TESTING.

Initial verification tests will be made by the Department on a sample from the initial delivery of each class of concrete to the jobsite each day for compliance with requirements for air content, temperature, and slump. The Contractor shall furnish the Department with sufficient concrete of each design mix as required for verification testing. The placement operation shall not proceed until the delivered concrete complies with specification tolerances for the plastic concrete. Non-complying loads which cannot be adjusted at the jobsite shall be rejected. Corrections shall be made by the concrete producer on subsequent loads.

After concrete placement begins, verification that the plastic concrete is within specification tolerances is discretionary with the Department based on visual inspection supplemented by intermediate verification tests as may be determined necessary by the Engineer.

Any load or partial load of concrete shown by intermediate verification test to be in non-compliance with the specification tolerances for air content, temperature, or slump will not be accepted for placement. If an intermediate verification test failure is obtained representing a load of concrete before any concrete from that load is placed, the load shall

be rejected and placement operations continued with the next load which is in compliance with requirements for air content, temperature, and slump. The LOT will not be terminated.

If an intermediate verification test failure is obtained representing a load of concrete which has been partially placed, the remainder of that load will be rejected, cylinders will be made from the same sample of concrete, and the LOT will be terminated. Failing intermediate verification tests which result in termination of a LOT and casting of cylinders must be per FM 1-T 141. A terminated LOT shall be represented by cylinders made immediately following the verification test failure from the same sample of concrete.

Following termination of a LOT, initial verification tests will be re-initiated until such time as the air content, temperature, and slump comply with the specification requirements. A new LOT will be initiated once the testing indicates compliance with the specification requirements.

Concrete not in compliance with specification plastic property target ranges shall be adjusted in accordance with 346-6.4. When three consecutive LOT's, or when five LOT's in two days of production of the same design mix are outside the specified tolerances, production shall be suspended until the Contractor makes the necessary revisions to concrete operations and/or the Quality Control Plan to bring the concrete back within allowable tolerances. The revisions must be approved by the District Materials Engineer prior to the suspension being lifted.

346-10 ACCEPTANCE SAMPLING AND TESTING.

346-10.1 General. Acceptance sampling and testing of concrete will be the responsibility of the Department. The Contractor shall furnish the Department sufficient concrete of each design mix as required for acceptance testing.

The Contractor shall furnish and maintain, throughout the required curing period, facilities suitable for curing concrete test cylinders in accordance with the requirements of FM 1-T 023 including power supply, equipment, and materials necessary for proper operation.

346-10.2 Sampling Frequency for Acceptance Tests. The concrete for each design mix shall be randomly sampled and tested for air content, temperature, slump, and compressive strength in accordance with the following schedules as a minimum. Acceptance samples shall be selected from each LOT on a random basis. A sample shall represent the entire LOT of concrete. Additional sampling and testing may be required by the Department's Material Sampling Testing and Reporting Guide or the Special Provisions. If concrete placement is expected to stop for more than 90 minutes, a new LOT shall begin when placement is restarted. Any acceptance test failure will terminate a LOT.

Class Concrete

Maximum LOT Size

I - Special	150 cubic yards or one day's production, whichever is less.
I - Paving	One lane mile or 1/2 day's production, whichever is less.
II, III, III - Drilled Shaft, IV, IV - Drilled Shaft, V, V - Special	50 cubic yards, or one day's production, whichever is less.
III - Seal	Each Seal placement.

346-10.3 Strength Test Definition. A strength test for a LOT shall be the average of the compressive strengths of two test cylinders cast from concrete sampled from the LOT, except that if one test cylinder shows evidence of improper sampling, molding, handling, curing, or testing, that cylinder shall be disregarded and the compressive strength value for the LOT shall be the test result for the remaining cylinder.

346-10.4 Acceptance of Hardened Concrete. Hardened concrete will be accepted (or rejected) on the basis of strength tests as defined in 346-10.3. Low strength (strength below the specified minimum strength) shall not be a basis for discarding a cylinder test result. To be acceptable at full pay, the concrete must be represented by a strength test result which equals or exceeds the specified minimum strength. Strength test results are to be obtained at the frequency specified in 346-10.2. Concrete production shall be controlled so that the following criteria are met:

(1) No average of any three consecutive strength tests shall fall below the specified minimum strength.

(2) No strength test shall fall more than 500 psi below the specified minimum strength.

Failure to meet either of the specified criteria above automatically voids the Department plant approval. Plant re-approval requires implementation of corrective actions as approved by the District Materials Engineer. The Engineer may allow to continue any ongoing concrete placement operation supplied from a plant for which approval is voided during the progress of that placement operation; but no concrete from an unapproved plant will be accepted for any new placement operation.

Acceptance of a terminated LOT due to out of tolerance air content, temperature, or slump will be made at the discretion of the Engineer, based on the environmental classification, degree of non-compliance, and other factors affecting the durability of the concrete. Payment for concrete accepted under these conditions will be made in accordance with 346-10, 346-11, and 346-12.

346-11 INVESTIGATION OF LOW STRENGTH CONCRETE FOR STRUCTURAL ADEQUACY.

346-11.1 General. When a concrete acceptance strength test result falls more than 10% or 500 psi below the specified minimum strength, whichever is less deviation from the specified minimum strength, and when determined necessary by the Department, an investigation into the structural adequacy of the LOT of concrete represented by that strength test result shall be made in accordance with 346-11.2.

346-11.2 Determination of Structural Adequacy. When the Department determines a need to investigate structural adequacy as per the provisions of 346-11.1, the Contractor shall perform a structural analysis as contained in (b) below and/or take drilled cores to determine the in-place concrete strength. If such cores are taken by the Contractor, both the Contractor and the Department shall accept the core strength test results obtained as per the provisions of 346-11.3, 346-11.4, and 346-11.5 as the in-place strength of the LOT of concrete in question. These core strength test results will be final and in lieu of the cylinder strength test results for determination of structural adequacy.

If drilled cores are taken and the core strength test results are less than 10% below the specified minimum strength, and this deviation from the specified minimum strength does not exceed 500 psi, the concrete represented by the cores shall be considered structurally adequate. If the core strength test results are more than 10% or 500 psi below the specified minimum strength, whichever is less deviation from the specified minimum strength, the concrete represented by the cores shall be considered structurally in question. The Contractor shall then either:

(a) Remove and replace the LOT of concrete in question at no additional cost to the Department, or

(b) Submit a structural analysis performed by a Specialty Engineer. If the results of the analysis approved by the Department indicate adequate strength to serve its intended purpose with adequate durability, the concrete may remain in place. Otherwise, the Contractor shall remove and replace the concrete at no additional cost to the Department.

All low strength concrete accepted by the Department shall be subject to reduced payment as per the provisions of 346-12.

346-11.3 Coring for Determination of Structural Adequacy.

If the Contractor elects to drill core samples from the hardened concrete for determination of structural adequacy, as per the provisions of 346-11.2, the costs of obtaining the cores and repairing the core holes shall be borne by him. The cores shall be drilled as directed by the Engineer, at the same approximate locations from which the test cylinder concrete was obtained. The location of the drilled cores will be selected so that the structure will not be impaired or sustain permanent damage after the core holes are repaired by the Contractor. When the Contractor elects to supply drilled core samples, three undamaged samples will be required. Cores taken without Department direction with respect to location will not be considered.

346-11.4 Core Conditioning and Testing. If the Contractor elects to provide drilled core

samples for determination of structural adequacy, the cores shall be tested in accordance with FM 1-T 024. Specimen moisture conditioning shall be that obtained after immersion of the cores in water for at least 40 hours; and the cores shall be tested wet.

346-11.5 Core Strength Representing In-Place Concrete Strength. Core strength obtained will be considered as the in-place concrete strength for structural determinations of the LOT in question. The strength value shall be the average of the compressive strengths of the three individual cores. This strength shall be used at its actual measured value, as determined by FM 1-T 024.

346-12 PAY ADJUSTMENTS FOR LOW STRENGTH CONCRETE.

346-12.1 General. Any LOT of concrete failing to meet the specified minimum strength as per the provisions of 346-3, 346-10, 346-11, and 346-12 may be accepted by the Department when the Department determines that the concrete has been adequately consolidated, cured, and satisfactorily meets all other requirements of the plans and specifications, including structural adequacy. Any LOT of low strength concrete accepted by the Department will be individually reduced in price according to the provisions of 346-12.

346-12.2 Basis for Pay Adjustments. When a concrete acceptance strength test result falls more than 10% or 500 psi below the specified minimum strength, whichever is less deviation from the specified minimum strength, the Contractor may elect to drill core samples from the respective LOT of concrete represented by the low strength test result for determining pay adjustments.

When cores are not taken as per the provisions of 346-11 or 346-12, payment reductions will be based upon the results of strength tests performed on acceptance sample cylinders required as per the provisions of 346-10.

When the Contractor elects to supply drilled cores and submits acceptable drilled core samples to the Department for testing as per the provisions of 346-11 or 346-12, payment reductions will be based upon the results of strength tests performed on those cores. Both the Contractor and the Department shall accept the results of strength tests of the drilled cores, subject to the provisions of 346-12.5 and 346-12.6, as final and in lieu of the results of strength tests of the cylinders.

Coring of hardened concrete for determining pay adjustments will not be permitted when the 28-day cylinder acceptance strength test results are less than 10% below the specified minimum strength, and this deviation from the specified minimum strength does not exceed 500 psi.

346-12.3 Coring for Determination of Pay Adjustments. If the Contractor elects to drill core samples from the hardened concrete for determination of pay adjustments, as per the provisions of 346-12.2, the costs of obtaining the cores and repairing the core holes shall be borne by him. The cores shall be drilled as directed by the Engineer, at the same approximate locations from which the test cylinder concrete was obtained. The location of the drilled cores will be selected so that the structure will not be impaired or sustain permanent damage after the core holes are repaired by the Contractor. When the Contractor elects to supply drilled core samples, three undamaged samples will be required.

Cores taken without Department direction with respect to location, etc. will not be considered.

346-12.4 Core Conditioning and Testing. If the Contractor elects to provide drilled core samples for determination of pay adjustments, as per the provisions of 346-12.2, the cores shall be tested in accordance with FM 1-T 024. Specimen moisture conditioning shall be that obtained after immersion of the cores in water for at least 40 hours; and the cores shall be tested wet.

346-12.5 Core Strength Representing Equivalent 28-Day Strength. For cores tested no later than 42 days after the concrete was cast, the core strengths obtained will be accepted as representing the equivalent 28-day strength of the LOT of concrete in question. The strength value shall be the average of the compressive strengths of the three individual cores. This strength shall be accepted at its actual measured value, as determined by FM 1-T 024.

346-12.6 Core Strength Adjustments. For cores tested later than 42 days after the concrete was cast, the equivalency between 28-day strength and strength at ages after 42 days shall be established based on test data developed by a Department approved testing laboratory to relate strength at the actual test age to 28-day strength for the particular class of concrete and design mix represented by the cores. Such data shall be obtained at no additional cost to the Department. When such data is not available and cannot be produced, as determined by the Department, the equivalent 28-day strength shall be determined by adjusting the tested core strengths according to the following relationship:

$$\text{Equivalent 28-Day Strength} = \frac{\text{Average Core Strength} \times 100}{F}$$

where:

$$F = 4.4 + 39.1 (\ln x) - 3.1 (\ln x) (\ln x) \quad (\text{Type I Cement})$$

$$F = -17.8 + 46.3 (\ln x) - 3.3 (\ln x) (\ln x) \quad (\text{Type II Cement})$$

$$F = 48.5 + 19.4 (\ln x) - 1.4 (\ln x) (\ln x) \quad (\text{Type III Cement})$$

x = no. of days since the concrete was placed

ln = natural log

346-12.7 Calculating Pay Adjustments. Payment reductions for low strength concrete accepted by the Department and represented by either cylinder or core strength test results below the specified minimum strength shall be determined in accordance with the following:

Reduction in Pay = \$ 0.80/ cu.yd. for each 10 psi of
strength test value below the specified
minimum strength.

Low strength concrete paid on a linear foot basis shall be denominated in cubic yards by

multiplying the plan cross-section of the element incorporating the low strength concrete by the full length of that element, or by 150 feet, whichever is less.

Low strength concrete paid on a lump sum basis shall be denominated in cubic yards using plan dimensions for the element, or that portion thereof, represented by the LOT of low strength concrete.

Reduction in pay shall be applied to the entire LOT of concrete represented by the low strength test results and the entire element or elements incorporating that low strength concrete otherwise paid on a linear foot basis as determined above.

PORTLAND CEMENT CONCRETE - CLASS I.

SECTION 345 (Pages 273-290) is deleted and the following new Section is substituted. (All reference to Section 345 in the Plans and Specifications regarding Class I Concrete is changed to Section 346 for Class I Structural Concrete and Section 347 for Class I Nonstructural Concrete):

SECTION 347
PORTLAND CEMENT CONCRETE - CLASS I
(NONSTRUCTURAL)

347-1 DESCRIPTION.

The requirements of this Section are applicable to concrete designated as Class I (Nonstructural), hereinafter referred to as concrete. Concrete shall be composed of a mixture of portland cement, aggregates, water, and where specified or allowed, admixtures, slag, and pozzolanic materials. It shall be delivered to the site of placement in a freshly mixed, unhardened state.

347-2 MATERIALS.

347-2.1 General. The materials used in concrete must be certified from the source and shall conform to the requirements of Division III as follows:

- (a) Portland Cement Section 921
- (b) Fine AggregateSection 902*
- (c) Coarse AggregateSection 901
- (d) WaterSection 923
- (e) AdmixturesSection 924
- (f) Slag, Fly Ash, and other
Pozzolanic MaterialsSection 929

*Only Silica Sand will be permitted except as provided in 902-5.2.3.

The materials used in concrete shall contain no hardened lumps, crusts, or frozen matter and shall not be contaminated with dissimilar material.

347-2.2 Types of Cement. Unless a specific type of cement is designated elsewhere, cement used in concrete shall be Type I, Type IP, Type IS, Type IP(MS), Type II, or Type III.

347-2.3 Fly Ash, Slag, and other Pozzolanic Materials. Fly Ash, slag, or other pozzolanic materials may be used as a cement replacement or as an admixture in concrete when Type I, Type II, or Type III cement is used with the following limitations:

(1) When fly ash or slag is used as a cement replacement, it shall be on a pound per pound basis.

(2) The pozzolan constituent of Type IP(MS) cement shall be in the range of 15 to 40 percent by weight of the portland-pozzolan cementitious material.

(3) Use of pozzolanic materials other than Class F fly ash must be approved by the State Materials Engineer.

(4) The quantity of cement replaced with slag shall not be greater than 70 percent of the total cementitious content.

(5) The quantity of cement replaced with fly ash shall not be greater than 40 percent of the total cementitious content.

347-2.4 Admixture Requirements. Chemical admixtures and air entrainment are optional to the Contractor as approved by the Department. Dosage rates shall be in accordance with the manufacturer's recommendation.

347-2.5 Mixing Different Coarse Aggregates. Substitution of aggregate of the same type and grade from a different source in an approved concrete mix may be permitted at the discretion of the District Materials Engineer. The aggregate to be substituted shall be from an approved source and have similar physical and chemical properties. If unsatisfactory results are obtained with the different source aggregate, the Contractor shall return to the aggregate from the originally approved aggregate source for his supply.

347-2.6 Material Storage.

347-2.6.1 Cementitious Materials Storage. As a minimum each plant shall comply with material specifications and provide a separate and clearly labeled weather proof facility to store each brand and/or cementitious material available during Department work. Each storage facility shall provide a suitable, safe and convenient means of collecting cementitious materials samples.

347-2.6.2 Aggregate Storage. As a minimum, each plant shall provide suitable bins, stockpiles or silos to store and identify aggregates without mixing, segregating or contaminating the different sources or grades. Identification shall include Department approved pit number and aggregate type/gradation.

347-2.6.2.1 Stockpiles - General Requirements. Whichever of the allowable methods of stockpiling aggregates, as specified below, is used by the concrete producer, it shall be his responsibility to handle the aggregates in such manner as to minimize segregation and to recover material from the stockpile for use in the mix in a manner that it will fall within the

limits of the Specifications. Stockpiles shall be maintained in a well drained condition to minimize free water content. The Producer shall make available to the Department's personnel, for sampling, the necessary quantities of aggregate on the recovery side of the stockpile where feasible, for their testing at a frequency necessary to ensure compliance with the Specifications.

347-2.6.2.2 Forming Stockpiles By Clamshell. Stockpiles of either coarse or fine aggregates, shall be built up in layers not to exceed three feet in height. Each layer shall be completely in place before the next layer is started.

347-2.6.2.3 Forming Of Ramped Stockpiles. When trucks and bulldozers are used to form a ramp-type stockpile, such stockpiles shall be constructed in lifts not exceeding three feet in height and a slope that will prevent segregation. Generally, only rubber-tired equipment will be permitted on the stockpile. Equipment other than rubber-tired equipment may be permitted by the Engineer when the Producer can show that the equipment produces no detrimental effect.

347-2.6.2.4 Forming Stockpiles By Belt Conveyor. When the stockpile is formed by a belt conveyor system, the discharge end of the conveyor shall be adjustable in height and capable of moving circularly, or the Producer shall provide means of keeping coning of stockpiles to a minimum to reduce segregation. Questions of segregation shall be resolved by sampling the aggregate from the last conveyor belt before entering overhead storage.

347-2.6.2.5 Storage Of Aggregates In Silos. When aggregates are stored in silos, the overhead charge shall be so arranged that segregation of the aggregates does not occur. The silos shall be maintained in a reasonably full condition, as far as practicable.

347-2.6.2.6 Wetting Coarse Aggregate Stockpiles, Storage Bins And Silos. The entire surface of the coarse aggregate shall be continuously and uniformly sprinkled with fresh water for a period of 24 hours preceding their introduction into the concrete mix to assure uniformity of concrete consistency.

Any request for deviations from the 24-hour sprinkling requirements should be addressed for consideration by the District Materials Engineer.

347-3 CLASSIFICATION, USE, STRENGTH.

Concrete shall have a 28-day minimum compressive strength requirement (specified minimum strength) of 2500 psi. Generally, concrete shall be used for miscellaneous, cast-in-place items including inlets, curb and gutter, valley gutter, slope pavement, manholes, pipe endwalls, and sidewalks, in all environmental classifications.

347-4 COMPOSITION OF CONCRETE.

The minimum cementitious content of concrete shall be 470 lbs./c.y. The maximum water cementitious ratio for concrete shall be 0.55 lb./lb. The maximum water cementitious ratio represents the maximum value at which mix designs will be approved. Water cement ratio will be calculated based on the total cementitious material including fly ash or slag. The slump range shall be between 0 and 6 inches.

347-5 SAMPLING AND TESTING METHODS.

Concrete sampling and testing shall be in accordance with the following standard methods:

- (1) Making and Curing Test Cylinders FM 1-T 023
- (2) Testing Cylinders FM 1-T 022
- (3) Early Sampling of Fresh Concrete from
 Revolving Drum Truck Mixers or Agitators FM 5-501
- (4) Taking and Testing Drilled Core Samples FM 1-T 024
- (5) Sampling Fresh Cement Concrete
 FM 1-T 141
- (6) Slump

FM 1-T

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347-6 CONTROL OF QUALITY.

347-6.1 Concrete Design Mix. Prior to production of any concrete, the Contractor shall submit a proposed mix to the District Materials Engineer on the attached "Concrete Mix Design" form. Only concrete design mixes having prior approval of the District Materials Engineer with concurrence from the State Materials Engineer shall be used. No change in design mix component materials shall be authorized except as per 347-2.5 prior to use. The design mix submittal shall include the requirements of (1) or (2) below.

(1) Evidence from 3 sets of production data, either from Department acceptance tests or independently verifiable commercial mixes, that concrete produced in accordance with the proposed design mix shall have the properties set out in 347-3 and 347-4.

(2) Test data from a single trial batch which demonstrates that concrete produced using the proposed mix, designated ingredients, and designated water-cement ratio shall have the properties set out in 347-3 and 347-4. When truck mixers or concrete plant central mixers are used, a minimum 3 cu. yd. trial batch is required. Trial batching will be witnessed by the Department at the discretion of the District Materials Engineer.

347-6.2 Batch Adjustment - Materials. Permissible adjustments to previously approved design mixes which may be made without a new design mix request are as follows:

- (1) Coarse or Fine Aggregate: ± 75 pounds per cubic yard of concrete.
- (2) Admixtures: Not to exceed 2.5 times manufacturer's recommended dosage.
- (3) Cementitious Materials: $\pm 5\%$ per cubic yard, but not less than the specified minimum for that class of concrete.
- (4) Adjusted mix shall meet the theoretical yield requirements of the approved mix design.
- (5) The Producer shall inform the District Materials Engineer of any adjustment to the mix. Batch adjustments shall be noted on the concrete "Delivery Ticket/Certification" form.

347-6.3 Delivery Certification. Certification shall be furnished to the Department with each batch of concrete before unloading at the site. Certification shall be on a delivery ticket on which is printed, stamped, or written the information required on the attached "Delivery Ticket/Certification" form.

347-7 CONCRETE PLANT REQUIREMENTS.

347-7.1 General. Concrete shall be produced at plants that are approved by the District Materials Engineer as per the requirements of this specification. Upon request by the Contractor and concurrence by the Engineer, certain requirements for plant approval may be waived by the District Materials Engineer for projects in remote locations. The plant operator must be capable of producing concrete in accordance with the requirements of this specification to the satisfaction of the District Materials Engineer. The plant operator shall witness all batching operations.

Equipment used for handling elements of concrete, mixing concrete, handling the mixed concrete, transporting and depositing the mixed concrete shall have no detrimental effect on the hardened concrete. Equipment surfaces which are in physical contact with the elements of concrete or the mixed product shall not be made of aluminum.

Concrete producers will be evaluated for compliance with the specifications. Plant reinspection will be performed on a periodic basis when the producer is actively supplying concrete to the Department. When discrepancies are found, the plant may be removed from the fully approved plant status and placed on either a conditional status or a non-approved status depending on the nature of the discrepancy and the corrective action required. When a plant is placed on non-approved status, the producer shall notify the District Materials Engineer, in writing, of the proposed corrective action. The District Materials Engineer will schedule a plant reinspection within three working days of receipt of the written acceptable corrective action.

347-7.2 Measuring Materials.

347-7.2.1 Water. Water may be measured by volume or weight. Whichever method is used, the equipment shall be constructed so that the accuracy of measurement will not be affected by variations in pressure in the water supply line. The meter or weighing device shall be capable of being set to deliver the required quantity and to automatically cut off the flow when the required quantity has been discharged. The measuring equipment shall have an accuracy, under all operating conditions, within one percent of the quantity of water required for the batch. The accuracy of measuring devices shall be verified at the request of the Department or at least quarterly as per the attached "Calibration of Water Measuring Devices" requirements.

Adjustment to mix consistency, within the allowable limit for the addition of water, is the Contractor's responsibility at the job site, and shall be made upon initial arrival and not thereafter.

347-7.2.2 Admixtures. Admixtures shall be measured by weight or volume. The measuring equipment shall have an accuracy, under all operating conditions, within three percent of the quantity of admixture required for the batch. The accuracy of measuring devices shall be certified by the admixture supplier annually. Each admixture shall be measured separately and added to the mixing water in a separate sequence as the mixing water is introduced into the mix.

Exceptions to the above method of admixture addition may be permitted by the District

Materials Engineer provided accuracy of measurement is not sacrificed and the desired goals of each admixture are achieved.

347-7.2.3 Cement, Fly Ash and Slag. Cement, fly ash, and slag shall be measured by weight within an accuracy of one percent of the required amount, except that for concrete batches of three cubic yards or less, a required accuracy of two percent will be permitted. Cement, fly ash, and slag shall be weighed separately from other materials. When cement, fly ash, and slag are weighed in a cumulative weigh hopper, the cement shall be weighed first.

If bag cementitious material is permitted, the batch shall be so proportioned that only whole bags are used.

347-7.2.4 Fine and Coarse Aggregates. Aggregates shall be measured by weight or volume within an accuracy of one percent of the required amount. Proper aggregate surface moisture corrections shall be applied.

Within two hours prior to each day's batching, free moisture shall be determined for the coarse and fine aggregates. When concrete production is expected to exceed three hours, an additional moisture test shall be required at approximately half way through the batching operations. The concrete producer shall use these values for adjustment of batch proportions.

Batch adjustments made necessary by aggregate free moisture may be made by one or more of the following methods:

1. By using moisture probe readings, speedy moisture tester or Chapman flask for fine aggregate moisture. The accuracy of the moisture probe will be verified at least weekly by the manufacturer's recommended method. The Chapman flask and speedy moisture tester will be verified at least weekly by method No. 2 below.
2. By calculating both coarse and fine aggregate free moisture based upon dry sample weights and adjusting for absorption.
3. By towel drying coarse aggregate to calculate free moisture on S.S.D. aggregate. The accuracy of towel drying shall be verified weekly by method No. 2 above.

347-7.2.5 Batching Accuracy. Failure to maintain batching operations of the plastic concrete within the tolerance for each component material requires immediate investigation and corrective action by the concrete producer and automatically places the plant on conditional status. Failure to implement corrective measures will be cause for placing the plant on a non-approved status.

347-7.3 Batching Plants.

347-7.3.1 Bins. All bins shall be of adequate capacity for the concrete production required. They shall be supported upon a rigid framework founded upon a stable foundation capable of holding them in a safe and secure position. Each compartment shall be designed to discharge efficiently and freely into the weigh hopper. Positive means of control shall be provided so that as the quantity desired in the weigh hopper is approached, the material can be added slowly and shut off precisely. The discharging mechanism shall not permit loss of material when it is closed. Aggregate storage bins shall be constructed sufficiently tight to prevent leakage of material and they shall be divided into at least one compartment for the fine aggregate and one compartment for each size of coarse aggregate

to be used. The compartment partitions shall be sufficiently tight and high enough to prevent the intermingling of the several materials. Cement bins shall be constructed leak-proof and moisture-proof, and shall be provided with vibrators or other means to aid the flow of cement from the bin.

347-7.3.2 Weigh Hoppers. Weigh hoppers shall consist of suitable containers freely suspended from scales and protected from the elements so that accuracy is not adversely affected. The hoppers shall be equipped with a discharge mechanism which prevents leakage or loss of material when closed. Hoppers shall be vented to permit air to escape and be equipped with vibrators or other equipment that ensures complete and efficient discharge of materials.

347-7.3.3 Scales. Scales shall be either beam type, or springless dial type, or electronic devices such as load cells, and the product of a recognized scale manufacturer. Where beam type scales are used, suitable means shall be provided to hold poises securely in position after they are set. Scales shall be kept clean and in good operating condition. Where necessary, the scale operator shall have an unobstructed view of all indicating devices and convenient access to all controls. The weigh beam, or dials shall be graduated to permit reading to one tenth of one percent of the capacity of the scales.

Prior to beginning any work, all scales and other weighing devices used in batching shall be checked for accuracy by a qualified representative of a scale company registered with the Bureau of Weights and Measures of the Florida Department of Agriculture.

Scales shall be rechecked once every three months or more often if deemed necessary. Scales shall be checked up to at least the maximum load normally handled on each respective scale.

Cement scales, fly ash scales, and coarse and fine aggregate scales shall be maintained to an accuracy of one half of one percent of the maximum load normally handled.

A certificate of inspection bearing the date of the certification and signed by the scale company representative shall be affixed to each weighing device. A copy of the scale company's report corresponding with the current certificate of inspection showing the date of inspection, signature of the scale company representative, the observed scale deviations for the loads checked, and a statement that the scale conforms to the requirements of Chapter 531 Florida Statutes pertaining to specifications, tolerances, and regulations, as administered by the Bureau of Weights and Measures of the Florida Department of Agriculture, shall be available at the plant.

347-7.4 Mixers.

347-7.4.1 General Requirements. All mixers shall be of an approved type and shall be capable of combining the components of the concrete into a thoroughly mixed and uniform mass, and shall be capable of discharging the concrete with a satisfactory degree of uniformity.

347-7.4.2 Design. Mixers may be truck mixers of the inclined axis revolving drum type, or concrete plant central mixers of the non-tilting, tilting, vertical shaft or horizontal shaft types.

A Copy of the manufacturer's design, showing dimensions and arrangement of blades,

shall be available at the batching plant at all times. The use of mixers that have been altered from such design in respect to blade design and arrangement, or to drum volume, may be permitted when recommended by the manufacturer and approved by the District Materials Engineer.

Metal rating plates shall be attached to each mixer specifying its mixing speed, agitating speed, rated capacity, and unit serial number.

347-7.4.3 Truck Mixers. The drums of truck mixers may be actuated by power sources independent of the truck engines or by suitable power take-offs. Either system used shall provide control of the rotation of the drum within the limits specified on the manufacturer's rating plate, regardless of the speed of the truck. A truck mixer of the revolving drum type shall be equipped with a hatch in the periphery of the drum shell which permits access to the inside of the drum for inspection, cleaning, and repair of the blades.

Truck mixers shall be equipped with revolution counters of approved type and mounting, by which the number of revolutions of the drum may be readily verified.

The water supply system mounted on truck mixers shall be equipped with a volumetric water gauge or approved water meter in operating condition. Each mixer shall display an identification card obtained from the District Materials Engineer prior to delivery of concrete to any Department project. Failure to display an identification card in the mixer truck shall be cause for rejection of the delivered concrete. The identification card may be removed by the engineer when a truck mixer is discovered to be in non-compliance.

As an exception to the above, when the deficiency involves only an inoperable revolution counter, the truck mixer identification and approval card will not be removed. However, the deficiency will be noted on the card by the Department's representative. The producer will be allowed to deposit concrete present in the mixer and then the truck mixer will be removed from use until the revolution counter is repaired or replaced. On the initial delivery to any Department project, after repair or replacement, the truck mixer operator will be expected to have the Department's representative note that the revolution counter is operable and initial the truck mixer approval card. Without such inspection and documentation of corrective action, the Department may reject the truck mixer at any time it is again found to have an inoperable revolution counter. The revolution counter will be set to zero prior to mixing.

All truck mixers shall be inspected by the producer at least once each week for changes due to accumulation of hardened concrete or wear of blades. Any appreciable accumulation of hardened concrete shall be removed before any mixer may be used under these procedures.

Maintenance of Mixers: Blades of revolving drum type mixers shall be repaired or replaced when the radial height is less than 90 percent of the design radial height. Mixers of other designs shall be repaired or adjusted per instructions of the manufacturer. Questions of performance shall be resolved through mixer uniformity tests as described in ASTM C 94.

347-7.4.4 Timers. Stationary type mixers shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum is charged and

release it at the end of the mixing period. In the event of failure of the timing device, the Engineer may allow operations to continue as may be necessary to avoid critical or uneconomical conditions. Such operations, however, shall not extend beyond the end of that working day.

If necessary, and in order to produce a homogeneous mixture, the minimum allowable mixing time specified may be increased or decreased if uniformity of mix is verified. The mixer shall be operated at the drum speed stipulated on the manufacturer's name plate on the mixer.

347-7.5 Trucks for Transporting Wet Batches. Wet batches of concrete may be transported in either agitating or nonagitating trucks. Bodies of nonagitating trucks shall be smooth, mortar tight containers with round internal corners, and shall be capable of discharging the concrete at a satisfactorily controlled rate without segregation. Covers shall be provided for nonagitating trucks for protection from the elements.

347-7.6 Records. All records must be made available at each plant, upon request by Department personnel. Records which shall be available at each plant are as follows:

1. Approved concrete design mixes.
2. Materials source/specification compliance (delivery tickets, certifications, certified mill test reports, miscellaneous test reports).
3. Plant and mixer design data as may be required by Specifications.
4. Federal Poster.
5. Department Specifications and approved drawings, if applicable.
6. A copy of the scale company or testing agency report showing the observed deviations from quantities checked during calibration of scales and/or meters. Certification document for the admixture weighing/measuring device.
7. Truck mixer inspection (a copy shall be located in the cab of the truck).
8. Moisture control records.

347-8 MIXING AND DELIVERING CONCRETE.

347-8.1 General Requirements. Truck mixers shall be operated at mixing speeds of 6 to 18 rpm and agitating speeds of 2 to 6 rpm (of the drum). Concrete plant mixers shall be operated at speeds per the manufacturer's design or recommendation. The volume of material mixed per batch shall not exceed the manufacturer's rated mixing capacity.

347-8.2 Central Mixing. All concrete shall be mixed a minimum of two minutes or manufacturer's recommended minimum, whichever is longer, after all materials are in the mixer, unless a reduced mixing time is authorized by the District Materials Engineer.

347-8.3 Transit Mixing. Each batch shall initially be mixed between 70 and 100 revolutions of the drum at mixing speed. When water is added at the job site, the concrete shall be mixed 30 additional mixing revolutions. Mixing for the purpose of adjusting consistency shall not cause the total number of revolutions at mixing speed to exceed 160. All concrete shall be discharged from truck mixers before total drum revolutions exceed 300, except as authorized by the District Materials Engineer.

Mixer trucks shall not haul more than the rated capacity in cubic yards shown on their

attached plates.

347-8.4 Mixing at the Site. Concrete mixing at the job site shall be by a mixer of sufficient capacity to prevent delays that may be detrimental to the quality of the work. The accuracy of batching equipment shall be in accordance with requirements of this Section.

347-8.5 Charging the Mixer. Each batch shall be charged into the drum so that some water will enter both in advance of and after the cementitious material and aggregates. If fly ash is used in the mix, it shall be charged into the drum over approximately the same interval as the cement. Other time intervals may be used for the introduction of fly ash into the mix when the Contractor demonstrates that uniformity of the concrete mix can be achieved using test requirements specified in ASTM C 94.

347-8.6 Mixing for Concreting in Cold Weather. No concrete shall be mixed when the air temperature is 45 degrees F and falling. Concrete may be mixed and placed when the air temperature in the shade, and away from artificial heat, is 40 degrees F and rising. Heating of aggregates, or use of salts to reduce the freezing temperature, will not be permitted. The Contractor must use extreme caution to protect the fresh concrete from freezing until the concrete reaches a minimum compressive strength of 1500 psi. This requirement does not apply where concrete is to be heat cured.

347-8.7 Transit Time. When nonagitator trucks are used, the elapsed time between the addition of water to the mix and depositing the concrete in place shall not exceed 45 minutes, except that when a water reducing and retarding admixture is used, such elapsed time shall not exceed 75 minutes. When the hauling is done in agitator trucks, such elapsed time shall not exceed 60 minutes, except that when a water reducing and retarding admixture is used, a maximum elapsed time of 90 minutes will be permitted. Extended transit time may be authorized by the District Materials Engineer.

All such time limits are subject to the ability of the Contractor to properly place and consolidate the concrete.

347-9 ACCEPTANCE SAMPLING AND TESTING.

347-9.1 General. Acceptance sampling and testing of concrete shall be the responsibility of the Department. The Contractor shall furnish to the Department sufficient concrete of each design mix as required for acceptance sampling and testing.

347-9.2 Acceptance Sampling and Testing. The concrete shall be sampled and tested for slump and compressive strength. All samples shall be obtained at the point of final placement. An acceptance test shall consist of a slump test and two individual test cylinders for determination of the compressive strength of each LOT of concrete in accordance with 347-5. A LOT shall represent 150 cubic yards or one day's production of each design mix, whichever is less. Any load or partial load with a slump in excess of 6 inches shall be rejected. Concrete will not be permitted to remain in a transporting vehicle to reduce slump.

Additional sampling and testing may be required by the Department's Material Sampling Testing and Reporting Guide, Specifications, or at the discretion of the Engineer.

347-9.3 Curing Concrete Test Cylinders. The Contractor shall furnish and maintain, throughout the required curing period, facilities suitable for curing concrete test cylinders in

accordance with the requirements of FM 1-T 023 including power supply, equipment, and materials necessary for proper operation.

347-10 ACCEPTANCE OF HARDENED CONCRETE.

347-10.1 Acceptance Test Definition. Hardened concrete will be accepted or rejected according to the results of a 28-day compressive strength test performed on the acceptance samples. Concrete shall meet or exceed the 28-day minimum compressive strength requirement of 2500 psi to be accepted for full payment.

347-10.2 Strength Test Definition. A strength test for a LOT of concrete shall be the average of the compressive strengths of two test cylinders cast from concrete sampled from the LOT in accordance with 347-5, except that if one test cylinder shows evidence of improper sampling, molding, handling, curing, or testing, that cylinder shall be disregarded and the compressive strength value for the LOT shall be the test result for the remaining cylinder.

347-10.3 Low Strength Concrete. Concrete failing to meet the 28-day minimum compressive strength requirement as represented by an acceptance test defined in 347-10.1 and 347-10.2 shall be removed and disposed of by the Contractor at his expense, except as provided in 347-10.4 and 347-10.5. Low strength (strength below the specified minimum strength) shall not be a basis for discarding an acceptance test result. If concrete produced, supplied, placed, and tested in accordance with these specifications fails to prove satisfactory and adequate to perform its intended purpose, as determined by the Engineer, the Contractor shall make revisions to the mix design, production, delivery, and/or placement procedures to alleviate the problems prior to continued production.

347-10.4 Acceptance of Low Strength Concrete. The Engineer, at his discretion, based on the degree of non-compliance and other factors affecting the durability of concrete, may allow concrete which fails to meet the 28-day minimum compressive strength requirement to remain in place with a 50 percent reduction in pay as applied to the contract unit price bid for the applicable pay item.

347-10.5 Alternate Acceptance Test. When the Department determines a need for an alternate acceptance test because test results defined in 347-10.1 and 347-10.2 are not available or determined to be unreliable, the Contractor shall supply drilled core samples. Low strength test results as defined in 347-10.1 and 347-10.2 shall not be a basis for requiring an alternate acceptance test. The need for an alternate acceptance test shall be solely the decision of the District Materials Engineer.

347-10.6 Handling and Curing Alternate Acceptance Test Samples. When the Department determines a need for an alternate acceptance test, three undamaged drilled core samples shall be supplied by the Contractor, at his expense, within ten days after notification by the Department of that requirement. Drilled core samples shall be taken by the Contractor from a location, within the LOT of concrete in question, selected by the Engineer in accordance with FM 1-T 024, which will not result in impairment or permanent damage to the structure. Specimen moisture conditioning shall be in accordance with FM 1-T 024.

347-10.7 Alternate Acceptance Test Results. When the Department determines a need for an alternate acceptance test, the average of the actual measured test strength values of the three individual cores, as determined by FM 1-T 024, shall be determined as representing the equivalent 28-day minimum compressive strength of the LOT of concrete represented by the cores. Both the Contractor and the Department shall accept these core strength test results as final and in lieu of any existing cylinder strength test results for the LOT of concrete represented by the cores.

SECTION 350 **CEMENT CONCRETE PAVEMENT**

350-12 Joints – Load-Transfer Devices.

In the fifth sentence of the first paragraph, reference to "one coat of red lead paint" is changed to "one coat of approved zinc rich paint" listed on the Department's Qualified Products List.

SECTION 400 **CONCRETE STRUCTURES**

400-7.1.1 Concreting in Cold Weather. The text is deleted and the following substituted:

No concrete shall be placed when the temperature of the concrete at placement is below 45 Degrees F.

Air temperature requirements for mixing and placing concrete in cold weather shall be as specified in 346-8.6. During the curing period, if the ambient temperature is predicted by the U.S. Weather Service (NOAA) to fall below 35 degrees F for twelve hours or more or to fall below 30 degrees F for more than four hours, the Contractor shall enclose the structure in such a way that the concrete and air within the enclosure can be kept above 60 degrees F for a period of three days after placing the concrete or until the concrete reaches a minimum compressive strength of 1500 psi.

The Contractor shall assume all risks connected with the placing and curing of concrete under the above conditions, and permission given to place concrete under such conditions will in no way relieve the Contractor of the responsibility for satisfactory results. Should concrete placed under such conditions prove unsatisfactory, it shall be removed, disposed of and replaced at the Contractor's expense.

400-7.1.2 Concreting in Hot Weather. The text is deleted and the following

substituted:

Temperature requirements and special measures for mixing and placing concrete in hot weather shall be as specified in 346-8.7.

When the temperature of the concrete as placed exceeds 75 degrees F, a water-reducing retarder or water reducer if allowed by Section 346 shall be incorporated in the concrete mix.

Deck slabs forms and reinforcing steel shall be sprayed with cool fresh water just prior to placement of concrete.

The Contractor shall assume all risks connected with the placement of concrete under the above conditions, and permission given to place concrete under such conditions will in no way relieve the Contractor of the responsibility for satisfactory results. Should concrete placed under such conditions prove unsatisfactory, it shall be removed, disposed of and replaced at the Contractor's expense.

400-7.5 Placing Concrete is expanded as follows:

All foundation concrete shall be placed against founding material that is moist at the time of concrete placement. If additional water is required, it shall be uniformly applied ahead of the concrete placement as directed by the Engineer. No concrete shall be placed on founding material that is frozen. A moisture barrier may be utilized in lieu of controlling the foundation grade moisture when proposed by the Contractor and approved by the Designer of Record and the Engineer.

400-7.6 Placing Concrete by Belt Conveyor is deleted and the following substituted:

Placing concrete by means of a belt conveyor system may be allowed only with written Department authorization. Authorization to use conveyor belt systems will remain in force only as long as the system consistently produces acceptable results. Conveyor belt systems which produce unsatisfactory results shall be removed before continuing operations. Concrete samples for assurance testing shall be taken at the discharge end of the belt conveyor system. The Contractor shall make available to the Department's personnel, for sampling, the necessary platform to provide a level and sturdy place for testing at a frequency necessary to insure compliance with the specifications. Any concrete placed in an unsatisfactory manner shall be removed before continuing operations.

Conveyor belt systems shall not exceed a total length of 550 linear feet, measured from end to end of the total assembly. The belt assembly shall be arranged so that each section discharges into a vertical hopper arrangement to the next section. To keep segregation to a minimum, scrapers shall be situated over the hopper of each section to remove mortar adhering to the belt and to deposit it into the hopper. The discharge end of the conveyor belt system shall be equipped with a hopper, and a chute or suitable deflectors to cause the concrete to drop vertically to the deposit area.

In order to avoid delays due to breakdowns, stand-by equipment with an alternate power source shall be provided prior to the beginning of the pour.

After the beginning of the pour the discharge from the belt conveyor shall be directed so that the concrete always falls on freshly placed concrete.

400-7.13 Slabs.

400-7.13.2 Placing Operations. The second paragraph is deleted and the following substituted:

The concrete in deck slabs shall be placed at a rate of not less than 18 cubic yards per hour. On pours of 50 cubic yards or less, the minimum average pour rate shall be 20 cubic yards per hour. On pours of greater than 50 cubic yards, the minimum average pour rate shall be 30 cubic yards per hour.

When the concrete placement rate does not meet the minimum requirements, future deck pours will not be permitted until an acceptable plan for meeting the minimum placement rate is submitted to the Engineer.

400-7.15 Bridge Floors.

400-7.15.2 Design of Screed. The first paragraph is deleted and the following substituted: The concrete shall be struck-off by means of an approved metal screed operating on rails or bulkheads. The screed shall consist of either a truss or heavy beams of sufficient strength and stiffness to retain its shape under all working conditions. The screed shall consist of a set of rotating drums of sufficient diameter to carry a two-inch mortar roll in front of the drum while making the initial pass. As an alternate to the drum type screed, a mechanical screed may be used. The mechanical screed with a metal strike-off shall be equipped with mechanical vibrators providing continuous uniform vibration to the entire length unless otherwise authorized. Small and irregularly shaped areas may be screeded in a manner approved by the Engineer.

The screed shall be of a type which will allow adjustment for vertical curves, dead-load deflection, camber and design configuration of the screed elements.

Prior to starting any deck pour, the Contractor shall provide a concrete placement plan and perform a dry run of screeding equipment to demonstrate in advance that the equipment, personnel and methods to be used can successfully place and finish the pour at the rate specified in 400-7.13.2.

400-7.15.3 Screeding is expanded as follows:

The machine shall leave the surface of the concrete true to grade and crown, and free of irregularities. The addition of water to the concrete surface to assist in finishing operations will not be permitted unless otherwise authorized by the Engineer. If the Engineer permits water to be added to the concrete surface, the only acceptable method of application will be by approved power driven spray equipment producing a fog spray.

400-7.16 Box Culvert Construction is expanded as follows:

The Contractor has the option of utilizing precast box culvert sections in lieu of cast-in-place box culvert construction provided that the provisions in Section 410 are satisfied.

400-14 REMOVAL OF FORMS. The text is deleted and the following substituted:

The time of removal of forms shall be as shown in the plans, determined from compressive strength tests, as shown in the table below, or as directed. The following table may be used as a guide for compressive strength required before removal of forms and removing form supports.

**Minimum Compressive Strength
for Form Removal (Percent of
Minimum 28-day Strength)**

(1) Centering under girders	80
(2) Floor slabs, top slabs of culverts and bottom of caps	70
(3) Forms under sidewalks and safety curb overhangs extending more than two feet	70
(4) Walls, piers, columns, sides of beams and other vertical surfaces	70
(5) Front face form of curbs	70

The Contractor shall cast test cylinders from representative concrete for compressive strength determination. Such test cylinders shall be cured as nearly as practical in the same manner as the concrete in the corresponding structural component and shall be tested in accordance with AASHTO T 22 and T 23. The casting, curing and testing shall be performed by the Contractor at his expense under the observation of the Department. When concrete strength tests indicate a compressive strength equal to or greater than the percentage of specified design strength, shown in the table above, the forms may be removed.

Forms shall not be removed at any time without the consent of the Engineer, however, such consent shall not act in a manner to relieve the Contractor of responsibility for the work.

400-15.2 Surface Finishes.

400-15.2.5 Class 4 Floor Finish. In the third paragraph, reference to "72-hour curing" is changed to "seven-day curing".

400-16.1 General.

400-16.1.1 Methods and Curing Time. The first sentence is deleted and the following substituted:

For surfaces other than bridge deck slabs on which forms are kept continuously in place, without loosening, for a period of three days or more, no further curing will be required. Bridge deck slabs shall be cured for a total period of at least seven days with removable forms kept continuously in place, without loosening.

400-16.1.2 Curing Methods. The second sentence of the first paragraph is deleted and the following substituted:

Membrane curing compound shall be mixed with a mechanically operated mixer immediately prior to each use to provide uniform consistency. Application shall be in accordance with the manufacturer's recommendations, subject to the rate of application

specified herein. If curing compound is to be applied by spraying, the sprayer shall be compressor driven and of sufficient size to provide uniform spray at the nozzle. All nozzles shall be kept clean and shall provide uniform mist. Standby equipment will be required in case of mechanical failure. Hand held, pump-up sprayers will be permitted for standby equipment. However, the hand held pump-up sprayers shall not be used except in case of mechanical failure and for applying compound on Class I Concrete (non-pavement). Failure to comply with these requirements will result in suspension of further concrete placements until proper control is re-established.

400-16.2 Curing Bridge Deck Slabs. In the third and fourth paragraphs, references to "72-hour curing period" are changed to "seven-day curing period".

400-17 PROTECTION OF CONCRETE.

400-17.1 Opening to Traffic. The first sentence is deleted and the following substituted:

Unless otherwise directed, concrete bridge floor and culverts shall be closed to traffic for a period of at least 14 days after placing and for such additional times as may be deemed advisable.

400-17.3 Time of Placing Superstructure. The table is deleted and the following substituted:

Superstructure 7 days
Beams 3 days

400-18 PRECAST PLANKS, SLABS AND GIRDERS.

400-18.1 General. The third sentence beginning with "Either normal strength" is deleted.

400-18.5 Moving, Placing and Opening to Traffic. The table is deleted and the following substituted:

Handling from casting
beds to storage areas 7 days
Placing in structure 14 days
Opening to traffic:
Precast elements 14 days
Cast-in-place slabs
over precast girders 14 days
Cast-in-place keys
joining precast slabs 7 days

SECTION 413

SEALING CONCRETE STRUCTURE SURFACES

413-4 APPLICATION OF SEALANT MATERIALS.

413-4.1 General. The second and third paragraphs are deleted and the following substituted:

Prior to application of any penetrant sealer, concrete shall have a minimum of 21 days curing time.

Application of the penetrant sealer shall be coordinated by the Contractor so that concrete surfaces prepared to receive penetrant sealer shall be sealed with the penetrant sealer within ten days after completion of the surface preparation and prior to contamination of the prepared surfaces.

413-4.4 Application. The third sentence is deleted and the following substituted:

A field trial to determine coverage rate shall be conducted at the beginning of any penetrant sealer application operation and additional confirmation field trials shall be conducted at a frequency of once for every 5000 square feet applied, production day of application or when the character of the work changes, whichever is sooner.

413-7 METHOD OF MEASUREMENT. The text is deleted and the following substituted:

Prestressed precast items designated in the plans to be sealed will not be measured for separate payment. Such cost of cleaning, sealing and penetrant shall be included in the items sealed. When separate payments for other areas are specified, the quantities to be paid for shall be the (1) number of gallons of Penetrant Sealer as determined by use of the field measured area satisfactorily sealed divided by the approved application rate, and (2) area in square feet as determined by field measurement.

SECTION 415 **REINFORCING STEEL**

415-5 PLACING AND FASTENING.

415-5.4 Splices. The text is deleted and the following substituted:

Where splices are authorized, the bars shall be rigidly clamped or tied in a manner meeting the Engineer's approval. The splice length shall be as indicated in the plans. Additional splices may be submitted by the Specialty Engineer, for approval, prior to use.

Welded splices shall not be permitted except as specifically authorized by the Engineer and, if authorized, shall conform to AWS D 1.4-79 "Structural Welding Code - Reinforcing Steel" of the American Welding Society.

415-5.13 Metal Chairs and Bolsters. The text is deleted and the following substituted:

415-5.13.1 General.

Reinforcing steel bar supports shall be manufactured in accordance with all requirements

of the CRSI Manual of Standard Practice. Chairs and bolsters must be of adequate strength to resist a 300 pound concentrated load without permanent deformation or breakage.

No more than five percent of the reinforcing steel bar supports shall exhibit unsatisfactory performance, breakage, or permanent deformation during rebar tying and/or concrete placement operations. If a bar support does not achieve this level of performance, the Contractor will be required to reduce the average spacing between bar supports by 15 percent, or shall remove that product from use on the job.

Bar supports shall not move during concrete placing operations. If necessary to prevent movement, supports shall be tied to the reinforcing steel.

When bar supports are used on corrugated metal stay-in-place forms, they shall be specifically designed for the form being used.

415-5.13.2 Metal Chairs and Bolsters.

Metal bar supports which are in contact with stay-in-place forms and metal bar supports in contact with boundary surfaces of concrete to be cast shall be constructed with molded plastic legs or plastic protected steel legs so that no portion of the bar support other than the molded plastic leg or plastic protected portion of the steel leg will be closer than 1/2 inch from the boundary surface of concrete to be cast.

When metal bar supports are used to support epoxy coated reinforcing, the bar supports shall be epoxy coated or plastic coated in accordance with the requirements of Section 416.

The Contractor shall certify that all metal bar supports meet the following requirements:

- That they are manufactured from cold drawn steel wire in accordance with the wire sizes and geometrical dimensions shown in Chapter 3, Table II of the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.
- That the plastic used for protection of the steel legs shall have a thickness of 3/32 inch or greater at points of contact with the form work.

Plastic protection may be provided by a dipping operation, by the addition of premolded plastic tips to the legs of the support or by molding plastic to the top wire of the support. The plastic material used for protection of steel legs shall not chip, crack, deform or peel under ordinary job conditions. Molded plastic legs shall have sufficient strength to carry the weight of the supported reinforcing steel in its required position without deformation and relaxation under job conditions.

415-5.13.3 Plastic Chairs and Bolsters.

The material from which plastic bar supports is manufactured shall be either virgin resin or first generation recycled industrial material, be colored white, gray, or black, and be chemically inert in concrete. Plastic may either be glass reinforced or non-reinforced, but shall meet the requirements shown in the following table for a working temperature range of 20 degrees F to 150 degrees F:

<u>Property</u>	<u>Requirement</u>	<u>ASTM Test Method</u>
Minimum Shear Strength	5,000 psi	D732
Minimum Compressive Strength	10,000 psi	D695
Maximum Water Absorption	0.1	D570

In addition to the physical properties specified, plastic rebar supports shall be molded in a configuration which does not restrict concrete flow and consolidation around and under the rebar support.

Exposed surfaces of supports shall be minimal. Continuous legs or rails will not be allowed on exposed surfaces of concrete.

Plastic rebar supports shall be on the Qualified Products List at the time of the material's use. Each individual bar support must have an identification number unique to the particular model of support permanently marked on the surface of the support and will be included in the approved listing for identification purposes. This number may be a patent number or manufacturer's model number.

SECTION 425

INLETS, MANHOLES AND JUNCTION BOXES

425-3 MATERIALS.

425-3.2 Gratings. The text is deleted and the following substituted:

Gratings and frames fabricated from structural steel shall be galvanized in accordance with the requirements of ASTM-A123 or shall be painted with two coats (2.5 to 4.0 dry mils per coat) of paint meeting the requirements of 971-8. The second coat of paint shall be black in color (Color No. 17038, Federal Standard 595a). Prior to painting, the steel shall be cleaned according to the Steel Structures Painting Council Surface Preparation Specifications, SSPC-SP2 or SSPC-SP7. All paint may be applied in the shop, by dipping, provided that the first coat application is thoroughly dry before the second coat is applied. These requirements do not apply when A-588 steel is used.

425-6 CONSTRUCTION METHODS.

425-6.2 Placing and Curing Concrete is expanded as follows:

The traffic surface shall be finished in accordance with 522-7.2.

425-6.6 Placing Pipe is expanded as follows:

For sealing precast inlets, manholes and junction boxes to pipe joints, to prevent leakage

along their outer surface, the Contractor may use resilient connectors as specified in 942-3 in lieu of a masonry seal.

SECTION 430

PIPE CULVERTS AND STORM SEWERS

430-4.1 General is expanded by the following:

No lift holes will be allowed in concrete pipe with the exception of elliptical pipe and round pipe which has a nominal diameter in excess of 54 inches unless specifically called for by the plans or Special Provisions. If allowed, lift holes shall be repaired by careful use of a hand-placed, stiff, non-shrink, one-to-one mortar of cement and fine sand, and with no additional preparation other than a thorough washing with water. The repaired area shall also be covered with a 24-inch by 24-inch piece of filter fabric secured to the pipe. The filter fabric shall meet the requirements of Section 985 for Subsurface Drainage.

The method of securing the filter fabric to the pipe shall be sufficient to hold the fabric in place until the backfill is placed and compacted. The method used to secure the fabric to the pipe may include grout mixtures, mastics, or strapping devices.

430-7 SPECIFIC REQUIREMENTS FOR CONCRETE PIPE.

430-7.1 Sealing Joints.

430-7.1.1 Round Concrete Pipe Other than Side Drain is expanded as follows:

Sealing of pipe joints with a profile rubber gasket meeting the requirements specified in 942-4 will be allowed for joints designed in accordance with the requirements of 941-1.6.

A prelubricated gasket may be used in lieu of a vegetable soap lubricant if the lubricating material is certified to be inert with respect to the rubber gasket material.

In addition to the round rubber gasket, a filter fabric jacket shall be furnished and installed around the first joint of all round concrete pipe entering or leaving a drainage structure.

Unless otherwise shown in the plans, the filter fabric jacket shall consist of a piece of filter fabric meeting the requirements in Section 985 for subsurface drainage. The filter fabric shall be 24 inches wide and shall be held securely against the outside of the pipe by steel or plastic strapping. Other methods approved by the Engineer which can be demonstrated to keep the fabric in place without visible openings between the pipe and fabric may be used. The ends of the filter fabric shall overlap a minimum distance of 24 inches. Unless otherwise provided for, the cost of furnishing and installing the filter fabric jacket shall be included in the cost of the pipe being wrapped.

430-7.2 Laying Requirements for Concrete Pipe with Rubber Gasket Joints. The text is

deleted and the following substituted:

For concrete pipe laid with rubber gasket joints, the pipe shall be laid to the line and grade shown in the plans within the following tolerances. Departure from and return to plan alignment and grade shall not exceed 1/16 inch per foot of nominal pipe length, with a total of not more than one inch departure from theoretical line and grade. In addition, the gap between sections of pipe shall not exceed 5/8 inch for pipe diameters of 12 inches through 18 inches, 7/8 inch for pipe diameters of 24 inches through 66 inches and one inch for pipe diameters 72 inches and larger. Where minor imperfections in the manufacture of the pipe create an apparent gap in excess of the tabulated gap, the joint will be acceptable provided that the imperfection does not exceed 1/3 of the circumference of the pipe and the rubber gasket is 1/4 inch or more past the pipe joint entrance taper. Installations where concrete pipe are outside of these tolerances shall be relaid without additional compensation. No mortar, joint compound, or other filler which would tend to restrict the flexibility of the joint shall be applied to the gap. Additional gap or departure from alignment or grade may occur during backfill, compaction and embankment construction operations. Therefore the Contractor is cautioned that utilization of all the allowable tolerance during the initial installation of the pipe can result in completed installations which are in excess of the maximum tolerance, requiring relay operations at the Contractors expense.

430-7.3 Field Joints for Elliptical Concrete Pipe is expanded by the following paragraph:

Unless otherwise specified in the plans, sealing of pipe joints with a profile rubber gasket meeting the requirements specified herein will be allowed for joints designed in accordance with the requirements of 941-2.

Pipe to be laid with a profile rubber gasket shall be subject to the following requirements:

(1) General: Installation shall be in accordance with the manufacturer's instructions and these specifications. The Contractor shall be responsible for obtaining a permanent water tight joint.

(2) Material: The profile rubber gasket shall conform to the requirements of 942-4.

(3) Joint Design: The pipe manufacturer shall furnish the Engineer with details in regard to configuration of the joint and gasket required to effect a satisfactory seal. No mortar, joint compound, or other filler which would tend to restrict the flexibility of the gasket joint shall be applied to the gap.

In addition to the above requirements, the outside of each joint (Regardless of joint seal used) shall be completely wrapped with either a woven or non-woven filter fabric. The fabric shall be a minimum of two feet width and held securely against the elliptical pipe or culvert by metal strapping around the entire structure circumference. Other methods which will hold the fabric securely against the wall of the structure until the backfill is placed and compacted may be used. (The filter fabric shall provide an Equivalent Opening Size (EOS) of 70 to 100 unless otherwise shown in the plans.)

(7) The outside of each joint shall be completely wrapped with either a woven or non-woven filter fabric. The fabric shall be a minimum of two feet in width and held securely against the elliptical pipe or culvert by metal strapping around the entire structure

circumference. Other methods which will hold the fabric securely against the wall of the structure until the backfill is placed and compacted may be used. (The filter fabric shall provide an Equivalent Opening Size (EOS) of 70 to 100 unless otherwise shown in the plans.)

430-7.3(1) General. The second sentence beginning with "The Contractor shall" is deleted.

430-8 SPECIFIC REQUIREMENTS FOR CORRUGATED STEEL PIPE.

430-8.1.2 Cross Drain, Storm Sewer and Gutter Drains. The first sentence of the first paragraph is deleted and the following substituted:

Where corrugated steel pipe is used as cross drain, storm sewer, or gutter drain, the above specified banded joints shall be gasketed with a rubber or neoprene gasket of a design shown to secure the joint performance specified.

430-8.1.2 Cross Drain, Storm Sewer and Gutter Drains. The second sentence of the second paragraph beginning "When two gaskets" is deleted and the following substituted:

When two gaskets are used, the overlapping area on the coupling band between the gaskets shall be sealed consistent with the joint performance specified.

430-8.1.2 Cross Drain, Storm Sewer and Gutter Drains is expanded by the following:

Unless otherwise indicated in the plans, the following minimum joint performance standards apply:

<u>Pipe Application</u>	<u>Minimum Standard</u>
Cross Drains	Soil-tight.
Storm Sewers	Soil-tight.
Gutter Drains	Water-tight.

SECTION 440
UNDERDRAINS

440-1 DESCRIPTION is expanded as follows:

The work specified in this Section also consists of the construction of Edgedrain (Draincrete) and Underdrain Outlet Pipes in accordance with the details and notes shown in the plans.

440-2 MATERIALS is expanded as follows:

(8) Draincrete shall be in accordance with Section 350.

Only polyvinyl-chloride pipe in accordance with 948-1.6 shall be used in Edgedrain (Draincrete) construction.

440-6 METHOD OF MEASUREMENT is expanded as follows:

The quantities to be paid for under this Section shall also be the length in feet of Edgedrain (Draincrete) and Underdrain Outlet Pipe measured in place, along the centerline of the edgedrain and outlet pipe.

440-7 BASIS OF PAYMENT is expanded as follows:

The quantities, as provided above, shall be paid for at the contract unit prices per linear foot for Edgedrain (Draincrete) and Underdrain Outlet Pipe. Such prices and payments shall be full compensation for all work and materials required, except as indicated otherwise in the plans.

The following new pay items are added:

Item No. 441-1-1 -Edgedrain (Draincrete)

-per linear foot.

Item No. 440-73 -Underdrain Outlet Pipe

-per linear foot.

SECTION 441 **EDGEDRAIN MAT (GEOCOMPOSITE DRAIN)**

441-2.1 Materials is expanded as follows:

(a) In the second paragraph, the following sentence is inserted ahead of the last sentence in this text:

Included with the submission shall be two 12-inch by 12- inch specimens of the Geocomposite Drain.

(b) The third paragraph is expanded by the following sentence:

The Geocomposite Drain shall be one of the products included on the Qualified Products List, current at the time of the products proposal for use.

441-2.3 Filter Fabric is revised as follows:

(a) Under the Test Method Property for Seam Strength, (wide mouth method) is changed to (wide-width strip method).

(b) The single asterisk note is deleted and the following substituted:

* Any drain's filter fabric that is overlapped and glued and/or bonded on the pavement side is the critical permeability section; and a section of filter fabric with the same characteristics, i.e., as fabricated and installed, shall be tested – to ensure that the overlapped section complies with the specified requirements. When the drain's filter fabric is not overlapped on the pavement side, a normal thickness of the filter fabric may be tested to determine its acceptability.

441-2.4 Geocomposite Drain is revised as follows:

(a) In the table under Test Method, the asterisk after ASTM D 1621 is deleted.

(b) In the table under Property, an asterisk is inserted after Peel Strength.

- (c) In the table under Test Method for Peel Strength, "ASTM D 1876" is deleted and "ASTM D 903" is substituted.
- (d) In the table under Requirements for In-Plane Flow, gpm is changed to gals.
- (e) The single asterisk note is deleted and the following substituted:

*Peel strength shall be tested for all three conditions. The test specimens are both flexible (filter fabric) when testing bonding fabric to fabric, and flexible to rigid (filter fabric to core) when testing bonding fabric to projection or core. Bonding of specimens to each other shall be typical of assembly conditions of a drain completely fabricated and installed. Thickness of the rigid (core) material is the normal core thickness, prior to the filter fabric encasement, and is an exception to the limiting 1/8-inch thickness of test materials specified in the test method.

SECTION 443

FRENCH DRAINS

443-1 DESCRIPTION.

In general, the work specified in this Section shall consist of the construction of French Drains, utilizing one of the authorized types of pipe, with coarse aggregate, or ballast rock when specified, and filter fabric, in accordance with these specifications and in conformity with the lines, grades, dimensions, notes and details shown in the plans.

443-2 MATERIALS.

443-2.1 Pipe. Unless a particular type is specified in the plans, the pipe furnished shall be any of the following types:

- (1) Concrete Pipe (Bell & Spigot):

At the option of the Contractor, slotted or perforated concrete pipe may be used. Concrete pipe shall meet the minimum D-load strength requirements of ASTM C-76 Class III pipe and the non-strength requirements of Section 941. Gaskets shall not be used, but the spigot shall be fully inserted in the bell, and brought home. Slotted pipe shall conform to Standard Index 285. Perforated pipe shall have perforations equally located 360 degrees around the pipe. There shall not be less than thirty 3/8-inch round perforations per square foot of inside pipe surface. Perforations shall extend to within six-inches of the bell or spigot area. Other perforations not less than 5/16-inch nor more than 3/8-inch in the least dimension are permitted if they provide an opening area not less than 3.31 square inches per square foot of pipe surface.

- (2) Corrugated Aluminum Alloy Culvert Perforated Pipe:

If the Contractor elects to use this item it shall be in conformity with Section 945. Perforations shall be equally located 360 degrees around the pipe. Perforations shall be

located either on the inside crests or on the neutral axis of all corrugations except that perforations are not required within four inches of each end of each length of pipe or in a corrugation where seams are located.

There shall not be less than thirty 3/8-inch round perforations per square foot of pipe surface. Other perforations not less than 5/16-inch nor more than 3/8-inch in the least dimension are permitted if they provide an opening area not less than 3.31 square inches per square foot of pipe surface.

(3) **Corrugated Steel Perforated Pipe:**

If the Contractor elects to use this item, it shall be in conformity with Section 943. Perforations shall be spaced and meet the requirements as specified in (2) above.

443-2.2 Coarse Aggregate. The Coarse Aggregate or Ballast Rock shall meet the gradation requirements as specified for No. 4 stone in 901-1.4.

443-2.3 Select Fill. The select fill, unless otherwise called for shall consist of well-graded limerock or limerock and sand fill. Sand, or fill having a high proportion of sand, will not be accepted as select fill. All select fill shall be approved by the Engineer prior to placing.

443-3 EXCAVATING TRENCH.

The excavation of the trench shall be in accordance with Section 125 unless specific trench excavation procedures are described in the plans.

The trench shall be excavated carefully to such depths as required to permit the filter fabric, coarse aggregate and the pipe to be placed in accordance with the details shown on the plans.

443-4 LAYING PIPE.

All pipe shall be carefully laid in conformity with the lines and grades specified in the plans and in accordance with these specifications. Unless otherwise specified in the plans, the pipe shall be set with a minimum cover of 36 inches and a maximum cover of 66 inches.

443-5 PLACING COARSE AGGREGATE AND BACKFILLING.

After the pipe has been laid and the laying approved, the coarse aggregate or ballast rock shall be placed carefully, so as not to disturb the pipe, around and over the pipe to a depth shown on the plans. The filter fabric shall then be folded over the coarse aggregate or ballast rock as shown on the plans, and the portion of the trench above the coarse aggregate filled with select fill material placed in layers not to exceed six-inch compacted thickness in conformance to the lines and grades as shown on the plans.

443-6 METHOD OF MEASUREMENT.

The quantity of French Drains to be paid for under this Section shall be the length in linear feet measured in place, completed and accepted or paid for separately under the several related pay items as specified on Roadway and Traffic Design Standards Drawing No. 285 for French Drains with a significantly different cross section.

443-7 BASIS OF PAYMENT.

The quantities determined as provided above shall be paid for at either (1) the Contract unit price per linear foot for French Drains or (2) separately under the several related pay items as defined in 443-6. Such prices and payments shall be full compensation for all the work specified in this Section and shall include all materials and all excavation, and shall also include sheeting or shoring, if required, the disposal of surplus material, pavement restoration, backfilling and tamping, but shall not include payment for items paid for elsewhere in the Specifications.

Payment shall be made under item:

- Item No. 430-721 -Slotted or Perforated Pipe Culvert - per linear foot.
- Item No. 443-70 -French Drains - per linear foot.
- Item No. 443-71 -Ballast Rock - per cubic yard.
- Item No. 514-71 -Plastic Filter Fabric - per square yard.

SECTION 450
PRESTRESSED CONSTRUCTION

450-3.8 Debonding Pretension Strands.

450-3.8(c). In the first sentence, reference to "0.075" is changed to "0.14".

450-14 ALTERNATE DETAILS FOR PRESTRESSED MEMBERS is deleted and the following substituted:

450-14 SUBMITTAL REQUIREMENTS FOR PRESTRESSED MEMBERS.

450-14.1 Pretensioned Members Constructed According to Contract Documents:

A formal Shop Drawing submittal is not required. In order to construct prestressed pretensioned members under these provisions, all detailed and specified materials, dimensions, component types and sizes and methods of stressing and detensioning must be in strict accordance with the plans and these specifications except where specifically permitted otherwise. In lieu of formal Shop Drawings, four copies of the following Construction Submittals shall be submitted to the Engineer:

- (1) Framing Plan with member designations for all superstructure components.
- (2) Strand detensioning schedule.
- (3) Tensioning and elongation calculations.

450-14.2 Permission to Use Alternate Materials or Methods. When Optional Details or Designs are Proposed:

If the Contractor desires to use materials or methods that differ in any respect from

those shown in the plans and described in these specifications, he shall submit full plan details and specifications. In order for any optional materials or methods to be considered, they will be required to comply fully with the following:

- (1) The provisions of these specifications.
- (2) The Standard Specifications for Highway Bridges, of the American Association of State Highway and Transportation Officials, latest edition.
- (3) The provisions of the Department's Structures Design Guidelines.
- (4) Design criteria and notes on the plans.
- (5) The recommendations of the materials manufacturer.

450-14.3 Permission to Use Optional Materials or Methods:

The Engineer shall be the sole judge as to the adequacy and propriety of any variation of materials or methods, and the right is specifically reserved to reject any proposal for materials or methods which, in the opinion of the Engineer, are not fully equivalent in all respects to those shown on the plans and described in these specifications.

STRUCTURES FOUNDATIONS - PILING.

SECTION A455 (Pages 419-443) is deleted and the following substituted:

SECTION A455
STRUCTURES FOUNDATIONS - PILING

SECTION A455

STRUCTURES FOUNDATIONS - PILING

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A455-1 DESCRIPTION.

The work specified in this Subsection consists of all work necessary to furnish and install piling including driving, jetting, preformed pile holes, cutting off, splicing, dynamic load testing and static load testing of piling. The piling shall be concrete, steel, or wood, as indicated in the plans. All work shall be done in accordance with these specifications and in conformity with the locations, elevations, dimensions and notes shown in the plans or ordered by the Engineer.

A455-2 CLASSIFICATION.

Piling shall be classified as follows:

- (1) Treated timber piling.
- (2) Prestressed concrete piling.
- (3) Steel piling.
- (4) Driven test piling.
- (5) Sheet piling.
 - (a) Concrete sheet piling.
 - (b) Steel sheet piling.

A455-3 GENERAL REQUIREMENTS.

A455-3.1 Protection of Existing Structures. When the plans require pile driving operations in close proximity to existing structures, the Contractor shall take all reasonable precautions to prevent damage to such structures. The requirements described herein apply to all types of structures (on or off the right of way) that may be adversely affected by foundation construction operations (including phase construction) due to vibrations, ground loss, ground heave, or dewatering. Utilities shall be protected as described in 7-11.6.

The Contractor shall monitor adjacent structures for settlement in an approved manner, recording elevations to 0.001 foot, during driving when the pile driving operations are required within a distance, in feet, equal to 0.5 times the square root of the hammer energy, in foot-pounds or the distance shown in the plans. Required measurements shall be taken before the initiation of driving and then daily on days when driving occurs or as indicated in the plans and weekly for two weeks after driving has stopped.

In addition, when pile driving operations occur within a distance, in feet, equal to 0.25 times the square root of the hammer energy, in foot pounds, or the distance shown in the plans, the Contractor shall engage the services of a qualified Professional Engineer registered in the State of Florida to conduct a survey of all (except as noted herein) structures, or portions thereof, within this distance before pile driving begins and again after all pile driving is completed. The Department will make the necessary arrangements for entry by the Contractor's Engineer to survey. The condition of the structures shall be adequately documented with descriptions and pictures. All existing cracks shall be thoroughly documented. Two reports shall be prepared documenting the condition of the structures; one report before driving begins and a second report after driving is complete. Both reports shall become the property of the Department. Predriving and post-driving surveys of the condition of bridges owned by the Department will not be required except when shown in

the plans or Special Provisions.

When shown in the Contract Documents, the Contractor shall also engage the services of a qualified Professional Engineer registered in the State of Florida to monitor and record vibration levels during the driving operations. Vibration monitoring equipment shall be capable of detecting velocities of 0.1 inch/second or less.

When shown in the Contract Documents or when authorized by the Engineer, the Contractor shall install the piling to the depth required to minimize the effects of vibrations or ground heave on adjacent structures by approved methods other than driving (performed holes, predrilling, jetting, etc.) In the event that performed pile holes are authorized to meet this requirement, payment for this work shall be as described in A455-3.10.3.

Piles shall not be driven within 200 feet of concrete less than two days old unless authorized by the Engineer.

When the plans require excavations for construction of footings or caps supported by piling, the Contractor shall be responsible for evaluating the need for, design of, and providing any necessary features to protect adjacent structures. Sheeting and shoring shall be constructed according to plans provided by the Contractor except when the sheeting and shoring are detailed in the plans. Sheeting and shoring installed to protect existing structures shall be designed by a Professional Engineer, employed by the Contractor, registered in the State of Florida and who shall sign and seal the plans and specification requirements. Plans and specifications for sheeting and shoring provided by the Contractor shall be sent to the Engineer for his record before construction begins.

Existing structures within a distance of three times the depth of excavation for the footing shall be monitored for movement. The number and location of monitoring points shall be as approved by the Engineer. Elevations shall be taken before the driving of any sheeting, daily during the driving of any sheeting and during excavation, read and recorded to 0.001 foot. The Contractor shall notify the Engineer of any movements detected and immediately take any remedial measures required to prevent damaging the existing structure.

When shown in the plans or directed by the Engineer, the Contractor shall install a piezometer near the right of way line and near any structure that may be affected by lowering the ground water when dewatering is required. The piezometer shall be monitored and the ground water elevation level recorded daily. The Contractor shall notify the Engineer of any ground water lowering near the structure of one foot or more.

At any time the Contractor detects settlement or heave of 0.005 foot, levels of vibration reaching 0.5 in/sec, the level otherwise shown in the Contract Documents, or damage to the structure, he shall stop driving immediately and notify the Engineer for instructions.

A455-3.2 Site Preparation.

A455-3.2.1 Excavation. All excavation of the foundations in which piles are to be driven shall generally be completed before driving begins. After driving is completed, all loose and displaced materials shall be removed from around the piles leaving a clean, solid surface. The soil surface on which concrete is to be placed or which will support the forming system for the concrete shall be compacted to a density not less than 90 percent of the maximum density as determined by AASHTO T 180 and which will support the load of

the plastic concrete without settling or causing the concrete to crack or as shown in the Contract Documents. No compaction will be required for excavations made below water for seals or when the footing or cap or forming system (including supports) do not rest on the ground surface unless shown in the plans.

A455-3.2.2 Abutment (End-Bent) Fill. The fill shall be in place and compacted before end-bent piling are driven, except that, when test piling are specified to be driven in end bents; or the plans show uncased piles through proprietary retaining wall fills, such piles may be driven prior to the placing and compacting of fill and the construction of the proprietary wall. When piles are driven prior to placing fill, the Contractor shall take necessary precautions to prevent displacement of piles during placing and compacting fill materials within 15 feet of the piles. The position of the piles shall be referenced and the pile position shall be checked by the Contractor at three approximately equal intervals during construction of the embankment.

Embankment material shall be placed in six-inch loose lifts in the 15-foot area around the piles. Embankment material within the 15-foot area adjacent to the piles shall be compacted to the required density with compaction equipment weighing less than 1000 pounds.

When piles are driven prior to the completion of the surrounding fills, they shall not be capped until the fills have been placed as near to final grade as possible, leaving only the necessary working room for construction of the caps.

A455-3.2.3 Predrilling of Pile Holes. Predrilled pile holes are either 4 foot maximum depth starter holes or holes drilled through embankment/fill material down to the natural ground surface. When low displacement steel piling such as structural shapes are used they shall be driven through the compacted fill without the necessity of drilling holes through the fill except when the requirements for predrilling are shown in the plans. When concrete or other high displacement piles are used, pile holes shall be drilled through fill, new or existing, to at least the elevation of the natural ground surface. The drill diameters listed below shall be used for square concrete piles unless shown otherwise in the plans.

12 inch square piles	15 inches
14 inch square piles	18 inches
18 inch square piles	22 inches
20 inch square piles	24 inches
24 inch square piles	30 inches
30 inch square piles	36 inches

The diameter of the drills for other pile sizes shall be as shown in the plans or approved by the Engineer. The pile holes shall be accurately drilled with the hole centered over the plan location of the piling. The location and vertical alignment shall be maintained within the tolerances allowed for the piling.

For predrilled holes which are required through rock material that may damage the pile during installation, the predrilled hole diameter shall be approximately two inches larger than the largest dimension across the pile cross section. For predrilled holes which are required through material that caves during driving to the extent that the predrilled hole does not serve its intended purpose, the hole shall be cased from the embankment surface to the

approximate elevation of the natural ground surface. The casing shall be filled with concrete sand or other approved clean sand in a manner approved by the Engineer after the pile is driven. After the piles are driven and accepted, the casings shall then be removed unless shown otherwise in the plans.

In the setting of permanent and test piling, initial predrilled holes may be provided to a depth up to four feet, except that where piles are to be installed in compacted fill, the holes shall be predrilled to the elevation of the natural ground surface. With prior written authorization of the Engineer, holes may be preformed to depths greater than four feet to minimize the effects of vibrations on existing structures adjacent to the work and/or for other reasons proposed by the Contractor. Such work when allowed, but not required by the Engineer, shall be performed at no cost to the Department. When such work is required by the Engineer and the plans do not provide for preformed holes, the additional cost of such work beyond the initial four feet shall be paid for as Unforeseeable Work as described in 455-3.10.2.

Any voids between the pile and soil remaining after driving through predrilled holes shall be filled with concrete sand or other approved clean sand in an approved manner.

All work described above such as specified drills, larger drills, casing, power supplies, handling equipment and all other required labor, equipment and materials shall be included in the bid price for driving piles per linear foot unless a pay item is specifically included for this work.

A455-3.2.4 Cofferdams. Cofferdams shall be constructed according to plans provided by the Contractor except when the cofferdams are detailed in the Contract plans. Cofferdam designs provided by the Contractor shall be sent to the Engineer for his records. Cofferdams shall be designed by a Professional Engineer, employed by the Contractor, and registered in the State of Florida, who shall sign and seal his plans and specification requirements.

The Contractor shall provide a qualified diver and safety diver to inspect the conditions of the foundation enclosure or cofferdam when a seal is required for construction. These divers shall be equipped with suitable voice communications and they shall inspect the foundation enclosure and cofferdam periphery including each sheeting indentation and around each piling to ensure that no layers of mud or other undesirable materials were left above the bottom of seal elevation during the excavation process. They shall also check to make sure the surfaces of the piles are sufficiently clean to allow bond of the concrete down to the authorized bottom of seal elevation. When required, the divers shall assure that there are no mounds of stone, shell or other authorized backfill material left after placement and grading. They shall also assist the Engineer as required to assure that the seal is placed as specified. Any deficiencies found by the divers shall be corrected by the Contractor. Upon completion of inspection by the Contractor's divers, the Department may also elect to have its divers inspect the work before authorizing the Contractor to proceed with subsequent construction operations. The Contractor shall furnish the Engineer a written report by his divers indicating the results of their underwater inspection before the seal concrete is authorized to be placed.

A455-3.2.5 Underwater Driving. Underwater driving is defined as any driving through water which is above the pile head at the time of driving.

When underwater driving is conducted, the Contractor shall provide a diver equipped with voice communications to aid in placing the hammer back on the pile, for required cushion changes or for subsequent re-driving, to attach or recover instrumentation used by the Engineer, to inspect the condition of the pile, or for other assistance as required.

The Contractor may select one of the following methods for underwater driving:

- (a) Underwater driving may be accomplished using conventional driving equipment and piling longer than authorized so that the piling will extend above the water surface during final driving. When this option is chosen, the Contractor shall furnish a pile hammer which satisfies the specification requirement for the longer pile being used.
- (b) Underwater driving may be accomplished using an underwater hammer meeting the requirements of these specifications and having the approval of the Engineer. When the Contractor selects this option, he shall provide at least one pile longer than authorized at each pile group, extending above the water surface at final driving. At each group location, the longer pile shall be driven first. The Engineer will evaluate the adequacy of the underwater driving system. The pile tip elevation of the longer pile, as driven and accepted, may be used by the Engineer to evaluate the acceptability of the piles driven with the underwater hammer.
- (c) Underwater driving may be accomplished using conventional driving equipment with a suitable approved pile follower. When the Contractor selects this option, he shall provide at least one pile longer than authorized at each pile group, extending above the water surface at final driving. At each group location the full length pile shall be driven first without using the follower. The Engineer will evaluate the adequacy of the follower used for underwater driving. The Engineer may choose to perform a dynamic load test on the first pile driven with the follower in each group. The pile tip elevation of the longer pile, as driven and accepted, may be used by the Engineer to evaluate the acceptability of the piles driven with the follower.

Prior to use, the Contractor shall submit details of the follower for evaluation and approval along with the information required in A455-8. The weight, cross section details, stiffness, type of materials, and dimensions of the follower shall be supplied.

A455-3.3 Pile Hammers.

The Contractor shall furnish to the Engineer all technical specifications and operating instructions related to his hammer equipment.

A455-3.3.1 Air/steam. Air/steam hammers shall be rated based on the theoretical kinetic energy of the ram at impact. A variable energy hammer shall be used to drive concrete piles. Air/steam hammers used to drive concrete piles shall be capable of providing at least two ram stroke lengths. The short ram stroke length shall be approximately half of the full stroke for hammers with strokes up to four feet, and shall be no more than two feet for hammers with maximum stroke lengths over four feet. Air/steam hammers shall be operated and maintained to operate within the manufacturer's specified

ranges. The plant and equipment furnished for steam and air hammers shall have sufficient capacity to maintain at the hammer, under working conditions, the volume and pressure specified by the manufacturer. The plant and equipment shall be equipped with accurate pressure gauges which are easily accessible to the Engineer. Final bearing shall not be accepted on piles driven with air/steam hammers unless the hammers are operating within ten percent of the manufacturer's rated speed in blows per minute, unless otherwise authorized by the Engineer.

A455-3.3.2 Diesel. Diesel hammers shall be rated based on the theoretical kinetic energy of the ram at impact. A variable energy hammer shall be used to drive concrete piles.

Diesel hammers used to drive concrete piles shall be capable of providing a selection of at least three fuel settings that will produce reduced strokes. Diesel hammers shall be operated and maintained to operate within the manufacturer's specified ranges. The rated energy of diesel hammers shall be determined using measured ram stroke length multiplied by the weight of the ram for open end hammers and by methods recommended by the manufacturer for closed end hammers. The actual hammer energy shall be determined in the field so that it is consistent with the hammer energy used for each bearing capacity determination.

Open-end (single acting) diesel hammers shall be equipped with a scale (jump stick) extending above the ram cylinder, to permit the Engineer to visually determine hammer stroke at all times during pile driving operations. The Contractor shall provide the Engineer a chart from the hammer manufacturer equating stroke and blows per minute for the open-end diesel hammer to be used. The Contractor shall also provide (and maintain in working order) for the Engineer's use an approved device to automatically determine and display ram stroke for open-end diesel hammers. Closed-end (double acting) diesel hammers shall be equipped with a bounce chamber pressure gauge, in good working order, mounted near ground level so as to be easily read by the Engineer. Also, the Contractor shall provide the Engineer a chart, calibrated to actual hammer performance within 30 days prior to initial use, equating bounce chamber pressure to either equivalent energy or stroke for the closed-end diesel hammer to be used.

A455-3.3.3 Hydraulic. Hydraulic hammers shall be rated based on the theoretical kinetic energy of the ram at impact. A variable energy hammer shall be used to drive concrete piles. Hydraulic hammers used to drive concrete piles shall be equipped with at least three hydraulic control settings that provide for predictable stroke control. The shortest stroke shall be no more than two feet for the driving of concrete piles. The remaining strokes shall be full stroke and approximately halfway between minimum and maximum stroke.

The hammer energy shall be determined according to the manufacturer's recommendations. When pressure measuring equipment is required to determine hammer energy, the pressure gauges shall be calibrated before use.

A455-3.3.4 Vibratory. Vibratory hammers may be used to drive steel sheet piles and with approval of the Engineer to drive steel bearing piles a sufficient distance to get the impact hammer on the pile (to stick the pile). The Engineer will determine the allowable

depth of driving using the vibratory hammer based on site conditions. However, in all cases, 15 or more feet of final driving of steel bearing piles shall be with a power impact hammer for bearing determinations. Vibratory hammers shall in all cases have sufficient capacity (force and amplitude) to perform the intended work.

A455-3.4 Cushions and Pile Helmet.

A455-3.4.1 Capblock. The capblock cushion (also called the hammer cushion) shall generally be as recommended by the hammer manufacturer. It shall be constructed of durable manmade materials with uniform known properties. Wood chips, wood blocks, rope, cable, or other material which permit excessive loss of hammer energy shall not be used. Capblock constructed of asbestos materials shall not be used. All proposed capblock materials and proposed thickness for use require approval by the Engineer and shall be subject to satisfactory performance in the field. Capblocks shall be maintained in good condition and changed when charred, melted, or otherwise significantly deteriorated. The capblock will be inspected before driving begins and weekly or at appropriate intervals determined by the Engineer based on field trial. Any hammer cushion which loses more than 25 percent of its original thickness shall be replaced or repaired, in accordance with the manufacturer's instructions, by the Contractor before further driving is permitted.

A455-3.4.2 Pile Cushion. The pile cushion shall be adequate to protect the pile from being overstressed in compression and tension during driving. The pile cushion shall be sized so that it will fully fill the lateral dimensions of the pile helmet. The thickness will depend upon the hammer-pile-soil system. The pile cushion for the driving of concrete piles shall generally be pine plywood sized to protect the pile against overstressing. Other materials may be used provided satisfactory proof is supplied to the Engineer showing it to be acceptable. All pile cushions require approval by the Engineer and shall be subject to satisfactory performance in the field. Pile cushions shall be maintained in good condition and changed when charred, splintered, excessively compressed, or otherwise deteriorated to the point it will not protect the pile against overstressing in tension and/or compression. Cushions shall be protected from the weather and remain dry, and shall not be soaked in any liquid unless approved by the Engineer. The pile cushion shall be replaced if, during the driving of any pile, the cushion is either compressed more than one-half the original thickness or begins to burn. A new cushion shall be provided for each pile unless approved otherwise by the Engineer after satisfactory field trial.

Used pile cushions in good condition shall be used to perform all set checks and redrives. The same cushion shall be used to perform the set check or redrive as was used during the initial driving, unless this cushion is unacceptable due to deterioration, in which case a similar used cushion may be utilized.

A455-3.4.3 Pile Helmet. The pile helmet shall be suitable for the type and size of piling being driven. It shall be deep enough to adequately contain the required thickness of pile cushion and to assist in maintaining pile-hammer alignment. It shall fit loosely over the pile head and shall be at least one inch larger than the pile dimensions. The pile helmet shall be designed so that it will not restrain the pile from rotating.

A455-3.5 Leads.

Pile leads shall be constructed in a manner which offers freedom of movement to the hammer, and they shall have the strength and rigidity to hold the hammer and pile in the correct position and alignment during driving. When followers are used, the leads shall be long enough and suitable to maintain position and alignment of the hammer, follower, and pile throughout driving.

A455-3.6 Followers.

Followers shall be used only for underwater driving. The type of follower, when used, and the method of connection to the leads and pile shall be approved by the Engineer. Followers shall be constructed of steel with an adequate cross section to withstand driving stresses. When driving concrete piles, the cross sectional area of the follower shall be at least 18 percent of the cross sectional area of the pile. When driving steel piles, the cross sectional area of the follower shall be greater than or equal to the cross sectional area of the pile. A pile helmet shall be provided at the lower end of the follower and it shall be sized according to the requirements of A455-3.4.3. Followers shall be constructed so that the alignment of the pile, follower and hammer can be maintained and the pile driven within the allowable tolerances. Followers shall be designed with guides adapted to the leads being used so that the hammer, follower and the piles are maintained in alignment.

Information from the driving of full length piles described in A455-3.2.5 compared to driving piles with the follower and/or dynamic load tests described in A455-3.14 will be used to evaluate the adequacy of the follower and to establish the blow count criteria when using the follower.

A455-3.7 Templates.

The Contractor shall provide an adequate fixed template to maintain the pile in proper position and alignment during driving with swinging leads or with semi-fixed leads. For Piles on land, the template shall be located within five feet of cutoff or within five feet of ground line whichever is lower. For piles in water, the template shall be located within five feet of cutoff or within five feet of the waterline, whichever is lower. Floating templates (attached to a barge) will not be allowed. Where practical, the template shall be placed so that the pile can be driven to cut-off elevation before the template is removed. When the Contractor proposes to use a free hammer, he shall provide a rigid double template which will independently support the pile. Free hammers shall be provided with approved guide extensions which hold the hammer in alignment with the pile to assure that the hammer blow is applied axially to the pile at all times. When driving piles with a follower using floating equipment, a double template or other approved equipment shall be provided to maintain alignment of the hammer, follower and pile. A double template shall consist of a pile template within five feet of cut-off elevation and a second upper support above the water surface for the leads. Where practical, the template shall be placed so that the pile can be driven to cut-off elevation before the template is removed. The individual pile positions of the second upper template shall be adjustable in size to serve as a guide for both the pile and follower. Templates shall not restrict the vertical movement of the pile.

A455-3.8 Water Jets.

Jetting will not be allowed without prior approval of the Engineer or unless addressed on

the plans. Jetting will not be allowed in the completed embankment. Where conditions warrant, with approval by the Engineer, holes may be jetted first, the pile placed therein and then driven to secure the last few feet of penetration. One jet will be acceptable for prejetting or jetting through piles constructed with a center jet-hole. Two jets will be required when piles are jetted and driven concurrently when using external jets. When jetting and driving, the jets shall be slightly behind the advancing pile tip (approximately three feet or as approved by the Engineer). When water jets are used in the driving, the pile bearing shall be determined only from the results of driving after the jets have been withdrawn, except where jets are used to continuously eliminate soil resistance through the scour zone, they shall remain in place as directed by the Engineer and operating during pile bearing determination.

Where practical, all piles in a pile group shall be jetted before driving begins. When large pile groups or pile spacing and batter make this impractical, or when a jet-drive sequence is specified in the plans, a sufficient number of previously driven piles in a pile group shall be set checked to confirm their capacity after all jetting is complete. Jet pumps, supply lines and the jet pipe shall provide adequate pressure and volume of water to freely erode the soil. Jet pumps shall have a minimum rated capacity of 250 gallons per minute at 50 pounds per square inch. The jet pipe and feed lines shall have a minimum inside diameter of two inches and three inches, respectively.

A455-3.9 Penetration Requirements.

The penetration of piles shall be measured from the elevation of natural ground, scour elevation shown in the plans or the bottom of excavation, whichever is lower. When the plans or Special Provisions show a minimum pile tip elevation or depth of penetration required, this is the highest elevation to which the tip of the pile is to be driven or the minimum penetration to be achieved. In all such cases, the bearing capacity of a pile shall be acceptable only if the required bearing value is achieved when the tip of the pile is at or below the specified minimum tip elevation or depth of penetration.

When the plans do not show a minimum depth of penetration, scour elevation or minimum tip elevation; the required penetration shall be at least ten feet into firm bearing material or at least 20 feet into soft material unless otherwise permitted by the Engineer. If a scour elevation is shown in the plans, these penetrations are to be achieved below the scour elevation. A penetration between 15 and 20 feet may be accepted when there is an accumulation of five consecutive feet or more of firm bearing material. Firm bearing material is any material offering a driving resistance greater than or equal to 30 tons per square foot of gross pile area as determined by Wave Equation (A455-3.12.2). Soft material is any material offering less than these resistances. The gross pile area shall be the actual pile tip cross sectional area for solid concrete piles, the product of the width and depth for H piles and the area within the outside perimeter for pipe piles and voided concrete piles. The Engineer may accept a driven pile when the pile has achieved minimum penetration, the blow count is increasing and the minimum required bearing capacity obtained for two feet of consecutive driving. At his discretion, the Engineer may also accept a driven pile when the minimum penetration is achieved and driving has reached practical refusal in firm material.

Piles shall not be driven beyond practical refusal (20 blows per inch). To meet the

requirements in this Subarticle, penetration aids such as jetting or preformed pile holes, will be required when piles cannot be driven to the required penetration without reaching practical refusal.

If unforeseen, isolated obstructions are encountered, which cannot be practically penetrated by driving, jetting or preformed pile holes, and that must be removed to obtain the required pile penetration, the costs for such removal will be paid for as Unforeseeable Work.

A455-3.10 Preformed Pile Holes.

A455-3.10.1 Description. Preformed pile holes are holes necessary due to the presence of rock or strong strata of soils which will not permit the installation of piles to the desired penetration by driving or a combination of jetting and driving or holes determined necessary by the Engineer or when authorized by the Engineer to minimize the effects of vibrations on adjacent existing structures. Preformed holes may be required for any type of pile, including sheet piles. Preformed Pile Holes serve as a penetration aid when all other pile installation methods fail to produce the desired penetration and when authorized by the Engineer to minimize the effects of vibrations on adjacent structures. All piles installed in Preformed Pile Holes shall be driven to determine that the bearing requirements have been met.

Any voids between the pile and soil remaining after driving through preformed holes shall be filled with concrete sand or other approved clean sand in an approved manner.

A455-3.10.2 Provisions for Use of Preformed Pile Holes. The necessity for Preformed Pile Holes will generally be anticipated and a pay item included in the proposal. When no pay item for Preformed Pile Holes is included in the contract, the work of providing preformed holes will be considered as Unforeseeable Work, when it is established that the required results cannot be obtained when driving the piles with specified driving equipment, while jetting the piles and then driving, or while jetting the piles during driving.

A455-3.10.3 Conditions Under Which Payment Will Be Made. Payment for Preformed Pile Holes will be made where it is demonstrated that such work is necessary to achieve the required penetration of the pile. Conditions considered as reasons for Preformed Pile Holes shall include, but not be limited to, the following:

- (a) Inability to drive piles to the required penetration with driving and jetting equipment.
- (b) To penetrate a hard layer (or layers) of rock or strong stratum which is not considered to be sufficiently thick to support the structure.
- (c) To obtain greater penetration into dense (strong) material and into dense material containing holes, cavities or unstable soft layers.
- (d) To obtain penetration into a stratum in which it is desired to found the structure.
- (e) To minimize the effects of vibrations or heave on adjacent existing structures.
- (f) To obtain a penetration up to 20 feet (except where a required pile penetration in excess of 20 feet is shown in the plans or Special Provisions).
- (g) To minimize the effects of ground heave on adjacent piles.

A455-3.10.4 Construction Methods.

(a) **Bearing Piles:** Preformed Pile Holes for bearing piles shall be constructed by drilling, or driving and withdrawing a suitable punch or chisel at the locations of the piles. The size of the hole shall be equal or slightly greater than the pile and of sufficient depth to obtain the required penetration. The preformed hole prepared to accommodate the pile shall be carefully formed by the use of a drill or punch guided by a template or other suitable device and shall not exceed the minimum dimensions necessary to achieve the required penetration of the pile. When Preformed Pile Holes are over sized to the extent that the sides of the pile are not in contact with the soil and the pile has inadequate lateral stability, the Contractor shall restore lateral stability by filling the space between the pile and the sides of the hole with concrete sand or other approved clean sand. When the plans call for the Preformed Pile Holes to be grouted, the minimum dimension of the pile hole shall be two inches larger than the largest pile dimension. The holes shall be constructed at the plan position of the pile and the tolerances in location and batter shall be the same as allowed for the pile.

(b) **Sheet Piles:** Holes for sheet piles may be preformed by any approved method including trenching, provided that the depth is sufficient to obtain the required pile penetration. Holes for sheet piling shall be located in plan position. They shall be of proper width to permit installation without loss of the ability of the sheet pile to withstand lateral pressure. Preformed Pile Holes for sheet piles which are too large to provide lateral stability for the sheet pile shall be backfilled with concrete sand or commercial grade concrete aggregate prior to backfilling to provide lateral stability and maintain alignment.

A455-3.10.5 Grouting of Pile Holes. Preformed Pile Holes for bearing piles will not ordinarily be grouted. However, when the plans require grouting after driving to provide for pile uplift and/or lateral resistance, the Preformed Pile Holes shall be cleaned and filled with cement grout as shown in the plans. The grout shall have a minimum compressive strength of 3,000 psi at 28 days or as specified. The grout shall be placed by pumping through three or more grout pipes initially placed at the bottom of the preformed hole. The grout pipes may be raised when necessary to prevent clogging and to complete the grouting operations. However, the grout pipes shall always be kept below the surface of the previously placed grout. Grouting shall continue until the grout reaches the ground surface all around the pile.

The Contractor shall provide divers to monitor grouting operations when the water depth is such that it is impractical to monitor from the ground surface. When grouting is shown in the plans, the cost shall be included in the price for Preformed Pile Holes. In the event that the Engineer determines that grouting will be required and the required grouting is not shown in the plans, the grouting work will be paid for as Unforeseeable Work.

A455-3.11 Bearing Requirements.

A455-3.11.1 General. Piles shall be driven to provide the bearing capacities required for carrying the loads shown in the plans. For all types of bearing piles, the driving resistance (as determined by the methods described herein) sufficient for carrying the specified loads shall be considered as the minimum bearing which shall be accepted for any type of piles. The method of determining pile bearing shall be as described herein or as

shown in the plans.

A455-3.11.2 Blow Count Criteria. The Engineer will determine the number of blows required to provide the required bearing according to the methods described herein. The pile bearing shall generally be determined by computing the penetration per blow averaged through one foot 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. The driving equipment supplied by the Contractor shall provide the required resistance at a blow count ranging from three blows per inch (36 blows per foot) to ten blows per inch (120 blows per foot) unless approved otherwise by the Engineer after satisfactory field trial.

A455-3.11.3 Practical Refusal. Practical refusal shall be defined as 20 blows per inch. Driving shall stop as soon as the Engineer determines that practical refusal has been reached. (The Engineer will generally make this determination within two inches of driving. However, in no case will the Engineer approve the continuation of driving at practical refusal for more than one foot.) When the required pile penetration cannot be achieved by driving without exceeding practical refusal, other penetration aids such as jetting or Preformed Pile Holes shall be used.

A455-3.11.4 Set-checks and Pile Redrive.

(a) Set-checks: In the event that the pile is driven to approximately one foot above cut-off and the required resistance has not been reached, the Engineer may require the Contractor to interrupt driving at least 15 minutes prior to performing set-checks. Set-checks shall consist of ten hammer blows or a foot or more of driving. The Contractor shall provide an engineer's level or other suitable equipment for elevation determinations to determine accurate pile penetration during the set-checks. In the event the results of initial set-checks are not satisfactory, the Engineer may direct additional set-checks for as long as 72 hours before renewing driving to determine time effects. There will be no separate payment for set-checks. Any set-checks ordered by the Engineer longer than 72 hours before renewing driving will be paid under the Pile Redrive item. However, when the template or ground elevation prevents driving the pile to one foot above cut-off and driving is interrupted to remove the template or to excavate to a deeper depth, the 72 hours for pile redrive shall begin after the pile is driven to approximately one foot above cut-off and the Engineer orders the driving stopped for set-checks. The Engineer may accept the pile as driven when a set-check shows that the minimum required pile bearing has been achieved and all other specification requirements have been met.

(b) Pile Redrive: Pile Redrive consists of re-driving the pile after 72 hours from original driving to determine time effects, to reestablish pile capacity due to pile heave, or for other reasons determined by the Engineer. Redrives shall be as directed by the Engineer and may range from ten hammer blows to one foot or more of driving. The Pile Redrive item shall be used only when authorized by the Engineer.

A455-3.11.5 Pile Heave. Pile heave is the upward movement of a pile from its originally driven elevation. The piles shall be driven in an approved sequence to minimize the effects of heave and lateral displacement of the ground. Piles previously driven in a pile

group shall be monitored by the Contractor for possible heave during the driving of the remaining piles. When required by the Engineer, the Contractor shall take elevation measurements to determine the magnitude of the movement of piles and the ground surface resulting from the driving process. All piles that have heaved $\frac{1}{4}$ inch or more shall be redriven by the Contractor unless the Engineer determines that the heave is not detrimental to pile capacity. All work in conjunction with redriving piles due to pile heave shall be paid for under the Pile Redrive item.

A455-3.11.6 Piles with Insufficient Bearing. In the case that the safe bearing capacity of any pile is determined to be less than the required bearing capacity, the pile may be spliced and driving continued, or may be extracted and a pile of greater length driven, or, if so ordered by the Engineer, additional piles shall be driven until the adjusted required bearing per pile is reduced to the determined bearing capacity of the piles already driven.

A455-3.12 Methods to Determine Pile Capacity.

A455-3.12.1 General. The method(s) of determining pile capacity shall be as described herein or as shown in the plans or Special Provisions. The wave equation shall be used to determine pile capacity for all structures or projects unless shown otherwise in the plans or Special Provisions. When necessary, the Engineer may require static load tests, or dynamic load tests, or both to confirm pile capacities estimated from wave equation predictions. When the Contract Documents do not include items for static load tests or dynamic load tests, all required testing will be considered Unforeseeable Work. When considered necessary by the Engineer, the blow count criteria for the wave equation shall be adjusted to match the resistance determined from static load tests or dynamic load tests, or both.

A455-3.12.2 Wave Equation.

A. General: The Engineer may use the Wave Equation Analysis for Piles (WEAP) programs (as documented in the most recent FHWA reports or supplemental updates) or other wave equation programs approved by the Department for wave equation analyses for resistance and pile stresses.

The Wave equation will be used to evaluate the suitability of the Contractor's proposed driving system (including the hammer, follower, capblock and pile cushions) as well as to determine the driving resistance, in blows/foot or blows/inch, to achieve the pile bearing requirements. The required driving resistance shall be equal to the design load multiplied by the appropriate factor of safety plus the scour and down drag resistance shown in the plans (no safety factor is required) or the ultimate bearing capacity shown in the plans, whichever is higher.

Unless otherwise shown in the plans, the factor of safety applied to the design load shall be:

- 2.0 when static load tests are required.
- 2.5 when the Pile Driving Analyzer and Wave Equation analysis are required.
- 3.0 when only the Wave Equation Analysis is required.

The scour resistance shown in the plans may be modified if the dynamic load test is

used to determine the actual soil resistance through the scour zone. Also, modifications in scour resistance may be made by the Engineer when the Contractor proposes drilling and/or jetting to reduce the soil resistance in the scour zone.

The soils data given in the plans will be used by the Engineer to determine the expected driving resistance. However, no hammer will be approved for driving unless wave equation analyses show it capable of driving to a resistance equal to at least 3.0 times the design load plus the scour and down drag resistance (if applicable) shown in the plans or Special Provisions or the ultimate resistance shown in the plans, whichever is higher, without overstressing the piling in compression or tension and without reaching practical refusal (20 blows per inch). The hammer provided shall also meet the requirements described in A455-3.11.2.

B. Required Equipment For Driving: Unless otherwise shown in the plans or Special Provisions, the Contractor shall supply for all pile driving a hammer and a ram with energy and weight that meets or exceeds the requirements described herein. All proposed driving equipment requires approval of the Engineer and is subject to satisfactory field performance.

Table 1 gives the estimated minimum ram weight for the driving of concrete and steel piles. Tables 2 and 3 provide estimates for minimum energy required to drive concrete and steel piles respectively to provide a given ultimate capacity (either the design load times an appropriate factor of safety or the ultimate capacity shown in the plans or Special Provisions) at ten blows and 20 blows per inch. The hammers determined from Tables 1,2 and 3 are considered theoretical minimum hammer sizes and may not provide for economical driving.

Use of inefficient cushions and/or followers may make them unacceptable. Also, these tables do not account for the efficiency loss resulting in reduced hammer energies due to pile batter or other causes.

Use the following steps as a guide to test the suitability of a given hammer:

1. Determine the design load, scour and/or down drag resistance in psi for a given pile size.
2. Multiply the design load in psi by the appropriate factor of safety (2.0, 2.5, or 3.0 from A. above or the value shown in the plans) and add the scour and/or down drag resistance in psi to determine the required ultimate pile capacity.
3. If the plans include an ultimate resistance value, divide by the pile area and convert to psi.
4. Use the maximum value from 2. or 3. above to determine the minimum required energy for ten blows per inch (interpolate between values shown, if necessary).
5. Multiply the design load in psi (from 1. above) by three and add the scour and/or down drag resistance in psi (if applicable) to get the required ultimate hammer capacity.
6. Use the value determined from 5. above to determine the minimum required energy for 20 blows per inch (interpolate between values shown, if necessary).
7. The estimated minimum energy is the maximum value from 4. or 6.
8. Select a given hammer with a rated energy equal or greater than that determined

in 7. above.

9. Divide the rated hammer energy by the ram weight to get the equivalent stroke (E_d/W).
10. Determine the estimated minimum ram weight from Table 1 for the equivalent stroke from 9. above.
11. The ram weight should be equal or greater than the value from Table 1. (If the ram weight of the selected hammer is equal or greater than that as determined from Table 1, the hammer is acceptable. If the ram weight is less than the Table 1 value, the hammer may not be acceptable. In this case select another hammer and repeat steps 8. through 11.)
12. The hammer energy should be equal or greater than the minimum value determined in 7. above. The Engineer may approve a hammer for field trial with less energy than determined according to the above procedures provided wave equation analyses show that the hammer will be acceptable. Final hammer approval is subject to satisfactory performance in the field.

Table 1
ESTIMATED MINIMUM RAM WEIGHT

(a) Concrete Piles

Rated Energy Ram Weight (ft)	12" sq. (lbs)	14" sq. (lbs)	18" sq. (lbs)	20" sq. (lbs)
2	4,600	6,300	10,500	12,900
3	3,800	5,200	8,600	10,600
4	3,300	4,500	7,400	9,200
5	3,000	4,000	6,700	8,200
6	2,700	3,700	6,100	7,500
7	2,500	3,400	5,600	6,900
≥8	2,300	3,200	5,300	6,500

<u>Rated Energy</u> Ram Weight (ft)	24" sq. (lbs)	30" sq. (lbs)	Other Concrete Piles W_h/A_p (psi)
2	18,600	29,000	32.2
3	15,200	23,800	26.4
4	13,200	20,600	22.9
5	11,800	18,500	20.5
6	10,800	16,800	18.7
7	10,000	15,600	17.3
≥8	9,300	14,600	16.2

W_h = weight of ram, lbs

A_p = pile area, sq. in.

Table 1
(continued)
ESTIMATED MINIMUM RAM WEIGHT

(b) Steel Piles

<u>Rated Energy</u> Ram Weight (ft)	HP12x53 (lbs)	(lbs)	HP12x74 (lbs)	HP14x89
2	4,570	6,390	7,680	
3	3,730	5,210	6,240	
4	3,230	4,510	5,240	
5	2,890	4,030	4,850	
6	2,640	3,680	4,430	
7	2,480	3,470	4,170	
≥8	2,280	3,180	3,820	

<u>Rated Energy</u> Ram Weight (ft)	Other Steel Piles	
	HP14x117 (lbs)	W_h/A_p (psi)
2	10,080	293
3	8,220	239
4	7,120	207
5	6,360	185
6	5,810	169
7	5,470	159
≥8	5,020	146

W_h = weight of ram, lbs

A_p = pile area, sq. in.

Table 2
ESTIMATED MINIMUM RATED HAMMER ENERGY
FOR CONCRETE PILES

(a) Estimated Energy For 10 Blows per Inch

<u>Ult. Cap.</u> Pile Area (psi)	12" sq.	14" sq.	18" sq.	20" sq.
	(ft-lb)	(ft-lb)	(ft-lb)	(ft-lb)
≤900	7,700	10,500	17,300	21,400
1200	11,000	15,000	24,800	30,700
1500	15,200	20,700	34,200	42,300
1800	20,000	27,200	44,900	55,500
2100	25,200	34,200	56,600	69,900
2400	30,900	42,000	69,500	85,800
2700	37,300	50,800	84,000	103,700

<u>Ult. Cap.</u> Pile Area (psi)	24" sq.	30" sq.	Other Concrete Piles E_h/A_p (ft-lb/sq. in.)
	(ft-lb)	(ft-lb)	(ft-lb/sq. in.)
≤900	30,800	48,100	53.5
1200	44,200	69,000	76.7
1500	60,900	95,100	105.7
1800	79,900	124,800	138.6
2100	100,600	157,200	174.7
2400	123,600	193,100	214.5
2700	149,300	233,400	259.3

E_h = rated hammer energy, ft-lb

A_p = pile area, sq. in.

Table 2
(continued)
ESTIMATED MINIMUM RATED HAMMER ENERGY
FOR CONCRETE PILES

(b) Estimated Energy for 20 Blows per Inch

<u>Ult. Cap.</u> Pile Area (psi)	12" sq. (ft-lb)	14" sq. (ft-lb)	18" sq. (ft-lb)	20" sq. (ft-lb)
≤900	5,500	7,400	12,300	15,200
1200	8,100	11,000	18,200	22,500
1500	11,100	15,100	25,000	30,800
1800	14,600	19,900	32,800	40,500
2100	18,600	25,300	41,900	51,700
2400	23,100	31,500	52,000	64,200
2700	28,200	38,300	63,400	78,200

<u>Ult. Cap.</u> Pile Area (psi)	24" sq. (ft-lb)	30" sq. (ft-lb)	Other Concrete Piles E_h/A_p (ft-lb/sq. in.)
≤900	21,800	34,100	37.9
1200	32,300	50,500	56.2
1500	44,400	69,400	77.1
1800	58,400	91,200	101.4
2100	74,500	116,400	129.3
2400	92,500	144,500	160.6
2700	112,600	176,000	195.6

E_h = rated hammer energy, ft-lb
 A_p = pile area, sq. in.

Table 3
ESTIMATED MINIMUM RATED HAMMER ENERGY
FOR STEEL PILES

(a) Estimated Energy for 10 Blows per Inch

<u>Ult. Cap.</u> <u>File Area</u>	HP12x53	HP12x74	HP14x89
(psi)	(ft-lb)	(ft-lb)	(ft-lb)
<9000	7,300	10,200	12,300
12000	11,300	15,900	19,100
15000	16,200	22,800	27,300
18000	21,800	30,700	36,700
21000	28,300	39,800	47,700
24000	35,500	49,900	59,700

<u>Ult. Cap.</u> <u>File Area</u>	HP14x117	Other Steel Piles
(psi)	(ft-lb)	E_h/A_p (ft-lb/sq. in.)
≤9000	16,200	470
12000	25,200	732
15000	36,000	1,046
18000	48,400	1,408
21000	62,900	1,828
24000	78,700	2,288

E_h = rated hammer energy, ft-lb

A_p = pile area, sq. in.

Table 3
(continued)
ESTIMATED MINIMUM RATED HAMMER ENERGY
FOR STEEL PILES

(b) Estimated Energy for 20 Blows per Inch

<u>Ult. Cap.</u> HP14x89 Pile Area (psi)	HP12x53 (ft-lb)	HP12x53 (ft-lb)	HP12x74 (ft-lb)
≤9000	5,100	7,100	8,500
12000	8,000	11,200	13,400
15000	11,600	16,300	19,500
18000	15,800	22,300	26,700
21000	20,700	29,100	34,800
24000	26,100	36,700	43,900

<u>Ult. Cap.</u> Pile Area (psi)	HP14x117 (ft-lb)	Other Steel Piles E_h/A_p (ft-lb/sq. in.)
<9000	11,200	326
12000	17,700	513
15000	25,700	748
18000	35,100	1,022
21000	45,900	1,334
24000	57,900	1,684

E_h = rated hammer energy, ft-lb

A_p = pile area, sq. in.

In the event that piles require different hammer sizes, the Contractor may elect to drive with more than one size hammer or with a variable energy hammer, provided the hammer is properly sized, cushioned and the wave equation analyses show that it will not damage the pile and will develop the required resistance.

C. Allowable Pile Stresses:

(a) General: The allowable stresses for concrete, steel, and timber piles are given below. In the event wave equation analyses show that the hammer will overstress the pile the

proposed driving system will be rejected and the Contractor shall modify the driving system or method of operation as required to prevent overstressing the pile. In such cases, reevaluation will be required with additional cushioning or other appropriate changes agreed upon by the Contractor and the Engineer. Penetration of weak soils by concrete piles will require thick cushions and/or reduced stroke to control tension stresses during driving.

(b) Concrete piles: The Engineer will use the wave equation to evaluate the pile cushioning proposed for use by the Contractor. The following equations shall be used to determine the maximum allowable stresses as predicted by the wave equation when driving prestressed concrete piling:

$$S_{\text{pc}} = 0.7 f_c - 0.75 f_{\text{pe}} \dots\dots\dots (1)$$

$$S_{\text{pt}} = 6.5 (f_c)^{0.5} + 1.05 f_{\text{pe}} \dots\dots\dots (2a)$$

(for piles less than 50 ft long)

$$S_{\text{pt}} = 3.25(f_c)^{0.5} + 1.05 f_{\text{pe}} \dots\dots\dots (2b)$$

(for piles over 50 feet long)

where:

- S_{pc} =maximum allowable pile compressive stress, psi
- S_{pt} =maximum allowable pile tensile stress, psi
- f_c =specified minimum compressive strength of concrete, psi
- f_{pe} =effective prestress (after all losses) at the time of driving, psi, taken as 0.8 times the initial prestress force ($f_{\text{pe}}=0$ for spliced piles).

(c) Steel piles: The maximum allowable pile compression and tensile stresses as predicted by the wave equation shall be equal to 0.9 times the yield strength (0.9 f_y) of the steel.

(d) Timber piles: The maximum allowable pile compression and tensile stresses as predicted by the wave equation shall be 3.6 ksi for Southern Pine and Pacific Coast Douglas Fir and 0.9 of the ultimate parallel to the grain strength for piles of other wood.

A455-3.12.3 Bearing Formulas.

The following formula may be used only for temporary timber piles:

Timber Piles:

$$R = \frac{2E}{S + 0.1} \text{ for power hammers}$$

Bearing Formulas shall not be used to determine pile capacity for any other pile

types.

where: R =Safe bearing value, in tons
S =The average penetration per blow, in inches

E =Energy per blow of hammer, in foot tons; (which shall be the product WH, for single-acting hammers, and the manufacturer's rated capacity for the speed used in driving for double-acting hammers. The energy per blow for diesel hammers shall be determined in accordance with the manufacturer's recommendations for closed-end diesel hammers and the product of the ram weight and stroke for open-end hammers. Bounce chamber pressure for closed-end diesel hammers and stroke for open-end diesel hammers shall be determined in the field.)

A455-3.12.4 Dynamic Load Tests. Dynamic load testing consists of predicting pile capacity from dynamic blows of the hammers during drive and/or redrive of an instrumented pile. Other useful information is also typically obtained.

A455-3.12.5 Static Load Tests. Static load testing consists of applying a static load to the pile to determine its capacity. The Modified Quick Test Procedure in accordance with the Special Provisions shall be used. Other useful information is also typically obtained.

A455-3.12.6 Fender Pile Installation.

Fender Piles: Piles used in fender systems, regardless of type or size of pile, shall either be driven full length or jetted to within two feet of cutoff and driven to cutoff elevation to seat the pile unless otherwise shown in the plans or authorized by the Engineer. No specific driving resistance is required unless noted in the plans. The methods and equipment used for installation by the Contractor shall not damage the piles. If the method or equipment used causes damage to the pile, the Contractor shall modify the methods or equipment at no cost to the Department.

A455-3.13 Test Piles.

A455-3.13.1 Description. This work shall consist of driving piles of the same cross section and type as the permanent piles shown in the plans, in order to determine any or all of the following:

- (a) the safe bearing value of the piles.
- (b) the nature of the soil.
- (c) the lengths of permanent piles required for the work.
- (d) the driving resistance characteristics of the various soil strata.
- (e) the amount of work necessary to obtain minimum required pile penetration.
- (f) the ability of the driving system to do the work.
- (g) the need for point protection.

Test piles are exploratory in nature and shall generally be driven harder (within the limits of practical refusal), deeper and to a greater bearing value than required for the permanent piling. Where practical, test piles will be driven their full length. Test piles which have been driven their full length and have developed only minimal required bearing

shall be built-up and further driving shall proceed until satisfactory results have been obtained.

As a minimum, unless otherwise directed by the Engineer, driving of test piles shall not cease until the required bearing capacity has been obtained continuously, where the blow count is increasing, for ten feet unless practical refusal is reached first. One exception to this is test piles which are to be statically load tested. These piles shall be driven as anticipated for the production piles.

When test piles attain practical refusal prior to attaining minimum penetration, the Contractor shall do all work necessary to attain minimum penetration and the required bearing designated by the Engineer. Where practical water jets shall be used as directed to break the pile loose for further driving. Where jetting is impractical and when ordered by the Engineer, the Contractor shall extract the pile and install a Preformed Pile Hole through which driving will continue. When the Contract Documents do not include items for Pile Extractions and Preformed Pile Holes, the work of extracting the pile and providing a preformed pile hole shall be considered Unforeseeable Work.

When test piles (other than low displacement steel test piles) are to be driven, water jets (as specified in A455-3.8) shall be at the site, ready for use, before the test pile driving begins. When the Contract Documents include Preformed Pile Hole items, the Contractor shall also have the appropriate equipment for such work at the project site before the test pile driving begins.

The Engineer may elect to interrupt pile driving up to four times on each test pile, two times for 15 minutes, two additional times within 72 hours of initial driving to determine time effects during the driving of test piles. Test piles shall be instrumented when dynamic load tests are included in the plans or when directed by the Engineer.

A455-3.13.2 Location of Test Piles. All test piles shall be driven in the position of permanent piles at the designated locations unless otherwise shown in the plans or ordered by the Engineer. Test piles shall be plumb piles unless all piles at the designated location are battered. All test piles designated to be statically load tested shall be plumb. In the event that all the piles are battered at a static load test site, the Engineer will designate an out-of-position location for driving a plumb pile for the load test.

A455-3.13.3 Equipment for Driving. The Contractor shall use the same type, size and weight hammer and equipment for driving test piles as he intends to use for the permanent piles. He shall also use the same equipment to redrive any test piles unless approved otherwise by the Engineer.

A455-3.13.4 Ground Elevations. At the time of driving test piles, the Contractor shall furnish the Engineer with elevations of the original ground at each pile or pile group location. The elevations shall include the highest and lowest elevation at each required location and the ground elevation at all the test piles. The elevations shall be presented in plotted and tabular form and submitted with the test pile data.

A455-3.14 Dynamic Load Tests.

Dynamic measurements will be taken by the Engineer during the driving of piles designated in the plans or authorized by the Engineer as Dynamic Load Test Piles. Test piles and selected permanent piles may be instrumented for dynamic load testing. When the Contract Documents include Dynamic Load Tests, all test piles will have dynamic load tests. Dynamic Load Tests will be performed to evaluate any or all of the following:

1. Evaluate suitability of Contractor's driving equipment including hammer, capblock, pile cushion, and any proposed follower.
2. Determine pile capacity.
3. Determine pile stresses.
4. Determine energy transfer to pile.
5. Determine distribution of soil resistance.
6. Evaluate soil variables including quake and damping.
7. Evaluate hammer-pile-soil system for wave equation analyses.
8. Evaluate pile installation problems.
9. Other.

Instruments (strain transducers to measure force and accelerometers to measure acceleration) shall be attached with screws to the pile for dynamic load testing. Wire leads shall be used to transmit the signals for recording, signal conditioning and processing. Dynamic load testing requires electrical power to operate an electric drill and to operate the pile driving analyzer equipment. The Contractor shall supply 110 volt, 60 cycle, 30 amps of AC electric power for this purpose. When required in the plans, the Contractor shall also provide a suitable shelter to protect the equipment from the elements. This shelter shall be located within 50 feet and within view of the test location. This shelter shall be seven feet high and eight feet by eight feet in plan. The Contractor shall also provide a suitable man basket to be lifted by the crane, for use as required, to provide access to the top of the pile. The man basket shall have a working area of at least four feet by four feet with four foot high safety rails all around. The Contractor shall supply a stable platform which is satisfactory, in the opinion of the Engineer, for reference of the pile penetration.

The Contractor shall make available each pile to be dynamically tested for drilling of holes for attachment of instrumentation and for wave speed measurements. The pile shall be supported with timber blocks placed at appropriate intervals, shall be in a horizontal position and shall not contact adjacent piles. A sufficient clear distance shall be provided at the sides of the pile for drilling the holes. The Engineer will furnish the equipment, materials, and labor necessary for drilling holes and taking the wave speed measurements. If the Engineer directs dynamic load testing of piles already driven, the Contractor shall provide the Engineer safe access to the top of the piles for drilling of the attachment holes. The Contractor shall provide the Engineer reasonable means of access to the piles to attach the instruments after placement of the leads and for removal of the instruments after driving is completed.

The stresses in the piles will be monitored with the dynamic test equipment during driving to ensure that the allowable stresses are not exceeded. If necessary, the Contractor

shall add additional cushioning, replace the cushions, or reduce the hammer stroke to maintain stresses below the maximum allowable. If non-axial driving is indicated by dynamic test equipment measurements, the Contractor shall immediately realign the driving system. If the cushion is compressed to the point that a change in alignment of the hammer will not correct the problem, the Contractor shall add cushioning or change the cushion as directed by the Engineer.

The Contractor shall drive the pile to the required penetration and resistance or as directed by the Engineer. The Engineer may elect to interrupt driving for up to two 15 minute, waiting periods (set-checks) during the initial driving of the pile. Dynamic load testing of a pile may average up to two hours longer than for driving an uninstrumented pile.

When directed by the Engineer, the Contractor shall perform instrumented redrives. A cold diesel hammer shall not be used for a redrive unless in the opinion of the Engineer it is impractical to do otherwise. Generally, the hammer shall be warmed up by applying at least 20 blows to a previously driven pile or to timber mats placed on the ground.

A455-3.15 Static Compression Load Test.

A455-3.15.1 General.

All static load testing shown in the plans shall be completed before the driving of any permanent piling. The Contractor shall obtain the services of a professional testing laboratory, or Professional Engineer with satisfactory pile load test experience, to conduct the load test in compliance with these specifications, record all data and furnish reports of the test results to the Engineer except when the plans or Special Provisions show that the Department will supply a Geotechnical Engineer to provide these services.

The use of load tests, the number of load tests and their locations shall be as shown in the plans. The maximum load for the test shall be three times the design load, the maximum load shown in the plans or as designated by the Engineer (within the limits of the test equipment provided) or the failure load whichever occurs first. Test loads shall not be applied to piles sooner than 48 hours (or the time interval shown in the plans) after driving of the test pile or reaction piles whichever occurs last.

Piles shall be load tested in the order directed by the Engineer. Static loads shall be completed as shown in the plans or as described herein. Certain load test equipment and/or personnel will be furnished by the Department when shown in the plans. The Contractor shall inspect all equipment to be furnished by the Department at least 30 days prior to use and shall notify the Engineer of any equipment that is not in satisfactory operating condition.

Any necessary repairs ordered by the Engineer to place the equipment in satisfactory operating condition will be considered Unforeseeable Work. The Contractor shall supply the remainder of the equipment and personnel needed to conduct the load tests. Unless shown otherwise in the plans or Special Provisions, the Contractor shall supply all equipment, materials, labor and technical personnel required to conduct the load tests including determination of anchor reaction member depths.

The Contractor shall include in his bid, the cost of transporting load test equipment and instrumentation supplied by the Department from their storage location to the job site and back. He shall handle these items with care and is responsible for their safe return in clean

and working condition. After completion of the static load tests, the Contractor shall return all Department furnished equipment in satisfactory operating condition. The Contractor shall repair all damage to the test equipment furnished by the Department to the satisfaction of the Engineer. He shall clean all areas of rust on structural steel items and repaint those areas in accordance with Section 561. All load test equipment supplied by the Department shall be returned by the Contractor within 30 days after completion of the load tests.

The Contractor shall, at all times while Department supplied load test equipment is the Contractor's responsibility, keep the equipment insured against loss or damage for the replacement cost thereof (the greater of \$150,000 or the amount shown in the plans) or for the full insurable value if replacement cost insurance is not available. The equipment shall be the responsibility of the Contractor from the time it leaves its storage area until the time it is returned by the Contractor.

The Contractor shall notify the Engineer at the preconstruction conference or no later than 30 days before test pile installation begins of his proposed testing schedule so that items supplied by the Department may be reserved. He shall give the Department at least ten working days notice before pickup or return of the equipment. During pick-up, a checklist of all equipment placed in the Contractor's possession shall be completed. This checklist will later be used to verify that all equipment is properly returned. The Contractor will provide personnel and equipment to load or unload the equipment at the Department's storage location. Department owned test girders shall be handled with lifting tongs or nylon slings provided by the Contractor. No cutting, welding or drilling will be permitted on Department owned girders, jacks, load cells or other equipment.

During conduct of the load test the Contractor shall provide safety equipment and employ safety procedures consistent with the latest approved practices for this work. These safety procedures shall include adequate support for the load test plates, jack, and load cell (when used) to prevent them from falling in the event of a sudden release of load due to hydraulic failure, test pile failure, or any other cause.

A455-3.15.2 Loading Apparatus. The apparatus for applying the vertical loads shall be as described in one of the following:

- (1) As shown and described in the plans and Special Provisions.
- (2) As supplied by the Contractor which shall be one of the following devices designed to accommodate a load at least twenty percent higher than that shown in the plans or described herein for test loads:

(a) **Load Applied by Hydraulic Jack Acting Against Weighted Box or Platform:** A test box or test platform, resting on a suitable support, shall be constructed over the pile and loaded with earth, sand, concrete, pig iron or other suitable material with a total weight greater than the anticipated maximum test load. Supports for the weighted box or platform shall be located at least six feet or three pile diameters whichever is greater from the edge of the pile to the edge of the supports. A hydraulic jack with pressure gauge shall be inserted between the test pile and the underside of the reaction beam, and the load shall be applied to the pile by operating the jack, between the reaction beam and the top of the pile.

(b) **Load Applied to Pile by Hydraulic Jack Acting Against Anchored Reaction**

Member: Two or more piles to be used as anchor piles shall be driven as far from the test piles as practical, but in no case closer than the greater of three pile diameters or six feet from the edge of the test pile. A girder of sufficient strength to act as a reaction beam shall be attached to the upper ends of the anchor piles. A hydraulic jack with pressure gauges shall be inserted between the head of the test pile and the underside of the reaction beam, and the test load applied to the pile by operating the jack, between the reaction beam and the pile head.

(c) Combination Devices: A combination of devices (a) and (b), as described above, may be used to apply the test load to the pile.

(d) Other Systems Proposed by the Contractor and Approved by the Engineer.

When necessary, horizontal supports shall be provided for the pile to be loaded. Horizontal supports shall be spaced so that the ratio of the unsupported length to the minimum radius of gyration of the pile does not exceed 120 for steel piles, and the unsupported length to the least cross section dimension does not exceed 20 for concrete piles. Horizontal supports shall provide full support without restraining the vertical movement of the pile in any way.

A455-3.15.3 Modified Quick Test.

(a) Loading Procedure: The load shall be placed on the pile continuously, in increments equal to approximately five percent of the maximum test load specified until the failure load, as indicated by the measuring apparatus and/or instruments is approached. Increments of approximately 2.5 percent shall then be applied until the pile "plunges" or the limiting load is attained. The Engineer may elect to stop the loading increments when he determines the failure criteria has been met or when a settlement equal to ten percent of the pile width or diameter is reached. Each load increment shall be applied immediately after the complete set of readings is taken and verified from all gauges and instruments. Each increment of load shall be applied within the minimum length of time practical and the readings shall be taken immediately. It is intended that the addition of a load increment and the completion of the readings shall be completed within five to fifteen minutes. The Engineer may elect to hold the maximum applied load up to one hour.

The load shall be removed in decrements of about ten percent of the maximum test load. Each decrement of load shall be removed within the minimum length of time practical and the readings shall be taken. It is intended that the removal of a load decrement and the completion of the readings shall be completed within five to fifteen minutes. The Engineer may also require up to two reloading cycles with five loading increments and three unloading decrements. The final recovery of the pile shall be recorded until movement is essentially complete for a period up to one hour after the last unload interval.

(b) Failure Criteria and Safe-Load: The criteria described herein shall be used to establish the failure load. The failure load is defined as the load that causes a pile top deflection equal to the calculated elastic compression plus 0.15 inch plus $\frac{1}{120}$ of the pile minimum width or diameter in inches for piles 24 inches or less in width, and equal to the calculated elastic compression plus $\frac{1}{30}$ of the pile minimum width or diameter for piles greater than 24 inches in width. The safe allowable load of any pile so tested shall be

considered as either 50 percent of the maximum applied load or 50 percent of the failure load, whichever is smaller.

A455-3.15.4 Measuring Apparatus.

The apparatus for measuring movement of the test piles shall consist of all of the following devices which shall be installed by the Contractor as directed by the Engineer:

(a) **Wire Line and Scale:** A wire shall be stretched as directed by the Engineer between two supports located at a distance at least ten feet from the center of the test pile but not less than 3.5 times the pile diameter or width. The wire supports shall be located as far as practical from reaction beam anchorages. At over-water test sites the wire line may be attached as directed by the Engineer to the sides of the service platform. The wire shall be pulley-mounted on one support and the end of the wire weighted to provide constant tension on the wire. The wire shall pass across the face of a scale mounted on a mirror attached to the test pile so that readings can be made directly from the scale. The scale readings shall be used as a check on an average of the dial readings.

(b) **Wooden Reference Beams And Dial Gauges:** Wooden reference beams as detailed in the plans or approved by the Engineer shall be attached to independent supports installed the greater of 3.5 times the pile diameter or width or ten feet from the center line of the test pile. The beam supports shall be located as far as practical from reaction beam anchorages. For over-water test sites, the Contractor may attach the reference beams as directed by the Engineer between two diagonal platform supports. Dial gauges, with their stems resting either on the top of the pile or on lugs or similar reference points on the pile, shall be attached to the fixed beams to record the movement of the pile head. The area on the pile or lug on which the stem bears shall be a smooth surface which will not cause irregularities in the dial readings. Two dial gauges, each with 0.001 inch divisions and with two-inch minimum travel, placed at 180 degrees or at the diagonal corners of the pile, shall be the minimum acceptable method for measuring vertical movement.

(c) **Survey Level:** As a check on the dial gauges, the elevation of a point near the top of the test pile (on plan datum) shall be determined by survey level at each load and unload interval during the load test. Unless approved otherwise by the Engineer, level survey precision shall be 0.001 foot. Alternately, the surveyor may read an engineer's 50 scale attached near the pile head. The first elevation shall be determined before application of the first load increment; intermediate readings shall be made immediately before a load increment or an unload decrement, and after the final unload decrement that completely removes the load. A final reading shall be made at the time of the last recovery reading or as directed by the Engineer.

For over-water test sites, when shown in the plans or directed by the Engineer, the Contractor shall drive an H pile through a 36-inch casing to provide a stable support for the level and to protect it against wave action interfering with level measurements. The Contractor shall provide a suitable movable jig for the surveyor to stand. The jig shall have a minimum of three legs, have a work platform providing at least four-foot width of work area around the casing and shall be approved by the Engineer before use. The described work platform may be supported by the protective casing when approved by the Engineer.

A455-3.15.5 Load Test Instrumentation.

(a) General: The intent of the load test instrumentation is to measure the test load on top of the pile (and, when provided in the plans and Special Provisions, its distribution between side friction and end bearing) to provide evaluation of the preliminary design calculations and settlement estimates and to provide information for final pile length design.

The Contractor shall provide assistance when requested by the Engineer during installation of any instrumentation supplied by the Department. The Contractor shall also supply 110 volt, 60 cycle, 30 amps of AC electric power to each test pile site during the installation of the instrumentation, during the load testing, and during any instrumented redrives ordered by the Engineer.

(b) Hydraulic Jack and Load Cell: The Contractor shall supply hydraulic jack(s) of adequate size to deliver the required test load to the pile unless shown otherwise in the plans.

The Contractor shall furnish a certificate (before load testing begins) from a reputable testing laboratory showing a calibration of gauge readings for all stages of jack loading and unloading for jacks furnished by him. The jack shall have been calibrated within the preceding six months unless approved otherwise. The Contractor shall also recalibrate the jack after load testing is completed if so directed by the Engineer.

The Contractor shall also provide an adequate load cell approved by the Engineer which has been calibrated within the preceding six months. An approved electrical readout device for the load cell shall also be provided. The Contractor shall furnish a certificate (before load testing begins) from a reputable testing laboratory showing a calibration of readings for all stages of loading and unloading for load cells furnished by him.

If the Department supplies the Contractor with the jack and/or load cell, the Contractor shall have the equipment calibrated and include the cost in the cost for static load test.

(c) Telltales: When shown in the Contract Documents, telltales shall be provided. The telltale shall consist of an unstressed steel rod placed, with appropriate clearance and greased for reducing friction and corrosion, inside a constant-diameter pipe that rests on a flat plate attached to the end of the pipe at a point of interest shown in the plans. Telltales shall be constructed in accordance with details shown in the Contract Documents. The Contractor shall install dial gauges reading to 0.001 inch with one-inch minimum travel, as directed by the Engineer to measure the movement of the telltale with respect to the top of the pile.

A455-3.15.6 Support Facilities. The Contractor shall furnish adequate facilities for making load and settlement readings 24 hours per day. Such facilities shall be provided for the instrumented area and shall include lighting and shelter from rain, wind and direct sunlight.

A455-3.15.7 Load Test Personnel Furnished by the Contractor. The Contractor shall supply a qualified welder (together with necessary cutting and welding equipment) to assist with the load test setup and to make any necessary adjustments during the load test. The Contractor shall also supply qualified personnel to operate the jack, generators and lighting equipment and one person with transportation to assist as required during load test setup

and conduct of the load tests. The Contractor shall provide experienced personnel required to read the dial gauges, take level measurements, and conduct the load test except when the plans or Special Provisions show that these personnel will be supplied by the Department.

A455-3.15.8 Cooperation by the Contractor. The Contractor shall cooperate with the Department's personnel and the Department's personnel shall have access to all facilities necessary for observation of the conduct and the results of the test.

A455-3.15.9 Required Reports. A static load test report shall be submitted to the Engineer within five days after the load test is completed. The report of the load test shall include the following information:

(a) A tabulation of the time of, and the amount of, the load and settlement readings, and the load and recovery readings taken during the loading and unloading of the pile.

(b) A graphic representation of the test results, during loading and unloading of pile top movement as measured by the average of the dial gauge readings, from wireline readings and from level readings.

(c) A graphic representation of the test results, when telltales are used, showing pile compression and pile tip movement.

(d) The estimated failure and safe loads according to the criteria described herein.

(e) Remarks concerning any unusual occurrences during the loading of the pile.

(f) The names of those making the required observations of the results of the load test, the weather conditions prevailing during the load test, and the effect of weather conditions on the load test.

(g) All supporting data including jack and load cell calibrations and certificates.

The Contractor shall provide the necessary report(s) prepared by a qualified Geotechnical Engineer registered in Florida as a Professional Engineer except when the plans or Special Provisions show that the Geotechnical Engineer will be provided by the Department. In this case, the Geotechnical Engineer supplied by the Department will write the report(s).

A455-3.16 Pile Lengths.

A455-3.16.1 Test Pile Length. The length of test piles shall be as shown in the plans or as directed by the Engineer.

A455-3.16.2 Production Pile Length: When shown in the plans, the lengths are based on information available during design and are approximate only. Final pile lengths will be determined in the field and may vary significantly from the lengths or quantities shown in the plans.

A455-3.16.3 Authorized Pile Lengths. The authorized pile lengths are the lengths determined by the Engineer based on all information available before the driving of the permanent piles including but not limited to information gained from the driving of test piles, dynamic load testing, static load testing, set-checks, pile redrives, supplemental soil testing, etc. These lengths shall represent the lengths which are assumed to remain in the completed structure. The Contractor may elect to provide piling with lengths longer than authorized to suit his method of installation. When the Contractor elects to provide longer than authorized pile lengths, the furnished length for which payment will be made shall be

either the originally authorized length or the length between cut-off elevation and the final accepted pile tip elevation whichever is the longer length.

Within 30 days after all the test piles are driven, all load tests are completed, all redrives are completed, and all test reports have been received, an itemized list of authorized pile lengths will be furnished to the Contractor by the Engineer. These lengths shall be used by the Contractor for furnishing the permanent piling for the structure. If the Contractor is willing to start his pile driving operations in areas designated by the Engineer, and if the Contractor so requests in writing at the beginning of the test pile program, pile lengths will be furnished for these designated areas within seven days after all the test piles are driven, all load tests are completed, all redrives are completed, and all test reports have been received for those designated areas.

On multiple phase projects, pile lengths on subsequent phases will not be authorized until the piling on initial phases are completed.

A455-3.17 Allowable Driving Tolerances.

A455-3.17.1 General. The tolerances described in this Subarticle shall be applied to the piles that are free standing without lateral restraint (after the template is removed). Piles shall not be moved laterally after they are driven to force them to be within the specified tolerances. Battered piles may be moved laterally to overcome the deflections due to self weight of the pile. When this is necessary calculations signed and sealed by a Professional Engineer, registered in the State of Florida, shall be submitted to the Engineer to verify the amount of dead load deflection prior to moving any piles.

A455-3.17.2 Position. The final position of the pile head at cut-off elevation shall be no more than three inches from the plan position indicated in the plans.

A455-3.17.3 Axial Alignment. The axial alignment of the driven piles shall not deviate by more than $\frac{1}{4}$ inch per foot from the vertical or batter line indicated in the plans.

A455-3.17.4 Elevation. The final elevation of the pile head shall be no more than $1\frac{1}{2}$ inches above, nor more than four inches below, the elevation shown in the plans. In no case shall the pile embedment be less than six inches below the elevation shown in the plans unless a minimum penetration requirement is shown.

A455-3.17.5 Deviation From Above Tolerances. When the above tolerances are not met, design changes in the pile caps or footings may be requested by the Contractor to incorporate piles driven out of tolerance. The costs of redesign and Unforeseeable Work resulting from approved design changes to incorporate piles driven out of tolerance shall be at the Contractor's expense. Any redesign shall be done by a Professional Engineer registered in the State of Florida who is qualified according to the rules of the Department of Transportation Chapter 14-75. Redesign drawings and computations prepared by the Contractor's Engineer shall be signed and sealed. Any redesign proposed by the Contractor shall not be implemented until the redesign has been reviewed for acceptability and approved by the Department.

A455-3.18 Disposition of Pile Cut-offs, Test Piles, and Load Test Materials.

A455-3.18.1 Pile Cut-offs.

a. Steel piling: Unless shown otherwise in the plans, cut-off sections, or portions of

cut-off sections, and unused piling 20 feet long or longer, which are not damaged shall remain the property of the Department and shall be delivered by the Contractor to the Department's nearest maintenance yard. Sections of piles delivered to the maintenance yard shall be straight and undamaged. Damaged portions shall be cut off by the Contractor prior to delivery. Cut-off sections less than 20 feet long shall become the property of the Contractor and shall be removed from the job and disposed of by him.

b. Other Pile Types: Upon completion of all work under the contract in connection with piling, unless shown otherwise in the plan, any unused cut-off lengths remaining shall become the property of the Contractor and shall be removed from the right of way and disposed of in areas provided by him.

A455-3.18.2 Test Piles. Where so directed by the plans or the Engineer, test piles shall be cut-off, or built up as necessary, and left in place as permanent piles. Test piles driven in permanent position and found not suitable for use shall be extracted and replaced at the Contractor's expense. Test piles driven out of permanent position shall be pulled, or cut-off at an elevation two feet below the ground surface or bottom of proposed excavation and the removed portion of the test pile shall be disposed of by the Contractor.

When test piles are required to be driven in permanent pile positions, the Contractor may elect to drive the test pile out of position, with the approval of the Engineer, provided that a replacement pile is furnished and driven by the Contractor at no cost to the Department in the position which was to be occupied by the test pile. Under this option, the test pile shall be paid for in the same manner as if it were in permanent position.

Unless otherwise directed in the plans or by the Engineer, test piles that are pulled or cut-off shall remain the property of the Contractor and shall be disposed of in areas provided by him.

A455-3.18.3 Load Test Materials. Upon completion of all load testing, the Contractor shall remove all load test equipment and materials from the site. Any load test equipment, materials or instrumentation supplied by the Department shall be thoroughly cleaned and repaired and returned in operating condition to the required storage location. Any reaction piles that are not extracted shall be cut-off two feet below the ground surface. All materials including reaction pile cut-offs shall be removed and disposed of out of the right of way in areas provided by the Contractor and the test pile site shall be restored to a condition satisfactory to the Engineer.

A455-4 TIMBER PILING.

A455-4.1 Description. Timber piling shall consist of round timber of the kind and dimensions called for in the plans, driven at the locations and to the elevations shown in the plans, or as directed by the Engineer; all in conformity with these specifications.

A455-4.2 Materials. The timber piling shall meet the requirements of Section 953. The piles shall be treated according to the applicable provisions of Section 955.

A455-4.3 Preparation for Driving.

A455-4.3.1 Caps. The heads of timber piles shall be protected during driving, by a cap of approved type, which will distribute the hammer blow over the entire cross section of

the pile. The head of the pile shall be cut square when necessary before driving begins.

A455-4.3.2 Collars. Collars or bands to protect piles against splitting and brooming shall be provided by the Contractor at his expense.

A455-4.3.3 Shoes. The piles shall be shod with metal shoes, of a design satisfactory to the Engineer, provided by the Contractor at his expense. Pile tips shall be shaped to receive the shoe and installation shall be in accordance with the manufacturer's directions.

A455-4.4 Storage and Handling. The method of storage and handling shall be that necessary to avoid damage to the piling. Special care shall be taken to avoid breaking the surface of treated piles. Cant dogs, hooks or pike holes shall not be used when handling and storing the piling. Cuts or breaks in the surface of the treated piles shall be given three brush coats of hot creosote oil of approved quality, and hot creosote oil shall be poured into all bolt holes.

A455-4.5 Cutting Off. The tops of all timber piles shall be sawed off at the elevation indicated in the plans. Piles which support timber caps shall be sawed to the exact plane of the superimposed structure and shall exactly fit it. Broken, split, or misplaced piles shall be withdrawn and replaced.

A455-4.6 Build-ups. No splices or build-ups will be permitted for timber piles. Piles driven below plan elevation will be extracted and a longer pile driven.

A455-4.7 Pile Heads.

A455-4.7.1 Piles with Timber Caps: On piles wider than the timber caps, the part of the pile head projecting beyond the sides of the cap shall be adzed off to a slope of 45 degrees. After this and all other necessary cutting has been done to receive the cap, the heads of piles shall be given three coats of hot creosote oil. They shall then be covered with a coat of hot tar over which shall be placed a sheet of copper, (of a weight of 10 oz. per square foot or greater), conforming to ASTM B 370. The cover shall measure at least four inches more in each dimension greater than the diameter of the pile and shall be bent down over the pile and the edges fastened with large head copper nails or three wraps of No. 12 copper wire.

A455-4.7.2 Fender and Bulkhead Piles. The heads of fender piles and of bulkhead piles shall first be painted with hot creosote, covered with hot tar, and then covered with copper as provided above for piles supporting timber caps.

A455-5 PRESTRESSED CONCRETE PILING.

A455-5.1 Description. These piles shall be of prestressed concrete construction and shall be manufactured, cured and driven in accordance with the requirements of the contract documents.

A455-5.2 Manufacture. The piles shall be fabricated in accordance with Section 450.

A455-5.3 Storage and Handling.

A455-5.3.1 Time of Driving Piles. Prestressed concrete piles may be driven at any time after the concrete has aged at least seven days and the concrete compressive strength is equal to or greater than the specified 28 day compressive strength.

A455-5.3.2 Handling. The method of storage and handling shall be such as to

eliminate the danger of fracture by impact, or of undue bending stresses in handling or transporting the piles from the forms and into the leads. In general, concrete piles shall be lifted by means of a suitable bridge, or slings attached to the pile at the locations shown in the plans. Slings used to handle piles shall be constructed of a fabric material or braided wire rope constructed of six or more wire ropes which will not mar the corners or the surface finish of the piles. (Chains will not be allowed to handle piles). During transport concrete piles shall be supported at the lifting locations shown in the plans or they shall be fully supported throughout 80 percent or more of their length. In the handling of piles for use in salty or brackish water, special care shall be exercised to avoid damage to the surface and corners of the pile.

A455-5.4 Cracked Piles.

Any pile that becomes cracked in handling, to the point that a transverse or longitudinal crack extends through the pile, shows failure of the concrete as indicated by spalling of concrete on the main body of the pile adjacent to the crack, or which in the opinion of the Engineer will not withstand driving stresses will be rejected. Occasional minor surface hairline cracking caused by shrinkage or tensile stress in the concrete from handling will not be cause for rejection.

Piling shall not be driven with irreparable damage which is defined as any cracks that extend through the pile cross sectional area that are (or will be) below ground or water level at the end of driving. Such cracks are normally evidenced by emitting concrete dust during their opening and closing with each hammer blow. Broken piles or piles cracked to the extent described above shall be removed and replaced by the Contractor at his expense. Cracks less than 0.005 inch which do not extend through the pile will be accepted. Piles with cracks greater than 0.005 inch at the pile head or above ground or water level and piles with cracks above ground or water level which extend through the cross sectional area of the pile shall be cut off and spliced or built up to cut-off elevation using approved methods. The Engineer, at his discretion, may require correction of pile damage or pile cracks by cutting down the concrete to the plane of sound concrete below the crack and rebuilding to cut-off elevation, or may reject the pile. Rejected damaged piles which cannot be repaired shall be extracted and replaced with an acceptable pile at the Contractor's expense.

The Contractor shall take appropriate steps to prevent the occurrence of cracking whether due to handling or driving. When cracking occurs during driving the Contractor shall take immediate steps to prevent additional cracking including the use of thicker cushions or reduced ram stroke length. When cracking occurs during handling and transportation, the Contractor shall revise his handling and transporting equipment and procedures as necessary to prevent cracking.

A455-5.5 Preparation for Transportation.

Any strands protruding beyond the ends of the pile shall be cut flush with the surface of the concrete using an abrasive cutting blade before the piles are transported from the casting yard.

The metal handling devices cast into the concrete shall be cut back to a minimum depth of one inch and patched with an approved epoxy mortar, mixed, applied and cured in

accordance with the manufacturer's recommendations before the piles are transported from the casting yard.

A455-5.6 Method of Driving.

Unless otherwise directed, piles shall be driven by a hammer or by means of a combination of water jets and hammer. When jets are used in combination with a hammer, the jets shall normally be withdrawn and the pile driven by the hammer alone, to secure final penetration and to rigidly fix the tip end of the pile. Jets shall remain in place if they are being used to continuously eliminate the soil resistance in the scour zone.

A455-5.7 Extensions and Buildups.

A455-5.7.1 General.

Where splices and buildups for concrete piles are necessary, such splices and buildups to be driven or those five feet or longer shall be prestressed precast sections. Buildups less than five feet in length and not to be driven shall consist of a non-prestressed reinforced section conforming to the requirements of A455-5.7.3. Buildups less than two feet in length may be constructed in accordance with A455-9.9. When a prestressed precast section is spliced onto the original pile and after driving the length of spliced section below cut-off elevation is five feet or less, the following methods shall be used:

(a) The spliced section is less than two feet, the pile concrete is removed to the cut-off elevation and the dowels are left in place to be incorporated into the cap as directed by the Engineer. The length of dowels which becomes exposed may be cut to a length of two feet-five inches from the plane of pile cut-off.

(b) The spliced section is greater than two feet but less than or equal to five feet, the pile concrete is removed to cut-off elevation and the strands and dowels if applicable are left in place to be incorporated into the cap as directed by the Engineer. Cut-off pile sections shall not be used for buildups of five feet or less.

These requirements are not applicable to specially designed piling. Splices for special pile designs shall be made as shown in the plans.

A455-5.7.2 Extensions to be Driven or Those Five Feet or Longer.

Extensions to be driven or those five feet or longer in length shall be constructed in accordance with the details shown in the plans in a manner including the requirements, sequences and procedures outlined below:

(a) The spliced section shall be cast in accordance with Section 450 with the dowel steel in the correct position and alignment or the Contractor shall provide a cut-off pile section of the same cross-section, mix design and minimum strength to be used as a spliced section in accordance with A455-9.2.6. If the splice is to be driven, the cut-off pile sections shall include the head of the cut-off pile installed on the original pile in its required position.

(b) Dowel holes shall be drilled using an approved steel template which will position and align the drill bit during drilling. Holes shall be drilled a minimum of two inches deeper than the length of the dowel to be inserted.

(c) The drilled dowel holes shall be cleaned by inserting a high pressure air hose to the bottom of the hole and blowing the hole clean from the bottom upward. The holes and the concrete surfaces to be joined shall be free of oil, dust, water and other deleterious

materials.

(d) The epoxy components shall be mixed in accordance with the manufacturer's directions. Sand or any other filler material shall not be mixed with the epoxy components unless it is prepackaged by the manufacturer for this specific purpose.

(e) After assuring that all concrete surfaces are dry, the dowel holes shall be filled with the mixed epoxy material.

(f) When cut-off pile sections are used for splices, the spliced section shall be installed by: drilling and cleaning the dowel holes, attaching the gasket and retaining form as shown on the Epoxy Bonded Buildup Details for Piles, filling the holes with epoxy, inserting the dowels; and allowing the epoxy to cure in accordance with the manufacturer's directions with the dowels held in correct position and alignment.

(g) Forms shall be placed around joints between the pile sections.

(h) The dowels of the spliced section shall be inserted into the epoxy filled holes of the bottom section and the spliced section shall be positioned so that the axes of the two sections are in concentric alignment and the ends of the abutting sections are spaced $\frac{1}{2}$ -inch apart. Small steel spacers of the required thickness may be used provided they have three or more inches of cover after the splice is complete. The space between the abutting sections shall be completely filled with the mixed epoxy.

(i) The spliced sections shall be secured in alignment until the epoxy is cured in accordance with the manufacturer's directions for the time appropriate with the prevailing ambient temperatures.

(j) After curing is completed, alignment braces and forms shall be removed and the spliced area shall be cleaned and dressed to match the pile dimensions.

A455-5.7.3 Precast Reinforced Buildups.

Precast Reinforced Buildups shall be constructed in accordance with the requirements of this Subarticle, Sections 346 and 400. The form surfaces for precast buildups shall be of the same material as was used to form the prestressed piles, concrete shall be the same mix as used in the prestressed pile and cross-section shall be of the same dimensions as piling being built up. Buildups shall be installed as specified in A455-5.7.2(b) through A455-5.7.2(j) with the exception of A455-5.7.2(f). Buildups shall have the same surface treatment or sealant applied to the surface as the prestressed piles. Payment for authorized buildups shall be made at the respective contract unit prices per linear foot for Item No. 455-3, Prestressed Concrete Piling Furnished.

A455-6 STEEL PILING.

A455-6.1 Description. This work consists of furnishing, driving and cutting off structural steel shapes to form bearing piles. It shall include installation of bracing members of structural steel by bolting or welding, and the construction of splices, all in accordance with these specifications and in conformity with lines, grades, dimensions and notes shown in the plans.

A455-6.2 Material. The material in rolled steel piles, pile bracing, scabs, wedges and splices shall conform to the requirements for structural steel as specified in 962-2.

A455-6.3 Pile Splices. The full authorized pile length shall be ordered and used where practicable. Splicing will not be permitted to obtain authorized lengths less than 40 feet except when shown in the plans. When approved by the Engineer, splicing will be permitted to obtain authorized lengths between 40 feet and 60 feet. Splicing will be permitted to obtain authorized lengths in excess of 60 feet. However, no payment for splices will be made to obtain authorized lengths 60 feet or less.

Where the pile length authorized is not sufficient to obtain the required bearing value or penetration, an additional length of pile shall be ordered and spliced to the original length.

All splices shall be made in accordance with the plan details.

A455-6.4 Welding. All welded connections to steel piles shall be made by electric arc welding, in accordance with details shown in the plans and in compliance with the requirements of 460-6.

A455-6.5 Pile Heads and Tips. All piles shall be cut off at the elevation shown in the plans. If a cutting torch is used the surface shall be made as smooth as practical.

Where foundation material is so dense the pile cannot be driven to the required penetration and firmly seated without danger of crumpling the tip, when shown in the plans or required by the Engineer, the tips shall be reinforced with approved cast steel point protectors. Point protectors shall be constructed in one piece of cast steel meeting the requirements of ASTM A-27 Grade 65-35 heat treated. The points shall provide full bearing for the piles and shall be attached by welding according to the recommendations of the manufacturer.

A455-6.6 Pile Bent Bracing Members. Structural steel sway and cross bracing, and all other steel tie bracing, shall be placed on steel pile bents and bolted or welded in place as indicated in the plans. Where piles are not driven into position in exact alignment as shown in the plans, the use of fills and shims between the bracing and the flanges of the pile may be required. All fills and shims required to square and line up faces of flanges for cross bracing shall be furnished and placed by the Contractor without additional cost to the Department.

A455-6.7 Painting. Exposed parts of steel piling, wedging, bracing and splices shall be painted in accordance with the provisions for painting structural steel, as specified in Section 561, except as might be called for otherwise in the plans.

A455-6.8 Storage and Handling. The method of storage and handling shall be to avoid damage due to bending stresses in handling or transporting the piles from the point of origin and into the leads. In general, steel piles shall be lifted by means of a suitable bridge, or a sling attached to the pile at appropriate points to prevent damage. The pile shall be lifted from the horizontal position in a manner that will prevent damage due to bending of the flanges and/or web.

A455-7 SHEET PILING.

A455-7.1 Description. This specification covers piling (permanent and temporary) as are shown in the plans or as ordered by the Engineer. Permanent piling will be left in place as part of the finished work while temporary piling will generally be removed after each

construction phase.

A455-7.2 Materials. The materials used shall conform with the requirements of the Standard Specifications as follows:

- (1) Steel Sheet Piles.....962-9.2*
- (2) Concrete with Air Entrainment Section 346
- (3) Bar Reinforcement.....931-1.1
- (4) Prestressing Reinforcement.....Section 933

*Temporary steel sheet piles shall meet the requirements called for in the plans.

A455-7.3 Steel Sheet Piling. This piling shall be driven and cut off true to line and grade. Steel sheet piling shall be installed with a suitable vibratory or power impact hammer. Any section damaged during handling and installation shall be removed and replaced at the Contractor's expense.

A455-7.4 Concrete Sheet Piling.

A455-7.4.1 Description. Concrete Sheet Piling shall be of prestressed concrete construction and shall be manufactured, cured and driven in accordance with the requirements of the contract documents. These piles are for use in bulkheads and abutments, and at other locations as shown in the plans.

A455-7.4.2 Manufacture of Piles. The piles shall be fabricated in accordance with Section 450.

A455-7.4.3 Method of Installation. Concrete sheet piling shall be jetted to grade where practical. A minimum of two jets will be required. The volume and pressure of the water at the nozzles shall be sufficient to freely erode material adjacent to the piles. Where rock or strong material is encountered, such that the sheet piles cannot be set to grade by jetting, the strong materials shall be removed by other acceptable means, such as excavation and backfilling or by punching with a suitable punch. When the plans do not indicate the existence of rock or strong material and the piles cannot be set by jetting, work of removing or punching the strong material or rock will be paid for as Unforeseeable Work.

A455-7.4.4 Grouting and Caulking. Concrete sheet piles are generally detailed to have tongues and grooves on their lower ends, and double grooves on their upper ends. Where so detailed, after installation, the grooves shall be cleaned of all sand, mud or debris, and grouted full. Approved plastic bags (sheaths) which will conform to the shape and length of the groove to be grouted shall be used to contain the plastic grout within the double grooves. Grout shall be composed of one part cement and two parts sand. Clean local sand or beach sand may be used in this grout. In lieu of sand-cement grout, Class I concrete, using small gravel or crushed stone coarse aggregate may be used. The grout shall be deposited through a grout pipe placed within a watertight plastic sheath (bag) extending the full depth of the double grooves and which, when filled, completely fills the slot formed by the double grooves.

A455-7.5 Storage and Handling. All sheet piles shall be handled and stored in a manner to prevent damage. Long sheet piles shall be handled with fabric slings or braided wire rope constructed of six or more wire ropes placed at appropriate lift points to prevent damage due

to excessive bending.

A455-8 PILE INSTALLATION PLAN.

At the preconstruction conference or no later than 30 days prior to driving the first pile, the Contractor shall submit a pile installation plan for approval by the Engineer. This plan shall provide detailed information including the following:

1. List and size of proposed equipment including cranes, barges, driving equipment, jetting equipment, compressors and preformed pile hole equipment. Include manufacturer's data sheets on hammers, cranes and compressors.
2. Department's Form Number 700-020-01-A and further described as follows:
 - (a) Manufacturer's specification data of the proposed hammer including all modifications. These data include element weights (including ram weight, anvil weight and helmet weight), rated energy, and the inside dimensions of the capblock and pile helmet assemblies.
 - (b) Complete description and dimensions including thickness of the material in the capblock.
 - (c) Complete description and dimensions including thickness of all the cushion material to be used between the pile and hammer.
 - (d) Other requested pertinent information (from the equipment manufacturer, cushion material suppliers, or other suitable sources) necessary for input in the wave equation program.
3. Methods to determine hammer energy in the field for determination of pile capacity. The submittal shall include necessary charts and recent calibrations for any pressure measuring equipment.
4. Detailed drawings of any proposed followers.
5. Detailed drawings of templates.
6. Details of proposed load test equipment and procedures including recent calibrations of jacks and required load cells.
7. Sequence of driving of piles for each different configuration of pile layout.
8. Proposed schedule for test pile program and production pile driving.
9. Details of proposed features and procedures for protection of existing structures.
10. Required shop drawings for piles, cofferdams, etc.
11. Methods and equipment proposed to prevent displacement of piles during placement and compaction of fill within 15' of the piles.
12. Other information shown in the plans or required by the Engineer.

The Engineer will evaluate the pile installation plan for conformance with the plans, specifications and Special Provision requirements. Within 20 days after receipt of the plan, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary in the opinion of the Engineer to meet the plans, specifications and Special Provisions requirements. Any parts of the plan that are unacceptable will be rejected and the Contractor will resubmit changes agreed upon for re-evaluation. The Engineer will notify the Contractor within seven days after receipt of

proposed changes of their acceptance or rejection. All approvals given by the Engineer shall be subject to trial and satisfactory performance in the field. The Contractor shall make any required changes that may result from unsatisfactory field performance. Final acceptance will be given after necessary modifications are made. No changes in the driving system may be made after final approval without the approval of the Engineer.

A455-9 METHOD OF MEASUREMENT (ALL PILING).

A455-9.1 Treated Timber Piling. The quantity of this item to be paid shall be the length, in feet, of Treated Timber Piling, furnished, placed and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

A455-9.2 Prestressed Concrete Piling.

A455-9.2.1 General. The quantities of these items to be paid for shall be as follows:

(1) The length, in feet, of Prestressed Concrete Piling Furnished and accepted according to the authorized lengths list, including any additions and excluding any deletions thereto, as approved by the Engineer.

(2) The length, in feet, of Prestressed Concrete Piling Driven measured from elevation of cut-off to tip of pile and accepted.

A455-9.2.2 Furnished Length. The furnished length of precast concrete piles shall be considered as the overall length from head to tip. Final pay length shall be based on the casting length as authorized in accordance with A455-3.16.3 subject to provisions of A455-9.2.3 through A455-9.2.7 and A455-9.9.

A455-9.2.3 Build-ups. The lengths of pile build-ups authorized by the Engineer, measured from the plane of cutback or the joint between the sections, to head of build-up, shall be included in the quantities of piling furnished.

A455-9.2.4 Piles Requiring Cut-offs. No deduction from the length, in feet, of piling furnished will be made if cut-offs are required after the pile has been driven to satisfactory bearing, and no additional compensation will be allowed for making the cut-offs.

A455-9.2.5 Piles Driven Below Cut-off Elevation. Where a pile is driven below cut-off elevation and satisfactory bearing is obtained so that no further driving is required, the length of pile driven shall be measured from cut-off elevation to tip of the pile.

A455-9.2.6 Use of Cut-offs as Build-ups. Cut-off sections in good condition and approved by the Engineer may be spliced to driven piles with epoxy bonded splices and used as build-ups, or they may be redriven in the position of permanent piles as directed by the Engineer. The length of cut-off sections used as build-ups, measured from the top of the original pile to elevation of cut-off, shall be included for payment as Piling Driven, unless the cut-off section is transported to another bridge site under the same contract and used as a build-up, in which case it will be paid for at 30 percent of the furnished price and 100 percent of the driven price. No additional payment for Piling Furnished will be made if used at the same bridge site.

A455-9.2.7 Use of Cut-offs as Permanent Piles. Pile cut-offs which meet specification requirements and are to be driven as permanent piles shall be paid for as follows: If the cut-

off section is to be driven in the same bridge (or adjacent bridge of a dual bridge) length of piling shall be paid for only as piling driven. If the section of piling is taken from another bridge in the same contract, it shall be paid for at 30 percent of the contract price for Piling Furnished and 100 percent of the contract price for Piling Driven.

A455-9.2.8 Isolated Driving. If a pile is driven below cut-off and satisfactory bearing is not obtained, and additional driving is required after construction of a satisfactory splice; the Contractor shall be paid for a Pile Redrive to compensate for isolated driving. When the plans do not include a Pile Redrive item, compensation for isolated driving will be equal to an additional quantity of 25 feet of driven pile made at the unit price for Piling Driven. This compensation for isolated driving, however, will not be allowed for set check tests ordered to be made for periods up to 72 hours after initial driving, or for test piles which are spliced and redriven.

A455-9.2.9 Replacing Piles. In the event a pile is broken or otherwise damaged to the extent that the damage is irreparable, in the opinion of the Engineer, the pile shall be extracted and replaced by the Contractor at no cost to the Department. In the event that a pile is mislocated by the Contractor, the pile shall be extracted and replaced by the Contractor at no cost to the Department except when a design change proposed by the Contractor is approved by the Department as provided in A455-3.17.5.

In the event that a pile is driven below cut-off without the required bearing being obtained, and the Engineer elects to have the pile pulled and a longer pile substituted therefor, the Contractor shall be paid for a Pile Extraction. When the plans do not include a Pile Extraction item and the Engineer orders a pile to be extracted and replaced with a longer pile, this work shall be paid for as Unforeseeable Work. In the event a pile is damaged or mislocated, and the damage or mislocation is determined to be the Department's responsibility, the Engineer may elect to have the pile extracted and the Contractor shall be paid for a Pile Extraction. When the plans do not have a Pile Extraction item, this work shall be paid for as Unforeseeable Work. If the extracted pile is undamaged and driven elsewhere its length shall again be included in the quantity of piling driven but no additional compensation shall be made under the item of piling furnished. When it is determined that the Department is responsible for damaged or mislocated pile, and a replacement pile is required, compensation shall be made under the item for piling furnished, for both the original pile and replacement pile.

As an option the Contractor may substitute a longer pile in lieu of splicing and building up a pile. In this event, the Contractor will be paid for the original authorized length of the pile plus any additional length furnished by the Contractor up to the authorized length of the build-up as piling furnished. In this case, no payment will be made for extracting the original pile furnished nor will any payment be made for a pile splice.

A455-9.2.10 Underwater Driving. When the Contractor selects one of the optional underwater driving methods, payment shall be made by selecting the applicable method from the following:

(a) Using a pile longer than the authorized length: Payment for piling furnished will be made only for the authorized length at that location unless the length of pile from cut-off

elevation to the final tip elevation is greater than the authorized length; in which case payment for piling furnished will be made from cut-off elevation to final tip elevation. No payment will be made for pile splice, when this option is selected, unless the pile is physically spliced and the splice is driven below cut-off elevation to achieve bearing. When a pile splice is made and driven below cut-off elevation to achieve bearing, the length to be paid for piling furnished shall be the length between cut-off elevation and final pile tip elevation. The length to be paid for piling driven shall be from pile cut-off elevation to final tip elevation for all cases cited.

(b) Using an underwater hammer: Payment for piling and pile splices shall be in accordance with A455-9.2.1 through A455-9.2.7 and A455-9.2.10. Additional lengths required to provide the full length confirmation pile shall be furnished by the Contractor at no cost to the Department. Payment for piling furnished, for the full length confirmation pile shall be the authorized length of the pile, unless the length driven below cut-off elevation is greater than the authorized length; in which case the furnished length to be paid for shall be the length between cut-off elevation and the final tip elevation. Splices in confirmation piles will be paid for only when the splice is driven below cut-off elevation.

(c) Using a pile follower: When a pile follower is used with a conventional pile driving system the method of payment shall be the same as shown above in "(b)".

A455-9.3 Steel Piling.

A455-9.3.1 General. The quantities to be paid for of this item shall be as follows:

(1) The length, in feet, of Steel Piling Furnished and accepted, according to the authorized length list, including any additions and excluding any deletions thereto as approved by the Engineer.

(2) The length, in feet, of Steel Piling Driven, measured from elevation of cut-off to tip of pile, and accepted.

A455-9.3.2 Point Protectors. The quantities of this item to be paid for shall be each for the total of point protectors authorized, furnished and properly installed.

A455-9.4 Test Piles. The quantities to be paid for of this item, of test piles of various types, shall be as follows:

(1) The length, in feet, of Test Piling Furnished and accepted, according to the authorized length list, and any additions or deletions thereof as approved by the Engineer.

(2) The length, in feet, of Test Piling Driven, measured from elevation of cut-off to tip of pile, and accepted for test piles incorporated in the structure or from the elevation shown in the plans to tip of pile, and accepted for test piles not incorporated in the structures.

Where a test pile is left in place as a permanent pile it shall be paid for only as Test Piles Furnished and Test Piles Driven. Any build-ups necessary to continue driving the pile for test purposes, as authorized by the Engineer, shall be paid for as Test Piles Furnished and Test Piles Driven. Other build-ups made only to incorporate the pile into the structure as a permanent pile shall be included in the quantities of regular Piling Furnished and Piling Driven and shall not be paid for as Test Piling.

A455-9.5 Dynamic Load Tests. The quantity to be paid for under this item shall be the number of dynamic load tests as shown in the plans or authorized by the Engineer, actually

applied to piles, completed and accepted in accordance with the plans and these specifications. Dynamic load tests may be applied to test piles and/or production piles.

No separate payment will be made for dynamic load tests used to evaluate the Contractor's driving equipment. This will generally be done on the first test pile or production pile driven on a project with each combination of proposed hammer and pile size and/or a separate pile to evaluate any proposed followers, or piles driven to evaluate proposed changes in the driving system.

The price for Dynamic Load Tests shall include all costs related to dynamic testing as described in A455-3.14 including the initial instrumented drive, up to two 15 minute set-checks and two additional instrumented set-checks within 72 hours after the initial driving of a dynamic load test pile. In the event the Engineer requires an instrumented redrive of a pile previously instrumented more than 72 hours after initial driving, the Contractor shall be compensated for one-half the bid price for a Dynamic Load Test.

A455-9.6 Steel Sheet Piling.

The quantity to be paid for under the steel sheet piling item shall be the plan quantity area in square feet measured from top of pile elevation to the bottom of pile elevation and longitudinally along the top of the sheet piles as shown in the plans. Sheet piling and installation shall be in accordance with the details and notes shown in the plans. Sheet piling used in cofferdams and to incorporate the Contractors specific means and methods, not ordered by the Engineer, shall be paid for as required in Section 125.

A455-9.7 Concrete Sheet Piling. The quantity to be paid for under this item shall be the product of the number of such piles satisfactorily completed, in place, times their lengths in linear feet as shown in the plans or authorized by the Engineer.

When the Engineer approves, the concrete sheet piling may be furnished by the Contractor in widths wider than shown in the plans; then the number of piles shall be the actual number of units completed times the width used divided by the width in the plans.

A455-9.8 Preformed Pile Holes. The quantity to be paid for under this item shall be the number of completed Preformed Pile Holes acceptably provided, complete for installation of the piles, regardless of the type of pile installed therein. Only such holes as authorized to be paid for, as provided in A455-3.10, will be included in the measurement for payment. Preformed pile holes shall be authorized for payment only when the pile has been placed in proper position and has achieved the desired penetration.

When preformed holes are used to obtain total penetration of the piles in excess of 20 feet, the work of preforming the holes shall be considered as Unforeseeable Work except when the required penetration in excess of 20 feet is shown in the plans as provided in A455-3.10.3.

A455-9.9 Pile Splices. Authorized splices in concrete piling, steel piling and test piling, which are made for the purpose of obtaining greater lengths than originally authorized by the Engineer, or for obtaining lengths greater than 60 feet in steel piling, or to incorporate test piling in the finished structure, or for further driving of test piling, will be paid for at contract unit price, each, for Pile Splices.

For concrete piles, where the head of the pile to be spliced is not more than two feet

below the elevation of cut-off, the Contractor, if he so elects, may cast the pile build-up with the cap, under the following conditions:

(a) Reinforcing steel and pile dimensions shall conform in every respect to a standard splice.

(b) Reinforcing steel used for the build-up will be paid for as an overrun in the contract quantity for substructure reinforcing steel.

(c) Concrete used for the build-up will be paid for as an overrun in the contract quantity for substructure concrete.

(d) Thirty percent of the contract price each, for pile splices, shall be paid for as compensation for drilling and grouting the dowels and all other costs for which provision has not otherwise been made.

(e) No payment for the build-up will be made under the item for Piling Furnished.

A455-9.10 Pile Redrive. The quantity to be paid for under this item shall be the number of redrives, each, authorized by the Engineer. Pile redrive shall be paid in addition to the Piling Driven item and shall be full compensation for additional costs due to redriving.

The Contractor shall be paid for a Pile Redrive under any of the following conditions:

(a) When the Engineer directs the Contractor to redrive a pile to determine its capacity after the 72 hour set-check time has expired.

(b) When the Engineer orders the Contractor to redrive piles to reestablish their capacity as the result of pile heave as described in A455-3.11.5.

(c) When a pile is spliced and has to be redriven as described in A455-9.2.8 as compensation for isolated driving.

A455-9.11 Pile Extraction. The quantity to be paid for under this item shall be the number of piles, each, authorized to be extracted by the Engineer and successfully extracted as provided in Section A455-3.18. No payment for extraction will be made for piling damaged or mislocated by the Contractor that are ordered extracted by the Engineer.

A455-9.12 Protection of Existing Structures. The quantity to be paid for under this item, when included in the Contract Documents, shall be at the contract lump sum price. Such price and payment shall include all cost of work shown in the plans or described herein for protection of existing structures. When the Contract Documents do not include an item for protection of existing structures, the cost of settlement monitoring as required by these specifications shall be included in the cost of the piling items; however, work in addition to settlement monitoring will be paid for as Unforeseeable Work when such additional work is ordered by the Engineer.

A455-9.13 Static Load Tests.

The quantity to be paid for under this item shall be the number of static load tests of the designated tonnages, each, as shown in the plans or authorized by the Engineer, actually applied to piles, completed and accepted in accordance with the plans and these specifications.

A455-10 BASIS OF PAYMENT (ALL PILING).

A455-10.1 Treated Timber Piling. The quantity of Treated Timber Piling, determined as provided in A455-9.1, shall be paid for at contract unit price per linear foot for Treated Timber Piling. Such price and payment shall be full compensation for furnishing all materials, including collars, metal shoes, copper cover sheets, preservatives and tar. Such price and payment shall also include furnishing the material for and wrapping pile clusters with wire cable, where so shown in the plans.

A455-10.2 Prestressed Concrete Piling. The quantity of this item, determined as provided in A455-9.2 shall be paid for at the respective contract unit prices per linear foot for Prestressed Concrete Piling Furnished and for Prestressed Concrete Piling Driven. Such prices and payments shall include the cost of furnishing and placing all reinforcing steel, cutting off and predrilling the piles, and furnishing the material for and wrapping pile clusters with wire cable where so shown in the plans. The unit price per linear foot for Piling Driven shall also include the cost of predrilling pile holes described in A455-3.2.3.

A455-10.3 Steel Piling. The quantity of this item, determined as provided in A455-9.3, shall be paid for at the respective contract unit prices per linear foot, for Steel Piling Furnished and for Steel Piling Driven. Should additional piling be required to complete the work, no payment will be made for any delay which may be due to ordering such additional piling. The above prices and payments shall include welding and painting as specified.

Bracing and other metal parts attached to or forming a part of piling or bracing and not otherwise classified, shall be measured and paid for as provided in Section 460.

The Contractor will be permitted to use the plates from cut-offs less than 20 feet long and from extra pile stock, for the purpose of making authorized splices. Cut-off sections less than 20 feet long shall become the property of the Contractor and shall be removed from the job and disposed of by him.

A455-10.4 Test Piles. The quantity of this item, determined as provided in A455-9.4, shall be paid for at the contract unit price per linear foot for Test Piles Furnished and Test Piles Driven, completed and accepted, which price and payment shall include all incidentals necessary to complete all the work of this item except splices, build-ups, pile extractions and preformed pile holes authorized by the Engineer and paid for under the regular piling items. The cost of all work necessary to assure required penetration and attain required bearing of the test piles shall be included in the price bid per linear foot of Test Pile Driven, including driving and all other related costs.

A455-10.5 Dynamic Load Tests. The quantity of this item, determined as provided in A455-9.5 shall be paid for at the contract unit price, each, for Dynamic Load Tests, completed and accepted.

A455-10.6 Steel Sheet Piling.

The quantity of steel sheet piling shall be paid for at the contract unit price per square foot for Steel Sheet Piling, completed and accepted. This payment shall be full compensation for all labor, equipment and materials required for furnishing and installing steel sheet piling, but shall not include furnishing and placing anchors when an anchored wall system, temporary or permanent, is designed and detailed in the plans. In such cases, furnishing and installing anchors will be paid for separately. For installations designed by the Contractor,

the cost of furnishing and installing anchors shall be incidental to the cost of steel sheet piling. For temporary installations, removal of the sheet piling, anchors, and incidentals shall be included in the cost per square foot for Steel Sheet Piling (Temporary).

A455-10.7 Concrete Sheet Piling. The quantity of this item, determined as provided in A455-9.7, shall be paid for at the contract unit price per linear foot for Concrete Sheet Piling, which price and payment shall include reinforcing steel and grouting.

A455-10.8 Preformed Pile Holes. The quantity of this item, determined as provided in A455-9.8, shall be paid for at the contract unit price each.

A455-10.9 Pile Splices. The quantity of this item determined as provided in A455-9.9, shall be paid for at the contract unit price each.

A455-10.10 Pile Redrive. The quantity of this item, determined as provided in A455-9.10, shall be paid for at the contract unit price each.

A455-10.11 Pile Extraction. The quantity of this item, determined as provided in A455-9.11, shall be paid for at the contract unit price each.

A455-10.12 Protection of Existing Structures. The quantity of this item, determined as provided in A455-9.12, shall be paid for at the contract lump sum price.

A455-10.13 Point Protectors. The quantities of this item, determined as provided in A455-9.3.2, shall be paid for at the contract unit price each.

A455-10.13A Static Load Tests.

The quantity of this item shall be paid for at the contract unit price each for Test Loads, completed and accepted.

A455-10.14 Items of Payment. The prices and payments specified in A455-10.1 through A455-10.13 above, shall be full compensation for all the work specified herein.

Payment shall be made under:

- | | |
|--------------------|---|
| Item No. 455-2 | -Treated Timber Piling - per linear foot. |
| Item No. 455-3 | -Prestressed Concrete Piling Furnished - per linear foot. |
| Item No. 455-4 | -Prestressed Concrete Piling Driven - per linear foot. |
| Item No. 455-7 | -Steel Piling Furnished - per linear foot. |
| Item No. 455-8 | -Steel Piling Driven - per linear foot. |
| Item No. 455-14 | -Concrete Sheet Piling - per linear foot. |
| Item No. 455-15 | -Preformed Pile Holes - each. |
| Item No. 455-17 | -Pile Splices - each. |
| Item No. 455-18 | -Protection of Existing Structures - lump sum. |
| Item No. 455-85 | -Pile Extraction - each. |
| Item No. 455-115 | -Pile Redrive - each. |
| Item No. 455-119 | - Test Loads - each. |
| Item No. 455-120 | -Point Protectors - each. |
| Item No. 455-133 | -Steel Sheet Piling -per square foot. |
| Item No. 455-133-1 | - Steel Sheet Piling (Temporary) - per square |

Item No. 455-137	foot.
Item No. 455-140	-Dynamic Load Tests - each.
Item No. 455-141	-Test Piles Furnished - per linear foot.
	-Test Piles Driven - per linear foot.

STRUCTURES FOUNDATIONS - DRILLED SHAFTS.

SECTION 455 (Pages 419-443) is deleted and the following substituted:

SECTION B455
STRUCTURES FOUNDATION - DRILLED
SHAFTS

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B455-1 DESCRIPTION.

Drilled shaft foundations shall consist of reinforced (or unreinforced when indicated in the plans) concrete drilled shafts with or without bell footings. Drilled shaft foundations shall be constructed in accordance with these specifications, the Special Provisions and in conformance with the details and dimensions shown in the plans.

B455-2 MATERIALS.

B455-2.1 Concrete. All concrete materials shall be in accordance with Section 346. Concrete shall be either Class III (Drilled Shaft) or Class IV (Drilled Shaft) as called for in the plans.

B455-2.2 Reinforcing Steel. Reinforcing steel shall conform to the requirements of Section 415. Reinforcing steel shall be in accordance with the sizes, spacing, dimensions and the details shown in the plans.

B455-3 CONSTRUCTION METHODS AND EQUIPMENT.

B455-3.1 General Requirements:

B455-3.1.1 Protection of Existing Structures. When the plans require drilled shaft excavations within close proximity to existing structures, the Contractor shall take all reasonable precautions to prevent damage to such structures. The requirements described herein apply to all types of structures (on or off the right of way) that may be adversely affected by foundation construction operations (including phase construction) due to ground loss, dewatering, or vibrations. If not otherwise provided in the plans, the Contractor shall be solely responsible for evaluating the need for, design of, and providing all reasonable precautionary features to prevent damage. These measures shall include but are not limited to selecting construction methods and procedures that will prevent damaging caving of the shaft excavation and monitoring and controlling the vibrations from construction activities including the driving of casings, driving of sheeting or from blasting. Utilities shall be protected as described in 7-11.6.

Structures within a distance of ten shaft diameters or the estimated shaft depth, whichever is greater, shall be monitored for settlement in an approved manner, recording elevations to 0.001 foot. The number and location of monitoring points shall be as approved by the Engineer. Elevations shall be taken before construction begins, during the driving of any required casings, and during excavation or blasting as directed by the Engineer.

When shown in the plans, the Contractor shall engage the services of a qualified Professional Engineer registered in the State of Florida to conduct a survey of all (except as noted herein) structures, or portions therein, within a distance of ten shaft diameters or the estimated depth of excavation, whichever is greater, or the distance shown in the plans before shaft operations begin and after shaft operations are completed. The Department

will make the necessary arrangements for entry by the Contractor's engineer to survey. The condition of the structures shall be adequately documented with descriptions and pictures. All existing cracks shall be thoroughly documented. Two reports shall be prepared documenting the condition of the structures; one report before shaft construction operations begin and a second report after drilled shaft operations are complete. Both reports shall become the property of the Department. Preconstruction and post-construction surveys of the condition of bridges owned by the Department will not be required except when shown in the plans or Special Provisions.

When the plans require excavations for construction of footings or caps supported by drilled shafts, the Contractor shall be responsible for evaluating the need for, design of, and providing any necessary features to protect adjacent structures. Sheeting and shoring shall be constructed according to plans provided by the Contractor except when the sheeting and shoring are detailed in the plans. Sheeting and shoring installed to protect existing structures shall be designed by a Professional Engineer, employed by the Contractor, registered in the State of Florida and who shall sign and seal the plans and specification requirements. Plans and specifications for sheeting and shoring provided by the Contractor shall be sent to the Engineer for his record before construction begins.

Existing structures within a distance of three times the depth of excavation for the footing shall be monitored for movement. The number and location of monitoring points shall be as approved by the Engineer. Elevations shall be taken before the driving of any sheeting, daily during the driving of sheeting and during excavation, read and recorded to 0.001 foot. The Contractor shall notify the Engineer of any movements detected and immediately take any remedial measures required to prevent damaging the existing structure.

When shown in the plans or Special Provisions, the Contractor shall install a piezometer near the right of way line and near any structure that may be affected by lowering the ground water when dewatering is required. The piezometer shall be monitored and the ground water elevation level recorded daily. The Contractor shall notify the Engineer of any ground water lowering near the structure of one foot or more.

When shown in the plans or Special Provisions, the Contractor shall engage the services of a qualified Professional Engineer registered in the State of Florida to monitor and record vibration level during the driving of casings, sheeting, or during blasting operations conducted by the Contractor. Vibration monitoring equipment shall be capable of detecting velocities of 0.1 inch/second or less.

At any time the Contractor detects settlement of 0.005 foot, vibration levels reaching 0.5 in/sec or damage to the structure, he shall immediately stop the source of vibrations, backfill any open drilled shaft excavations and contact the Engineer for instructions.

B455-3.1.2 Site Preparation. All excavation of the foundations in which drilled shafts are to be constructed shall be completed before shaft construction begins unless otherwise authorized by the Engineer. After shaft construction is completed all loose and displaced materials shall be removed from around the shafts, leaving a clean, solid surface. The soil surface on which concrete is to be placed or which will support the forming system for the concrete shall be compacted to a density not less than 90 percent of the maximum density as

determined by AASHTO T 180, and which will support the load of the plastic concrete without settling or causing the concrete to crack, or as shown in the Contract Documents. No compaction will be required for excavations made below water for seals or when footings or caps or forming system (including supports) do not rest on the ground surface unless shown in the plans.

Unless shown otherwise in the plans, the Contractor shall construct the drilled shafts after the placement of abutment fills. Permanent casings shall be provided for all drilled shafts through mechanically stabilized fills (for example, behind proprietary retaining walls). Permanent casings shall be provided for conventional fills 15 feet or greater in height except when shown otherwise in the plans. Permanent casings shall not be provided for conventional fills less than 15 feet in height except when shown in the plans or when directed by the Engineer. Temporary casings shall be installed through the completed conventional fill when permanent casings are not required.

When permanent casings are required, they shall be provided before the fill is placed extending a sufficient distance into the existing ground to provide stability to the casings during construction of the abutment fill. When casings are driven prior to placing fill, the Contractor shall take necessary precautions to prevent displacement of the casings during placing and compacting fill materials within 15 feet of the casings. The position of the casings shall be referenced and the casing position shall be checked by the Contractor at three approximately equal intervals during construction of the embankment. Embankment material shall be placed in six-inch loose lifts in the 15-foot area around the casings. Embankment material within the 15-foot area adjacent to the casings shall be compacted to the required density with compaction equipment weighing less than 1,000 pounds.

When drilled shafts are constructed prior to the completion of the surrounding fills, they shall not be capped until the fills have been placed as near to final grade as possible, leaving only the necessary working room for construction of the caps.

B455-3.1.3 Cofferdams. Cofferdams shall be constructed according to plans provided by the Contractor except when the cofferdams are detailed in the contract plans. Cofferdam designs provided by the Contractor shall be sent to the Engineer for his records. Cofferdams shall be designed by a Professional Engineer, employed by the Contractor, registered in the State of Florida and who shall sign and seal his plans and specification requirements.

The Contractor shall provide a qualified diver and safety diver to inspect the conditions of the foundation enclosure or cofferdam when a seal is required for construction. These divers shall be equipped with suitable voice communications and they shall inspect the foundation enclosure and cofferdam periphery including each sheeting indentation and around each drilled shaft to ensure that no layers of mud or other undesirable materials were left above the bottom of seal elevation. They shall also check to make sure the surface of the drilled shafts are sufficiently clean to allow bond between the shafts and the seal down to the authorized bottom of seal elevation. When required the divers shall assure that there are no mounds of stone, shell or other authorized backfill material left after placement and grading. They shall also assist as required to assure that the

seal is placed as specified. Any deficiencies found by the divers shall be corrected by the Contractor. Upon completion of inspection by the Contractor's divers, the Department may also elect to inspect the work before authorizing the Contractor to proceed with subsequent construction operations. The Contractor shall furnish the Engineer a written report by the divers indicating the results of their underwater inspection before the seal concrete is authorized to be placed.

B455-3.1.4 Templates. A fixed template, adequate to maintain shaft position and alignment during all excavation and concreting operations, shall be provided when drilling from a barge. Floating templates (attached to a barge) will not be allowed. A template will not be required for shafts drilled on land provided the Contractor demonstrates satisfactorily to the Engineer that shaft position and alignment can be properly maintained. A fixed template, adequate to maintain shaft position and alignment during all excavation and concreting operations, will be required for shafts drilled on land when the Contractor fails to demonstrate satisfactorily that he can properly maintain shaft position and alignment without use of a template.

B455-3.1.5 Drilled Shaft Installation Plan. At the preconstruction conference or no later than 30 days before drilled shaft construction begins, the Contractor shall submit a drilled shaft installation plan for approval by the Engineer. This plan shall provide detailed information including the following:

1. Name and experience record of drilled shaft superintendent or foreman in responsible charge of drilled shaft operations. The person in responsible charge of day to day drilled shaft operations shall have satisfactory prior experience constructing shafts similar to those described in the plans and Special Provisions. Final approval by the Engineer will be subject to satisfactory performance in the field.
2. List and size of proposed equipment including cranes, drills, augers, bailing buckets, final cleaning equipment, desanding equipment, slurry pumps, core sampling equipment, tremies or concrete pumps, casings, etc.
3. Details of sequence of construction operations and sequence of shaft construction in bents or shaft groups.
4. Details of shaft excavation methods.
5. Details of slurry including proposed methods to mix, circulate, desand, test methods and proposed testing laboratory to document test results.
6. Details of proposed methods to clean shaft after initial excavation.
7. Details of shaft reinforcement to include methods to ensure centering/required cover, cage integrity during placement, placement procedures, cage support, and tie downs.
8. Details of concrete placement including proposed operational procedures for concrete tremie or pump including initial placement, raising during placement, and overfilling of the shaft concrete. Provisions to ensure proper final shaft cutoff elevation shall also be provided.
9. Details of casing removal when removal is required including minimum concrete head in casing during removal.
10. Required submittals including shop drawing and concrete design mixes.

11. Details of any required load tests including equipment and procedures, and recent calibrations for any jacks or load cells supplied by the Contractor.

12. Methods and equipment proposed to prevent displacement of casing and/or shafts during placement and compaction of fill.

13. Details of environmental control procedures used to prevent loss of slurry or concrete into waterways or other protected areas.

14. Other information shown in the plans or requested by the Engineer.

The Engineer will evaluate the drilled shaft installation plan for conformance with the plans, specifications and Special Provisions. Within 20 days after receipt of the plan, the Engineer will notify the Contractor of any additional information required and/or changes that may be necessary in the opinion of the Engineer to satisfy the plans, specifications and Special Provisions. Any part of the plan that is unacceptable will be rejected and the Contractor shall submit changes agreed upon for reevaluation. The Engineer will notify the Contractor within seven days after receipt of proposed changes of their acceptance or rejection. All approvals given by the Engineer shall be subject to trial and satisfactory performance in the field.

The Contractor shall demonstrate the adequacy of methods and equipment during construction of the first drilled shaft which shall be an out of position test hole generally constructed as an unreinforced shaft. When the drilled shafts are supporting sign posts or high mast light poles the test hole may be placed in the location of a permanent shaft. This test hole shall be drilled in the position shown in the plans or as directed by the Engineer and shall be drilled to the maximum depth for any production shaft shown in the plans. Failure to demonstrate the adequacy of methods or equipment to the Engineer is cause for the Engineer to require appropriate alterations in equipment and/or method by the Contractor to eliminate unsatisfactory results. Any additional test holes required to demonstrate the adequacy of methods or equipment shall be at the Contractor's expense. No changes in methods or equipment will be made after initial approval without the consent of the Engineer.

B455-3.1.6 General Methods & Equipment. The Contractor shall perform the excavations required for the shafts and bell footings, through whatever materials encountered, to the dimensions and elevations shown in the plans or otherwise required by the specifications and Special Provisions. The Contractor's methods and equipment shall be suitable for the intended purpose and the materials encountered. The Contractor shall provide equipment capable of constructing shafts to a depth equal to the deepest shaft shown in the plans plus 15 feet or plus three times the shaft diameter, whichever is greater, except when the plans instruct the Contractor to provide equipment capable of constructing shafts to a deeper depth.

Drilled shafts shall be constructed as indicated in the plans or described herein or in the Special Provisions generally by either the dry method, wet method, casing method or permanent casing method as necessary to produce sound, durable concrete foundation shafts free of defects. The permanent casing method shall be used only when required by the plans or authorized by the Engineer. When the plans describe a particular method of

construction, this method shall be used except when permitted otherwise by the Engineer after field trial. When the plans do not describe a particular method, the Contractor shall propose a method on the basis of its suitability to the site conditions and submit it for approval by the Engineer.

The Contractor shall set a suitable temporary removable surface casing. The minimum surface casing length shall be the length required to prevent caving of the surface soils and to aid in maintaining shaft position and alignment. Predrilling with slurry and/or overreaming to the outside diameter of the casing may be required to install the surface casing at some sites.

B455-3.1.7 Available Borings And Samples. A representation of available soil borings is included in the plans. Available soil samples and/or rock cores obtained during the soil boring operations may be examined by the Contractor at the appropriate District Materials Office.

B455-3.2 Dry Construction Method.

The dry construction method shall be used only at sites where the ground water table and soil conditions (generally stiff to hard clays or rock above the water table) make it feasible to construct the shaft in a relatively dry excavation and where the sides and bottom of the shaft are stable and may be visually inspected by the Engineer prior to placing the concrete.

The dry construction method consists of drilling the shaft excavation, removing accumulated seepage water and loose material from the excavation and placing the shaft concrete in a relatively dry excavation.

The dry construction method shall be used only when shaft excavations, as demonstrated in a test hole, have 12 inches or less of seepage water accumulated over a four hour period, the sides and bottom remain stable without detrimental caving, sloughing or swelling for a four hour period and the loose material and water can be satisfactorily removed prior to inspection and prior to placing concrete. The Contractor shall use the wet construction method or the casing construction method for shafts that do not meet the requirements for the dry construction method.

B455-3.3 Wet Construction Method.

The wet construction method shall be used at all sites where it is impractical to provide a dry excavation for placement of the shaft concrete.

The wet construction method consists of drilling the shaft excavation below the water table, keeping the shaft filled with water (including natural slurry formed during the drilling process) or mineral slurry, desanding and cleaning the slurry and final cleaning of the excavation by means of a bailing bucket, air lift, submersible pump or other approved devices and placing the shaft concrete (with a tremie or concrete pump beginning at the shaft bottom) which displaces the water or slurry as the shaft excavation is concreted. Temporary surface casings shall be provided to aid shaft alignment and position and to prevent sloughing of the top of the shaft except when the Contractor demonstrates to the satisfaction of the Engineer that the surface casing is not required.

Where drilled shafts are located in open water areas, the shafts shall be constructed by

the wet method using exterior casings extending from above the water elevation into the ground to protect the shaft concrete from water action during placement and curing of the concrete. The exterior casing shall be installed in a manner that will produce a positive seal at the bottom of the casing so that there is no intrusion or extrusion of water or other materials into or from the shaft excavation.

B455-3.4 Casing Construction Method.

The casing method shall be used at all sites where it is inappropriate to use the dry or wet construction methods without the use of temporary casings other than surface casings. In this method, the hole is advanced through caving material by the wet method as described above. When a formation is reached that is nearly impervious, a casing shall be placed in the hole and sealed in the nearly impervious formation. Drilling may proceed as with the dry method to the projected depth. The placement of the concrete shall proceed as with the dry method except that the casing shall be withdrawn when the concrete is placed. In the event seepage conditions prevent use of the dry method, excavation shall be completed using wet methods.

Where drilling is through materials having a tendency to cave, the drilling shall be advanced by drilling in a mineral slurry. In the event that a caving layer or layers are encountered that cannot be controlled by slurry, the Contractor shall install temporary removable casing through such caving layer or layers. Overreaming to the outside diameter of the casing may be required. The Contractor shall take whatever steps are required to prevent caving during shaft excavation including installation of deeper casings. If the Contractor elects to remove a casing and replace it with a longer casing through caving soils, he shall adequately stabilize the excavation with slurry or backfill the excavation. Soil previously excavated or soil from the site may be used if the excavation is backfilled. Other approved methods which will control the size of the excavation and protect the integrity of the foundation soils may be used to excavate through caving layers.

Before the casing is withdrawn, the level of fresh concrete shall be at such a level that the fluid trapped behind the casing is displaced upward. As the casing is withdrawn care shall be exercised to maintain the level of concrete within the casing so that fluid trapped behind the casing is displaced upward out of the shaft excavation without mixing with or displacing the shaft concrete.

The casing method may be used, when approved by the Engineer, to construct shafts through weak caving soils that do not contribute significant shaft shear resistance. In this case, a temporary casing is placed through the weak caving soils before excavation begins. Excavation is conducted using the dry construction method where appropriate for site conditions or the wet construction method where the dry construction method is not appropriate. The temporary casing shall be removed during the concreting operations unless approved otherwise by the Engineer.

B455-3.5 Permanent Casing Method.

The permanent casing method shall be used when required by the plans. In this method, a casing is placed to the prescribed depth before excavation begins. If full penetration cannot be attained, the Engineer may direct the excavation through the casing to

be accomplished and the casing advanced again until reaching the desired penetration. In some cases overreaming to the outside diameter of the casing may be required before placing the casing.

The casing is cut off at the prescribed elevation upon reaching the proper construction sequence and the remainder of the casing is left in place.

B455-3.6 Excavations.

The plans generally indicate the expected depths, the top of the shaft elevations and the estimated bottom of shaft elevations between which the drilled shaft shall be constructed as a minimum. Drilled shaft excavations may be extended deeper by extra depth excavation when the Engineer determines that the material encountered while drilling the shaft excavation is unsuitable and/or is not the same as anticipated in the design of the drilled shaft.

The Contractor shall take cores when shown in the plans or directed by the Engineer to determine the character of the material directly below the shaft excavation. The cores shall be cut with an approved core barrel to a minimum depth of five feet below the bottom of the drilled shaft excavation at the time the shaft excavation is approximately complete. The Engineer may require any core to be cut below the five-foot minimum depth up to a total depth of 20 feet below the bottom of the drilled shaft excavation. The Engineer will inspect the cores and determine the depth of required excavation. When considered necessary by the Engineer, additional cores shall be taken.

The Engineer may direct Core (Shaft Excavation) be conducted through part or all of the shaft, prior to excavation, to a depth up to 20 feet below that shaft's planned tip elevation.

The Engineer may exercise this option not to exceed one core for piers with less than ten shafts and one core per ten shafts for piers with more than ten shafts, rounding the number of shafts in a pier to the nearest ten. When the Engineer elects to use this option, he may eliminate some or all of the cores at the bottom of the remaining shafts.

The core barrel shall be designed: (a) to cut a core sample from four to six inches in diameter, (b) so that the sample of material cored can be removed from the shaft excavation and the core barrel in an undisturbed state and (c) in sufficient length to provide core samples, as directed by the Engineer up to a depth of 20 feet below the bottom of the drilled shaft excavation. The Engineer may elect to substitute Standard Penetration Tests (SPT) for coring when he determines that it will be beneficial. In such cases, the Contractor shall supply these tests at no additional cost per foot to the Department above that bid for coring.

The Contractor shall maintain a drilling log during shaft excavation and during coring operations. The log shall contain information such as the description of and approximate top and bottom elevation of each stratum encountered, depth of penetration, drilling time in each of the various strata, material description and remarks. Core samples shall be classified, measured, and described in the Contractor's drilling log. The core samples shall be placed in suitable containers, identified by shaft location, elevation from and to, job number and delivered to the Department's project personnel within 48 hours after cutting. Two copies of the drilling log, signed by a designated representative of the Contractor and cosigned by a designated representative of the Department, shall be furnished by the

Contractor to the Department at the time the shaft excavation is completed and accepted.

Unsuitable materials and excess materials as defined in 120-5 which are removed from shaft excavations shall be disposed by the Contractor in areas provided by him. The disposal shall be subject to all requirements pertaining to pollution.

When shown in the plans, bells shall be excavated to form a bearing area of the size and shape shown. Bell outlines varying from those shown in the plans are permissible provided the bottom bearing area equals or exceeds that specified. If the diameter of the bell exceeds three times the shaft diameter the excavation shall be drilled deeper as directed and a new bell footing shall be formed. Bells shall be excavated by mechanical methods.

The additional drilled shaft concrete over the theoretical amount required to complete filling any excavations for bells and shafts which are larger than required by the plans or authorized by the Engineer, shall be furnished by the Contractor at his expense.

B455-3.7 Casings.

Casings shall be metal (or concrete when indicated in the plans) of ample strength to withstand handling and driving stresses and the pressure of concrete and of the surrounding earth materials, and they shall be smooth and water tight. The inside diameter of casing shall not be less than the specified size of shaft except as provided below. No extra compensation will be allowed for concrete required to fill an oversize casing or oversize excavation.

The Contractor will be allowed to supply casing with an outside diameter equal to the specified shaft diameter (O.D. casing) provided he supplies additional shaft length at the shaft tip. The additional length of shaft required may be determined by the following relationship:

$$\text{Additional length} = \frac{(D1 - D2)L}{D2}$$

- where:
- D1 =casing inside diameter specified = shaft diameter specified
 - D2 =casing inside diameter provided (D2 = D1 minus twice the wall thickness)
 - L =authorized shaft length below ground

The Contractor shall bear all costs relating to this additional length including but not limited to the cost of extra excavation, extra concrete and extra reinforcing steel.

All casings shall generally be removed from shaft excavations except those used for the Permanent Casing Method. The portion of casings installed under the Permanent Casing Method of construction below the shaft cut-off elevation shall remain in position as a permanent part of the Drilled Shaft. Casings that in the opinion of the Engineer will not adversely affect the shaft capacity may be left in place when approved by the Engineer. When casings which are to be removed become bound in the shaft excavation and cannot be practically removed, the shaft excavation shall be drilled deeper as directed by the Engineer to compensate for loss of capacity due to the presence of the casing. No compensation will be paid for the casing remaining. The additional length of shaft shall be

paid under Item No. B455-88 and the additional excavation shall be paid under Item No. B455-125.

When the shaft extends above ground or through a body of water, the portion exposed above ground or through a body of water, may be formed with removable casing except when the Permanent Casing Method is specified (see B455-11.10). When approved, drilled shafts extending through a body of water may be formed with permanent or removable casings. However, for permanent casings, the portion of metal casings between an elevation two feet below the lowest water elevation and the top of shaft elevation shall be removed after the concrete is cured. Casing removed to expose the concrete as required above shall be removed in a manner which will not damage the drilled shaft concrete. Removable casings can be removed when the concrete has attained sufficient strength provided (a) curing of the concrete is continued for the full 72 hour curing period in accordance with specifications; (b) the shaft concrete is not exposed to salt water or moving water for seven days or until reaching a compressive strength of at least 2500 psi.

Generally when removal of the temporary casing is required, the removal shall not be started until all concrete placement is completed in the shaft. Movement of the casing by rotating, exerting downward pressure and tapping it to facilitate extraction or extraction with a vibratory hammer will be permitted. Casing extraction shall be at a slow, uniform rate with the pull in line with the axis of the shaft. Temporary casings shall be removed while the concrete remains workable.

When conditions warrant, the casing may be pulled in partial stages. A sufficient head of concrete shall be maintained above the bottom of the casing to overcome the hydrostatic pressure of water outside the casing. At all times the elevation of the concrete in the casing shall be maintained high enough to displace the drilling slurry between the outside of the casing and the edge of the hole as the casing is removed.

Special casing systems may be used in open water areas, when approved, which are designed to permit removal after the concrete has hardened. Special casings shall be designed so that no damage occurs to the drilled shaft concrete during their removal.

B455-3.8 Slurry And Fluid In Excavation At Time Of Concrete Placement.

B455-3.8.1 Slurry.

When slurry is employed in the drilling process as described earlier, a mineral slurry shall be employed. Mineral slurry shall be processed attapulgite or bentonite clays. Polymer slurries will not be allowed. The slurry shall have a mineral grain size such that it will remain in suspension and it shall have sufficient viscosity and gel characteristics to transport excavated material to a suitable screening system. The percentage and specific gravity of the material used to make the suspension shall be sufficient to maintain the stability of the excavation and to allow proper placement of concrete. The material used to make the slurry shall not be detrimental to concrete or surrounding ground strata. During construction, the level of the slurry shall be maintained at a height sufficient to prevent caving of the hole. In the event of a sudden significant loss of slurry such that the slurry level cannot practically be maintained by adding slurry to the hole, the construction of that foundation shall be delayed until an alternate construction procedure has been approved.

The mineral slurry shall be premixed thoroughly with clean fresh water prior to introduction into the shaft excavation. The percentage of mineral admixture used to make the suspension shall be such as to maintain the stability of the shaft excavation. Adequate water and/or slurry tanks are required when necessary to perform the work in accordance with these specifications. No excavated pits will be allowed on projects requiring slurry tanks without the written permission of the Engineer. Adequate desanding equipment will be required when shown in the plans or Special Provisions. However, desanding equipment will not be required for drilled shafts for sign post or lighting mast foundations unless shown in the plans or Special Provisions. The Contractor shall take the steps necessary to prevent the slurry from "setting up" in the shaft including but not limited to agitation, circulation and/or adjusting the composition and properties of the slurry. Disposal of all waste slurry shall be offsite in suitable areas provided by the Contractor and shall be subject to all requirements pertaining to pollution.

Control tests using suitable apparatus shall be carried out on the mineral slurry mixture by a qualified professional soil testing laboratory approved by the Engineer and engaged by the Contractor, to determine the following parameters:

(a) Freshly mixed mineral slurry:

The density of the freshly mixed mineral slurry shall be measured regularly as a check on the quality of the suspension being formed. The measuring device shall be calibrated to read within ± 0.5 lb/cf.

(b) Mineral slurry supplied to the drilled shaft excavation:

The following tests shall be applied to the mineral slurry supplied to the shaft excavation and the results shall be within the ranges stated in the table below:

Item to be measured	Range of Results at 20 deg.	Test Method
Density	64 - 73 lb/cf (in fresh water) 66 - 75 lb/cf (in salt water)	Mud density balance - FM 8-RP13B-1
Viscosity	28-40 seconds	Marsh Cone Method - FM 8-RP13B-2
pH	8-11	electric pH meter or pH indicator paper strips - FM 8-RP13B-4

The limits in the above table may be adjusted when field conditions warrant as successfully

demonstrated in a Test Hole or with other methods approved by the Engineer. All changes must be approved in writing by the Engineer before continued use.

Tests to determine density, viscosity and pH value shall be carried out initially until a consistent working pattern has been established, taking into account the mixing process, and blending of freshly mixed mineral slurry and previously used mineral slurry. A minimum of four sets of tests shall be made to determine density, viscosity and pH value during the first eight hours slurry is in use.

When the results show consistent behavior, the tests for pH value may be discontinued, and tests to determine density and viscosity only shall be carried out during each four hours slurry is in use. In the event of a change in the established working pattern, the additional tests for pH value shall be reintroduced for the time required to establish consistency of the test values within the specification parameters.

(c) Reports of all mineral slurry tests required above, signed and sealed by a Professional Engineer registered in the State of Florida, representing the soil testing laboratory engaged by the Contractor, shall be furnished to the Department on completion of each drilled shaft.

(d) Representatives of the Department may perform comparison tests as determined necessary during the mineral slurry operations.

During construction, the level of mineral slurry in the shaft excavation shall be maintained within the excavation and at a level not less than four feet above the highest expected piezometric water pressure along the depth of a shaft.

At any time the slurry method of stabilizing excavations fails in the opinion of the Engineer to produce the desired final result, the Contractor shall discontinue this method of construction and he shall propose modifications in procedure or alternate means of construction for approval.

B455-3.8.2 Fluid In Excavation At Time Of Concrete Placement.

Prior to placing concrete in any shaft excavation, the Contractor shall ensure that heavily contaminated suspensions, which could impair the free flow of concrete from the tremie pipe, has not accumulated in the bottom of the shaft. Samples of the fluid in the shaft (natural slurry formed during the drilling operations or mineral slurry) shall be taken from the base of the shaft and at intervals not exceeding ten feet up the shaft, using an approved sampling tool. When the fluid in the shaft is water, not natural or mineral slurry, density testing is only required at the base of the shaft. The density of the fluid in the shaft excavation prior to concreting shall be less than 75 pounds per cubic foot. Tests for pH and viscosity are not required for slurry in the excavation. Projects that require desanding equipment shall have a sand content not greater than four percent as determined by Florida Test Method FM 8-RP13B-3, sand content test. The Contractor shall take whatever action is necessary to modify the fluid in the shaft excavation prior to placing the concrete to bring the fluid within the specification requirements.

When slurry is used, the applicable density test method and reporting requirements described in B455-3.8.1 apply to tests of slurry in the shaft prior to placing the concrete. When water (including natural slurry formed during the drilling process) is used and a

testing laboratory is not required for testing, the tests prior to placing the concrete may be performed by an experienced person furnished by the Contractor and approved by the Engineer. Such tests shall be performed in the presence of a representative of the Department. A Department representative may also perform comparison tests. The Contractor shall provide equipment for such comparison tests when requested by the Engineer.

B455-3.9 Tremies.

B455-3.9.1 General. Tremies used to place concrete shall consist of a tube of sufficient length to meet the requirements below. No aluminum parts having contact with concrete will be permitted. The Contractor may use concrete pumps approved by the Engineer in lieu of tremies to place concrete for drilled shafts. Tremies and concrete pumps shall have sufficient capacity to place the concrete within the time limit specified. The pump lines shall have a minimum four inch diameter and shall be constructed so that all sections have water-tight joints.

B455-3.9.2 Dry Excavations. The tremie for depositing concrete in a dry drilled shaft excavation shall consist of: a tube of solid construction; a tube constructed of sections which can be added and removed; or a tube of other approved design. Concrete may be passed through a hopper at the top of the tube or through side openings as the tremie is retrieved during concrete placement. The tremie shall be supported so that the free fall of the concrete is less than five feet at all times. If the free falling concrete causes the shaft excavation to cave or slough, the Contractor shall control the movement of concrete by reducing the height of free fall of the concrete and/or reducing the rate of flow of concrete into the excavation.

B455-3.9.3 Wet Excavations. The tremie used to deposit concrete beneath the surface of water shall be constructed so that it is water-tight and will readily discharge concrete. The discharge end of the tremie shall be constructed to prevent water intrusion and permit the free flow of concrete during placement operations. The tremie shall have sufficient weight that it will rest on the shaft bottom before start of concrete placement. The length of the tremie shall be sufficient to extend to the bottom of the excavation. The discharge end shall be entirely immersed in concrete at all times after starting. The tremie shall be supported so that it can be raised to increase the discharge of concrete and lowered to reduce the discharge of concrete. The flow of the concrete shall be continuous and the concrete in the tremie shall maintain a positive pressure differential at all times to prevent water or slurry intrusion into the shaft concrete.

B455-3.10 Excavation and Drilling Equipment.

B455-3.10.1 General.

All shaft excavation shall be "Unclassified Shaft Excavation" and extra depth excavation shall be "Unclassified Extra Depth Excavation". "Drilled Shaft Sidewall Overreaming" will be required when inspections show it to be necessary. These terms are defined in the B455-3.10.2, B455-3.10.3 and B455-3.10.4, respectively.

The excavation and drilling equipment shall have adequate capacity including power, torque, and downthrust and the excavation and overreaming tools shall be of adequate

design, size and strength to perform the work shown in the plans or described herein. When the material encountered cannot be drilled using conventional earth augers and/or underreaming tools, the Contractor shall provide special drilling equipment including but not limited to rock augers, core barrels, rock tools, air tools, blasting materials and other equipment as necessary to continue the shaft excavation to the size and depth required. In the event blasting is necessary, the Contractor shall obtain all necessary permits and shall consider and be responsible for its effect on already completed work and adjacent structures.

Approval of the Engineer will be required for all blasting.

B455-3.10.2 Unclassified Shaft Excavation. Unclassified Shaft Excavation shall be defined as all processes required to excavate a drilled shaft of the dimensions shown in the plans and/or described in the specifications to the depth indicated in the plans or directed by the Engineer, completed and accepted. The work shall include all shaft excavation, whether the material encountered is soil, rock, weathered rock, stone, natural or man-made obstructions, or materials of other descriptions.

B455-3.10.3 Unclassified Extra Depth Excavation. Unclassified Extra Depth Excavation shall be defined as all processes required to excavate a drilled shaft of plan dimensions below the elevation of the bottom of the shaft as indicated in the plans.

B455-3.10.4 Drilled Shaft Sidewall Overreaming. This item is defined as the unclassified excavation required to roughen its surface or to enlarge the drilled shaft diameter due to softening of the sidewalls or to remove excessive buildup of slurry cake when slurry is used. Overreaming shall increase the shaft radius minimum of $\frac{1}{2}$ inch and a maximum of three inches. Overreaming may be accomplished with a grooving tool, overreaming bucket or other approved equipment.

The limit for depth of sidewall overreaming into the shaft sidewall material and the elevation limits between which sidewall overreaming shall be accomplished, shall be as shown in the plans or as authorized by the Engineer.

B455-3.11 Inspection of Excavations.

B455-3.11.1 Dimensions and Alignment. The Contractor shall provide equipment for checking the dimensions and alignment of each permanent shaft excavation. The dimensions and alignment of the shaft excavation shall be determined by the Contractor under the observation and direction of the Department inspectors. Generally the alignment and dimensions may be checked by any of the following methods as necessary:

- (a) Check the dimensions and alignment of dry shaft excavations using reference stakes and a plumb bob.
- (b) Check the dimensions and alignment of casing when inserted in the excavation.
- (c) Insert a casing in shaft excavations temporarily for alignment and dimension checks.
- (d) Insert a rigid rod or pipe assembly with several 90 degree offsets equal to the shaft diameter into the shaft excavation for alignment and dimension checks.
- (e) Other methods provided by the Contractor and approved by the Engineer.

Any casing, rod or pipe assembly, or other device used to check dimensions and alignment shall be inserted by the Contractor into the excavation to full depth.

B455-3.11.2 Depth. The depth of the shaft during drilling shall generally be referenced to appropriate marks on the Kelly bar or other suitable methods. Final shaft depths shall be measured with a suitable weighted tape or other approved methods after final cleaning.

B455-3.11.3 Shaft Inspection Device. The Department, when shown in the plans, may use a shaft inspection device (SID) comprised of a television camera sealed inside a water-tight jacket to inspect the bottoms of the shafts. A side wall sampler attached to the shaft inspection device may also be used to sample the sides of the shafts. The Contractor shall cooperate with the Department in using this device, including cooperation with regard to the placement of the device in position for inspection and removal after the inspection. The Contractor will be required to furnish 110 volt single phase current (minimum 30 amp service), 220 volt single phase current (minimum 15 amp service) and a 150 psi compressor (8 cfm minimum) to operate the SID. All of the Contractor's cost related to the inspection device shall be included in the cost of drilled shaft items.

The Contractor shall provide his projected drilled shaft construction schedule to the Engineer at the preconstruction conference or no later than 30 days before drilled shaft construction begins so that the SID may be scheduled. The Contractor shall include in his bid the cost of transporting the SID from its storage location to the job site and back. The Department shall be notified at least ten days prior to the desired pick-up date. During pick-up, a checklist of all equipment placed in the Contractor's possession shall be completed. This checklist will later be used to verify that all equipment is properly returned.

The Contractor shall at all times while the device is the Contractor's responsibility, keep the device insured against loss or damage for the replacement cost thereof (the greater of \$120,000 or the amount shown in the plans) or for the full insurable value if replacement cost insurance is not available. The device shall be the responsibility of the Contractor from the time it leaves its storage area until the time it is returned by the Contractor.

The Contractor shall return the device in good working condition to its proper location within 30 days after completion of the drilled shafts. The Contractor shall notify the Department at least ten working days prior to returning the SID.

B455-3.11.4 Shaft Cleanliness Requirements. The Contractor's cleaning operation will be adjusted so that a minimum of 50 percent of the base of each shaft will have less than 1/2 inch of sediment at the time of placement of the concrete. The maximum depth of sedimentary deposits or any other debris at any place on the base of the shaft excavation shall not exceed 1 1/2 inches. Shaft cleanliness will be determined by the Engineer by visual inspection for dry shafts, using divers or SID or other methods deemed appropriate to the Engineer for wet shafts.

When slurry is used it shall meet the requirements of B455-3.8 at the time of concrete placement.

B455-3.11.5 Time of Excavation. Any unclassified excavation work lasting more than 36 hours (measured from the beginning of excavation for all methods except the Permanent Casing Method which shall begin at the time excavation begins below the casing) before placement of the concrete may require overreaming the sidewalls to the depth of softening

or to remove excessive slurry cake buildup as indicated by samples taken by the sidewall sampler or other test methods employed by the Engineer. The minimum depth of overreaming the shaft diameter shall be 1/2 inch and the maximum depth shall be three inches. The Contractor shall bear the cost of any overreaming required when the 36-hour limit is exceeded unless the time limit is exceeded solely to accomplish Unclassified Extra Depth Excavation ordered by the Engineer. The Department will pay the Contractor for authorized overreaming resulting from softening or excessive slurry cake buildup which is indicated by sidewall samples or other test methods employed by the Engineer during the initial 36-hour time period and when sidewall samples indicate softening or excessive filter cake buildup in shaft excavations which exceed the 36-hour time limit in order to accomplish Unclassified Extra Depth Excavation ordered by the Engineer.

When slurry is used, the Contractor shall adjust his excavation operations so that the maximum time that slurry is in contact with the bottom five feet of the shaft (from time of drilling to concreting) does not exceed 12 hours. If the 12-hour time limit is exceeded, the bottom five feet of shaft shall be overreamed at no additional cost to the Department prior to performing other operations in the shaft.

B455-4 REINFORCING STEEL CONSTRUCTION AND PLACEMENT.

B455-4.1 Cage Construction and Placement. The cage of reinforcing steel, consisting of longitudinal bars, ties, and cage stiffener bars shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted and immediately prior to concrete placement. All intersections of drilled shaft reinforcing steel shall be tied with cross ties or "figure 8" ties. Double strand ties or ties with larger tie wire shall be used when necessary. Final approval of the cage construction and placement is subject to satisfactory performance in the field.

B455-4.2 Splicing Cage. If the bottom of the constructed shaft elevation is lower than the bottom of shaft elevation in the plans, a minimum of one-half of the longitudinal bars required in the upper portion of the shaft shall be extended the additional length. Tie bars shall be continued for the extra depth, spaced on two-foot centers, and the stiffener bars shall be extended to the final depth. These bars may be lap spliced, or unspliced bars of the proper length may be used. Welding to the planned reinforcing steel will not be permitted unless shown in the plans or Special Provisions.

B455-4.3 Support, Alignment and Tolerance. The reinforcing steel in the shaft shall be tied and supported so that the reinforcing steel will remain within allowable tolerances as specified in B455-8 and Section 415.

Concrete wheels or other approved noncorrosive spacing devices shall be used at sufficient intervals (near the bottom and intervals not exceeding 15 feet up the shaft) to insure concentric spacing for the entire length of the cage. Block type spacers will not be allowed. A minimum of one spacer per 2.5 feet of circumference of cage with a minimum of three at each level shall be used. Concrete spacers, constructed as shown in the plans or approved by the Engineer, shall be provided at the bottom of the drilled shaft reinforcing cage to insure that the specified distance between the bottom of the cage and the bottom of

the shaft is maintained. The number of bottom spacers shall be as shown in the plans or approved by the Engineer. The Spacers shall be constructed of approved material equal in quality and durability to the concrete specified for the shaft. Approval of spacers is subject to satisfactory field performance.

The elevation of the top of the steel cage shall be checked before and after the concrete is placed. If the rebar cage is not maintained within the specified tolerances, corrections shall be made by the Contractor as directed by the Engineer. No additional shafts shall be constructed until the Contractor has modified his rebar cage support in a manner satisfactory to the Engineer.

B455-5 CONCRETE PLACEMENT.

B455-5.1 General. The work shall be performed in accordance with the applicable portions of Sections 346 and 400, Subarticles B455-3.2, B455-3.3, B455-3.4, B455-3.5, B455-3.8, B455-3.9, and with the requirements herein.

Concrete shall be placed as soon as possible after all excavation is complete, the shaft excavation has been cleaned, inspected and found satisfactory, and immediately after reinforcing steel placement. Concrete placing shall be continuous in the shaft to the top elevation of the shaft. Concrete placement shall continue after the shaft is full until good quality concrete is evident at the top of the shaft. Concrete shall be placed through a tremie or concrete pump using approved methods.

If the pressure head is lost during concrete placement for any reason, the integrity of the shaft shall be suspect and integrity testing shall be performed as directed by the Engineer at no cost to the Department.

B455-5.2 Placement Time Requirements. The elapsed time from the beginning of concrete placement in the shaft to the completion of the placement shall not exceed two hours except as provided herein. The beginning of placement time is defined as the time that concrete is first placed in the tremie or the time that concrete (or grout preceding the concrete) is placed in the concrete pump used to place the concrete. The completion of placement includes the removal of any temporary casings that cause or should cause the concrete to flow into the space previously occupied by the casing. The concrete shall maintain a minimum slump of four inches or more throughout the two-hour maximum placement time. All admixtures used to meet the specified placement time shall meet the applicable specifications for Class III (Drilled Shaft) or Class IV (Drilled Shaft) concrete. The admixtures in the concrete mix shall be adjusted as approved for the conditions encountered on the job so that the concrete remains in a workable plastic state throughout the placement. Satisfactory slump loss tests that demonstrate that the concrete will maintain a four-inch or greater slump for a period of time equal to the estimated transport plus the two-hour placement time shall be provided before drilled shaft construction begins. Slump loss tests shall be conducted according to procedures described in the applicable specifications for drilled shaft concrete.

The Contractor may request a longer placement time provided he supplies a concrete mix that will maintain a slump of four inches or greater over the longer placement time as

demonstrated by slump loss tests. The slump loss tests shall be conducted using concrete and ambient temperatures appropriate for site conditions.

B455-5.3 Forms. When the top of shaft elevation is above ground, the portion of the shaft above ground shall be formed with a removable form or another approved method to the dimensions shown in the plans.

When the shaft extends above the ground through a body of water, the portion through the water may be formed with removable forms except when the Permanent Casing Method is specified.

When approved, the portion through the water may be formed with permanent forms provided the forms are removed from two feet below the lowest water elevation to the top of shaft elevation.

B455-5.4 Riser Blocks. A riser block of equal diameter as the column and of a maximum height of six inches may be cast at the top of the completed shaft. When the Contractor elects this option he shall extend any dowel steel above the top of shaft an additional six inches.

B455-5.5 Curing. The top surface shall be cured in accordance with 400-16 and any construction joint area shall be constructed as shown in the plans. Portions of drilled shafts exposed to a body of water shall be protected from the action of water by leaving the forms in place for a minimum of seven days after casting the concrete. Forms may be removed prior to seven days provided the concrete strength has reached 2500 psi or greater as evidenced by cylinder breaks.

B455-6 TEST HOLES.

The construction of test holes will be used to determine if the methods and equipment used by the Contractor are sufficient to produce a shaft excavation meeting the requirements of the plans and specifications. Ability to control dimensions and alignment of excavations within tolerances; to seal the casing into impervious materials; to control the size of the excavation under caving conditions by the use of mineral slurry or by other means; to properly clean the completed shaft excavation; to construct excavations in open water areas; to establish elevations for belling; to determine the elevation of ground water; satisfactorily place concrete meeting the specifications within the prescribed time frame; and to satisfactorily execute any other necessary construction operation will be evaluated during Test Hole excavations. The Contractor shall revise his methods and equipment as necessary at any time during the construction of the test hole when he is unable to satisfactorily carry out any of the necessary operations described above or he is unable to control the dimensions and alignment of the shaft excavation within tolerances.

Test holes will be drilled out of permanent position at the location shown in the plans, or as directed by the Engineer. The diameter and depth of the test hole or holes shall be the same diameter and depth of the production drilled shafts as shown in the plans or as directed by the Engineer. The Test Hole will be unreinforced unless shown otherwise in the plans or special provisions and shall be filled with concrete in the same manner that production reinforced shafts will be constructed. When shown in the plans or directed by

the Engineer, the test holes may be backfilled with suitable soil in a manner satisfactory to the Engineer. The concreted test holes will be left in place except that the top of the shaft shall be removed to a depth of two feet below the ground line. This also shall apply to shafts constructed in water. The disturbed areas at the sites of test holes drilled out of position shall be restored as nearly as practical to their original condition. When the Contractor fails to satisfactorily demonstrate, to the satisfaction of the Engineer, the adequacy of his methods or equipment and alterations are required, additional Test Holes shall be provided at no cost to the Department. The cost of all test holes shall be included in the cost of the Drilled Shafts.

B455-7 TEST BELLS.

When shown in the plans or when ordered by the Engineer in writing, the reaming of bells at specified test holes will be required to establish the feasibility of belling in a specific soil strata. The diameter and shape of the test bell shall be as shown in the plans or as approved in writing.

B455-8 CONSTRUCTION TOLERANCES.

The following construction tolerances shall apply for drilled shafts.

(a) The top of the drilled shaft shall be no more than three inches laterally from the position indicated in the plans.

(b) The vertical alignment of the shaft excavation shall not vary from the alignment shown in the plans by more than $\frac{1}{4}$ inch per foot of depth.

(c) After all the concrete is placed, the top of the reinforcing steel cage shall be no more than six inches above and no more than three inches below plan position.

(d) The reinforcing cage shall be concentric with the shaft within a tolerance of $1\frac{1}{2}$ inches. Concrete cover shall be six inches plus or minus $1\frac{1}{2}$ inches unless shown otherwise in the plans.

(e) All casing diameters shown in the plans refer to I.D. (inside diameter) dimensions.

However, casing with an outside diameter equal to the specified shaft diameter may be used if the extra length described in B455-3.7 is provided. In this case, the ID of the casing shall not be less than the specified shaft diameter less one inch. When approved, the Contractor may elect to provide a casing larger in diameter than shown in the plans to facilitate meeting this requirement. When casing is not used, the minimum diameter of the drilled shaft shall be one inch less than the specified shaft diameter. When conditions are such that a series of telescoping casings are used, the casing shall be sized so that the minimum shaft diameters listed above can be maintained.

(f) The bearing area of bells shall be excavated to the plan bearing area as a minimum. The diameter of the bells shall not exceed three times the specified shaft diameter. All other plan dimensions shown for the bells may be varied, when approved, to accommodate the Contractor's equipment.

(g) The top elevation of the drilled shaft concrete shall have a tolerance of plus one

inch and minus three inches from the top of shaft elevation shown in the plans.

(h) The dimensions of casings are subject to American Pipe Institute tolerances applicable to regular steel pipe.

(i) Excavation equipment and methods shall be designed so that the completed shaft excavation will have a flat bottom. The cutting edges of excavation equipment shall be normal to the vertical axis of the equipment within a tolerance of plus or minus $\frac{3}{8}$ inch per foot of diameter.

B455-9 DRILLED SHAFT EXCAVATIONS CONSTRUCTED OUT OF TOLERANCE.

Drilled shaft excavations constructed in such a manner that the concrete shaft cannot be completed within the required tolerances are unacceptable. When approved, corrections may be made to an unacceptable drilled shaft excavation by any approved combination of the following methods:

(a) Overdrilling the shaft excavation to a larger diameter to permit accurate placement of the reinforcing steel cage with the required minimum concrete cover.

(b) Increasing the number and/or size of the steel reinforcement bars.

(c) Enlargement of the bearing area of the bell excavation within tolerance allowed.

(d) Other methods proposed by the Contractor and approved by the Engineer.

The approval of correction procedures is dependent on analysis of the effect of the degree of misalignment and improper positioning. Correction methods will be approved only as design analyses indicate. Any redesign shall be done by a Professional Engineer registered in the State of Florida who is qualified according to the rules of the Department of Transportation Chapter 14-75. Redesign drawings and computations prepared by the Contractor's Engineer shall be signed and sealed.

Any out of tolerance shafts shall be backfilled in an approved manner when directed by the Engineer until the redesign is complete and approved. Additional materials and work necessary, including engineering analysis and redesign, to effect corrections of out of tolerance drilled shaft excavations shall be furnished by the Contractor at no cost to the Department.

B455-10 DRILLED SHAFT STATIC COMPRESSION LOAD TESTS.

B455-10.1 General. When the plans include load testing, all load tests shall be completed before construction of any production drilled shafts. The Contractor shall allow up to four weeks after the last load test for the analysis of the load test data and to provide all the estimated production drilled shaft tip elevations. If the Contractor is willing to construct production shafts in areas designated by the Engineer, shaft tip elevations can be set as required to keep the Contractor working, beginning one week after the final load test.

The Contractor shall obtain the services of a Professional Engineer registered in the State of Florida with satisfactory drilled shaft load test experience, to conduct the load test in compliance with these specifications, record all data and furnish reports of the test results to the Engineer except when the plans or Special Provisions show that the Department will

supply a Geotechnical Engineer.

The use of load tests, the number of load tests and the locations shall be as shown in the plans or as designated by the Engineer. Loads for the tests shall be the maximum load shown in the plans or the maximum load that the shaft will support whichever occurs first.

Static load testing of drilled shafts shall not begin until the concrete has attained a compressive strength of 3400 psi. High early strength concrete may be used to obtain this strength at an earlier time to prevent testing delays. Drilled shafts shall be load tested in the order directed by the Engineer. Static loads shall be completed as described hereafter. Certain load test equipment and/or personnel will be furnished by the Department when shown in the plans. The Contractor shall inspect all equipment to be furnished by the Department at least 30 days prior to use and shall notify the Engineer of any equipment that is not in satisfactory operating condition. Any necessary repairs ordered by the Engineer to place the equipment in satisfactory operating condition will be considered Unforeseeable Work. The Contractor shall supply the remainder of the equipment and personnel needed to conduct the load tests. Unless shown otherwise in the plans or Special Provisions, the Contractor shall supply all equipment, materials, labor and technical personnel required to conduct the load tests including determination of anchor reaction member depths. In this case the Contractor's loading apparatus shall be designed to accommodate the maximum load plus an adequate safety factor.

During the conduct of the load test the Contractor shall provide safety equipment and employ safety procedures consistent with the latest approved practices for this work. These safety procedures shall include adequate support for the load test plates and jack to prevent them from falling in the event of a release of load due to hydraulic failure, test shaft failure or any other cause.

The Contractor shall include in his bid, the cost of transporting load test equipment and instrumentation supplied by the Department from their storage location to the job site and back. He shall handle these items with care and is responsible for their safe return in clean and working condition. After completion of the static load tests, the Contractor shall return all Department furnished equipment in satisfactory operating condition. The Contractor shall repair all damage to the test equipment furnished by the Department to the satisfaction of the Engineer. He shall clean all areas of rust on structural steel items and repaint those areas in accordance with Section 561. All load test equipment supplied by the Department shall be returned by the Contractor within 30 days after completion of the load tests.

The Contractor shall at all times while Department supplied load test equipment is the Contractor's responsibility, keep the equipment insured against loss or damage for the replacement cost thereof (the greater of \$150,000 or the amount shown in the plans) or for the full insurable value if replacement cost insurance is not available. The equipment shall be the responsibility of the Contractor from the time it leaves its storage area until the time it is returned by the Contractor.

The Contractor shall notify the Engineer at the preconstruction conference or no later than 30 days before drilled shaft construction begins of his proposed testing schedule so that

items supplied by the Department may be reserved. He shall give the Department at least ten working days notice before pickup or return of the equipment. During pick-up, a checklist of all equipment placed in the Contractor's possession shall be completed. This checklist will later be used to verify that all equipment is properly returned. The Contractor will provide personnel and equipment to load or unload the equipment at the Department's storage location unless otherwise stated in the plans. Department owned test girders shall be handled with lifting tongs or nylon slings provided by the Contractor. No cutting, welding or drilling will be permitted on Department owned girders, jacks, load cells, or other equipment.

B455-10.2 Loading Apparatus. The apparatus for applying the vertical loads shall be as described in one of the following:

1. As shown and described in the plans and Special Provisions.

2. As supplied by the Contractor which shall be one of the following devices designed to accommodate a load at least 20 percent higher than that shown in the plans for test loads:

(a) **Load Applied by Hydraulic Jack Acting Against Weighted Box or Platform:** A test box or test platform resting on a suitable support shall be constructed over the test shaft and loaded with earth, sand, concrete, metal or other suitable material with a total weight greater than the anticipated maximum test load. Supports for the weighted box or platform shall be located at least three shaft diameters, measured from the center of the test shaft to the center of supports. A hydraulic jack with pressure gauge shall be inserted between the test shaft and the underside of the reaction beam, and the load shall be applied to the test shaft by operating the jack between the reaction beam and the top of the shaft.

(b) **Load Applied to the Test Shaft by Hydraulic Jack Acting Against Anchored Reaction Member:** Reaction Member Anchorages shall be constructed as far from the test shaft as practicable, a minimum of three shaft diameters, measured center to center of anchorages and the test shaft or ten feet (whichever is greater) measured from center of the test shaft to center of the anchorages. If drilled shafts with bells are used as reaction member anchorages, the top of the bell of any reaction shaft anchorage shall be at least three shaft diameters below the bottom of the test shaft. A member or members of sufficient strength to act as a reaction beam shall be attached to the upper ends of the anchorages. Hydraulic jacks with pressure gauges shall be inserted between the top of the shaft and the reaction beam, and the load shall be applied to the shaft by operating the jack, between the reaction beam and the top of the shaft.

(c) **Combination Devices:** Load applied to the test shaft by hydraulic jacks acting against a combination of devices (a) and (b) as described above.

(d) **Other Systems Proposed by the Contractor and approved by the Engineer.**

When necessary, horizontal supports shall be provided for the shaft to be loaded and spaced so that the ratio of the unsupported height to the shaft diameter does not exceed 20. Horizontal supports shall provide full support without restraining the vertical movement of the shaft in any way.

When shown in the plans or required by the Special Provisions, a horizontal load shall be applied to the shaft either separately or in conjunction with the vertical load. The load

shall be applied to the test shaft by hydraulic jacks, jacking against reaction devices provided by the Contractor. After approval of the proposed method of load application is received, the horizontal load shall be applied in increments and relieved in decrements as required by the plans and Special Provisions.

B455-10.3 Measuring Apparatus.

The apparatus for measuring movement of the shaft shall consist of all of the following devices:

(a) Wire Line and Scale: A wire shall be stretched between two supports, each installed into the ground in an approved manner at a distance not less than three shaft diameters, or 12 feet (whichever is longer) from the centerline of the shaft to be tested. At over-water test sites the wire line may be attached as directed by the Engineer to the sides of the service platform. When both horizontal and vertical movement are to be measured, separate wires shall be mounted to indicate each movement, horizontal or vertical. Horizontal movements shall be measured from two reference wires set normal to each other in a horizontal plane. The wire supports shall be located as far as practical from reaction beam anchorages. The wire shall be pulley-mounted on one support and the end of the wire weighted to provide constant tension on the wire. The wire shall pass across the face of a scale mounted on a mirror attached to the shaft so that readings can be made directly from the scale. The scale readings shall be used as a check on an average of the dial readings.

(b) Wooden Reference Beams and Dial Gauges: Wooden reference beams as detailed in the plans or approved by the Engineer shall be attached to independent supports installed into the ground at a distance not less than three shaft diameters or 12 feet (whichever is longer) from the centerline of the shaft to be tested. The reference beam supports shall be located as far as practical from reaction beam anchorages. For over-water test sites, the Contractor may attach the reference beams as directed by the Engineer between two diagonal service platform supports. Dial gauges, with their stems resting either on the shaft or on lugs or similar reference points on the shaft, shall be attached to the fixed reference beams to record the movement of the shaft head. The area on the shaft or lug on which the stem bears shall be a smooth surface which will not cause irregularities in the dial readings. Three dial gauges, each with 0.001 inch divisions and with two-inch minimum travel, placed at 120 degree intervals around the shaft, shall be the minimum acceptable method for measuring vertical movement. Four dial gauges, each with 0.001 inch divisions and with two-inch minimum travel, placed at 90 degree intervals shall be the minimum required for measuring horizontal movement.

(c) Survey level: As a check on the dial gauges, the elevation of a point near the top of the test shaft shall be determined by survey level at each load and unload interval during the load test. Unless approved otherwise by the Engineer, level survey precision shall be 0.001 foot. Alternately, the surveyor may read an engineer's 50 scale attached near the shaft head. The first elevation shall be determined before application of the first load increment; intermediate readings shall be made immediately before a load or unload increment, and after the final unload increment. A final reading shall be made at the time of the last recovery reading or as directed by the Engineer.

For over-water test sites, when shown in the plans or directed by the Engineer, the Contractor shall drive an H pile through a 36-inch casing to provide a stable support for the level and to protect it against wave action interfering with level measurements. The Contractor shall provide a suitable movable jig on which the surveyor will stand. The jig shall have a minimum of three legs, have a work platform providing at least four feet width of work area around the casing and shall be approved by the Engineer before use. The described work platform may be supported by the protective casing when approved by the Engineer.

B455-10.4 Load Test Instrumentation.

B455-10.4.1 General. The load test instrumentation will measure the test load on top of the shaft (and, when provided in the plans or Special Provisions its distribution into the various soil layers penetrated, by side friction and end bearing) to provide evaluation of the preliminary design calculations and settlement estimates and to provide information for final shaft design. The instrumentation shall be as described in the plans or Special Provisions.

All of the internal instrumentation will be placed on the rebar cage before installation in the test shaft. The Contractor shall construct the rebar cage at least two days before required for construction of the test shaft. The Contractor shall provide assistance during installation of instrumentation supplied by the Department including help to string, place and tie the instrumentation and any assistance needed in moving or repositioning the cage to facilitate installation. The rebar cage shall be placed in one segment complete with its instrumentation. Multiple lift points and/or a suitable "stiffleg" (length of H pile or other suitable section) may be required to get the cage in a vertical position without causing damage to the instrumentation. The Contractor shall successfully demonstrate his lifting and handling procedure before the instrumentation is installed.

The Contractor shall also supply 110 volt, 30 amps of AC electric power to each load test site during the installation of the instrumentation and during the load testing.

B455-10.4.2 Hydraulic Jack and Load Cell.

B455-10.4.2.1 Hydraulic Jack. When shown in the plans or Special Provisions the Department will supply the hydraulic jack for the shaft load test. When the plans or Special Provisions require the Contractor to furnish hydraulic jacks, they shall be of adequate size to deliver the required maximum load to the shaft and equipped with gauges which show the load being applied. The Contractor shall furnish a certificate from an approved testing laboratory showing a recent calibration of gauge readings for all stages of loading and unloading. Unless otherwise approved, calibrations for gauges shall have been within the preceding six months. The accuracy of the gauge shall be within five percent of the true load. If the Department supplies the Contractor with the jack, the Contractor shall have the jack calibrated by an approved testing laboratory and include the cost in the cost of the load test.

B455-10.4.2.2 Load Cell. Load cells will generally be required for drilled shaft load tests. When shown in the plans or Special Provisions the Department will supply the load cell for the shaft load test. When the plans or Special Provisions require the Contractor to furnish load cells, they shall be of adequate size to measure the maximum load to be

applied to the shaft. It shall be equipped with a suitable electrical readout device. The Contractor shall furnish a certificate from an approved testing laboratory showing a recent calibration of the load cell for all stages of loading and unloading. Unless otherwise approved, calibrations for the load cells shall have been within the preceding six months. The accuracy of the load cell shall be within one percent of the true load. If the Department supplies the Contractor with the load cell, the Contractor shall have the load cell calibrated by an approved testing laboratory and include the cost in the cost of the load test.

B455-10.4.3 Embedded Strain Gauges. When shown in the plans or Special Provisions the Contractor shall supply strain gauges which shall be placed in the test shaft to measure the distribution of the load. The type, number and location of the strain gauges shall be as shown in the plans or as directed by the Engineer. Strain gauges shall be of a waterproof type and shall have suitable shielded cable that is unspliced within the shaft.

B455-10.4.4 Telltales. When shown in the Contract Documents, telltales shall be provided. The telltale shall consist of an unstressed steel rod placed, with appropriate clearance and greased for reducing friction and corrosion, inside a constant-diameter pipe that rests on a flat plate attached to the end of the pipe at a point of interest shown in the plans. Telltales shall be constructed in accordance with details shown in the Contract Documents. The Contractor shall install dial gauges reading to 0.001 inch with one inch minimum travel, as directed by the Engineer to measure the movement of the telltale with respect to the top of the shaft.

B455-10.5 Support Facilities. The Contractor shall furnish adequate facilities for making load and settlement readings 24 hours per day. Such facilities shall be provided for the instrumented area and shall include lighting and shelter from rain, wind and direct sunlight.

B455-10.6 Load Test Personnel Furnished by the Contractor. The Contractor shall supply a qualified welder (together with necessary cutting and welding equipment) to assist with the load test setup and to make any necessary adjustments during the load test. The Contractor shall also supply qualified personnel to operate the jack, generators and lighting equipment and one person with transportation to assist as required during load test setup and conduct of the load tests. The Contractor shall provide experienced personnel to read the dial gauges, take level measurements, and conduct the load test except when the plans or Special Provisions show that these personnel will be supplied by the Department.

B455-10.7 Loading Procedure. Vertical loads shall be applied concentric with the longitudinal axis of the shaft to be tested so that the load acting on the shaft at any time may be accurately determined and controlled.

The load shall be placed on the shaft continuously in increments equal to approximately five percent of the maximum test load specified until the failure load, as indicated by the instruments, is approached. Increments of approximately 2.5 percent shall then be applied until the shaft "plunges" (continues to settle without an increase in load) or the limiting load is attained. The Engineer may elect to stop the loading increments when he determines that the failure criteria has been met or a settlement equal to ten percent of the shaft width is reached. Each load increment shall be applied immediately after the complete

set of readings is taken and verified from all gauges and instruments. Each increment of load shall be applied within the minimum length of time practical and the instrument system readings shall be taken immediately. It is intended that the addition of a load increment and the completion of the instrument system readings shall be completed within five to 15 minutes. The Engineer may elect to hold the maximum applied load up to one hour.

The load shall be removed in decrements of about 10 percent of the maximum test load. Each decrement of load shall be removed within the minimum length of time practical and the instrument system readings shall be taken immediately. It is intended that the removal of a load decrement and the completion of the instrument system readings shall be completed within five to 15 minutes. The Engineer may also require up to two reloading cycles with five loading increments and three unloading decrements. The final recovery of the shaft shall be recorded until movement is essentially complete for a period up to one hour after the last unload interval.

The criteria described herein shall be used to establish the failure load unless shown otherwise in the plans or Special Provisions. The failure load is defined as the load that causes a shaft top deflection equal to the calculated elastic compression plus 0.15 inch plus $\frac{1}{120}$ of the shaft diameter in inches for shafts with diameters up to 24 inches and equal to the calculated elastic compression plus $\frac{1}{30}$ of the shaft diameter for shafts with diameters larger than 24 inches. The safe allowable load of any shaft so tested shall be considered as either 50 percent of the maximum applied load or 50 percent of the failure load, whichever is smaller.

B455-10.8 Cooperation by the Contractor. The Contractor shall cooperate with the Department's personnel and the Department's personnel shall have access to all facilities necessary for observation of the conduct and the results of the test.

B455-10.9 Required Reports. A preliminary static load test report shall be submitted to the Engineer within five days after the load test is completed. When internal instrumentation is not required, the final report shall be submitted within ten days after the load test is completed. The final report of test results for internally instrumented shafts shall be furnished within 30 days after the load test is completed. The report of the load test shall include the following information:

- (a) A tabulation of the time of, and the amount of, the load and settlement readings, and the load and recovery readings taken during the loading and unloading of the shaft.
- (b) A graphic representation of the test results in the form of a load-settlement curve.
- (c) Remarks concerning any unusual occurrences during the loading and unloading of the shaft.
- (d) The names of those making the required observations of the results of the load test, the weather conditions prevailing during the load test, and the effect of weather conditions on the load test.
- (e) All supporting data, including calibration certificates for hydraulic jack gauges, load cells and other equipment requiring calibration.
- (f) When internal instrumentation of the shaft is required, the Contractor shall furnish all of the data taken during the load test together with instrument calibration certifications.

In addition, the Contractor shall provide a report showing an analysis of the results of axial load and lateral load tests in which soil resistance along and against the shaft as a function of deflection is reported.

(g) All supporting data including jack and load cell calibrations and certificates.

B455-10.10 Disposition of Loading Material. After all load tests have been completed, the Contractor shall clean, remove all rust on structural steel, repaint all areas having damage to the paint in accordance with Section 561 and return all load test equipment supplied by the Department to its designated storage area. At least ten working days advance notice shall be given so that arrangements can be made to unload the equipment. All equipment and materials remaining the property of the Contractor shall be removed from the site. The site shall be cleaned up and restored to the satisfaction of the Engineer.

B455-10.11 Disposition of Tested Shafts. After testing is completed, the tested shafts (and any reaction shafts) shall be cut-off at an elevation two feet below the finished ground surface. The shaft cut-offs removed shall remain the property of the Contractor and shall be disposed of in areas provided by him.

B455-11 METHOD OF MEASUREMENT.

B455-11.1 Drilled Shafts. The quantities to be paid for shall be the length in feet of the reinforced concrete drilled shaft of the diameter shown in the plans, complete and accepted. The length shall be determined as the difference between the top of shaft elevation as shown in the plans and the final bottom of shaft elevation as authorized and accepted. When the Contractor elects to provide outside diameter (O.D.) sized casing rather than inside diameter (I.D.) sized casing as allowed in B455-3.7, the pay quantity measured as described above shall be multiplied by a factor (F) determined as follows:

$$F = \frac{2D2 - D1}{D2}$$

where: F =factor to adjust pay quantities to compensate for smaller shafts.
D1 =casing inside diameter specified = shaft diameter specified.
D2 =casing inside diameter provided (D2 = D1 minus twice the wall thickness).

B455-11.2 Drilled Shafts (Unreinforced). When designated in the plans, unreinforced concrete drilled shafts shall be constructed. The quantities to be paid for shall be the length in feet of unreinforced concrete drilled shaft of the diameters shown in the plans, completed and accepted. The length shall be determined as the difference between the top of shaft elevation as shown in the plans and the final bottom of shaft elevation as authorized and accepted. When the Contractor elects to use O.D. casing, the quantity as determined above shall be multiplied by the factor "F" determined as described in B455-11.1.

B455-11.3 Unclassified Shaft Excavation. The quantities to be paid shall be the length in feet of unclassified shaft excavation of the diameter shown in the plans, completed and accepted, measured in linear feet along the centerline of the shaft from the ground surface

elevation to the plan bottom of shaft elevation authorized and accepted. When drilled shafts are constructed through fills placed by the Contractor, the original ground surface before the fill was placed shall be used to determine the quantity of unclassified shaft excavation. When the Contractor elects to use O.D. casing, the quantity as determined above shall be multiplied by the factor "F" determined as described in B455-11.1.

B455-11.4 Unclassified Extra Depth Excavation. The quantities to be paid shall be the length in feet of unclassified shaft excavation of the diameter shown in the plans measured in linear feet along the centerline of the shaft from the bottom of shaft elevation shown in the plans to the final authorized bottom of shaft elevation when below the plan bottom of shaft elevation. When the Contractor elects to use O.D. casing, the quantity as determined above shall be multiplied by the factor "F" determined as described in B455-11.1.

B455-11.5 Drilled Shaft Sidewall Overreaming. The quantities to be paid shall be the length in feet of drilled shaft sidewall overreaming authorized, completed and accepted, measured between the elevation limits shown in the plans or authorized by the Engineer. When the Contractor elects to use O.D. casing, the quantity as determined above shall be multiplied by the factor "F" determined as described in B455-11.1.

B455-11.6 Bell Footings. The quantity of bell footings shall be the number of bells of the diameter and shape shown in the plans, completed and accepted.

B455-11.7 Test Holes. The cost of all test holes shall be included in the cost of Drilled Shafts.

B455-11.8 Test Bells. The quantity of test bells shall be the number of test bells, completed and accepted.

B455-11.9 Core (Shaft Excavation). The quantity to be paid for under this item shall be the length in linear feet, measured from the bottom of shaft elevation to the bottom of the core-hole, for each authorized core drilled below the shaft excavation; completed and accepted. When the Engineer authorizes Core (Shaft Excavation) extending through part or all of the shaft, prior to excavation, to some depth below the shaft bottom, the quantity shall be the length in linear foot, measured from the top elevation to the bottom elevation authorized by the Engineer; completed and accepted. When SPT tests are substituted for coring as provided in B455-3.6, the quantity shall be determined as described above for coring.

B455-11.10 Casings. The quantity to be paid for under this item shall be the linear feet of each size casing as directed and authorized to be used. The length to be paid for shall be measured along the casing from the top of the shaft elevation or the top of casing whichever is lower to the bottom of the casing at each shaft location where casing is authorized and used except as described below when the top of casing elevation is shown in the plans. Casing shall be paid for only when the Permanent Casing Method is specified, when the plans show a casing that becomes a permanent part of the shaft, or when the Engineer directs the Contractor to leave a casing in place which then becomes a permanent part of the shaft. No payment shall be made for casings which become bound or fouled during shaft construction and cannot be practically removed. The Contractor shall include the cost of all temporary removable casings for methods of construction other than that of the Permanent

Casing Method in the bid price for Unclassified Shaft Excavation item.

When the Permanent Casing Method and the top of casing elevation are specified, the casing shall be continuous from top to bottom. In this case, no special temporary casings will be allowed unless shown in the plans or authorized by the Engineer in writing. In such cases authorization for temporary casing will not be given unless the Contractor demonstrates that he can maintain alignment of the temporary upper casing with the lower casing to be left in place during excavation and concreting operations. When artesian conditions are or may be encountered he shall also demonstrate that he can maintain a positive water-tight seal between the two casings during excavation and concreting operations.

When the top of casing elevation is shown in the plans, payment shall be from the elevation shown in the plans or from the actual top of casing elevation, whichever is lower, to the bottom of the casing. When the Contractor elects to use an approved special temporary casing system in open water locations, the length to be paid for shall be measured as a single casing as provided above.

B455-11.11 Protection of Existing Structures. The quantity to be paid for under this item, when included in the Contract Documents, shall be one lump sum. Such price and payment shall include all cost of work shown in the plans or described herein for protection of existing structures. When the Contract Documents do not include an item for protection of existing structures, the cost of settlement monitoring as required by these specifications shall be included in the cost of Unclassified Shaft Excavation; however, work in addition to settlement monitoring will be paid for as Unforeseeable Work when such additional work is ordered by the Engineer.

B455-11.12 Static Load Tests. The quantity to be paid for under this item shall be the number of load tests conducted according to the loading procedures described in B455-10.7 of the designated tonnages shown in the plans or authorized, applied and accepted.

B455-11.13 Instrumentation and Data Collection. The quantity to be paid for shall be at the lump sum price for this item and shall include all specified instrumentation and data collection, all cost associated with collection of data, all required analyses and any required reports.

B455-12 BASIS OF PAYMENT.

B455-12.1 Drilled Shafts. Drilled shafts shall be paid for at the contract unit price per linear foot for Drilled Shaft of the diameter specified. Such price and payment shall include the cost of concrete and reinforcing steel including all labor, materials, equipment and incidentals necessary to complete the drilled shaft.

B455-12.2 Drilled Shafts (Unreinforced). Drilled shafts (Unreinforced) shall be paid for at the contract unit price per linear foot for Drilled Shafts (Unreinforced) of the diameter specified. Such price and payment shall include the cost of concrete and all labor, equipment, materials and incidentals necessary to complete the drilled shaft.

B455-12.3 Unclassified Shaft Excavation. Unclassified shaft excavation shall be paid for at the contract unit price per linear foot for Unclassified Shaft Excavation of the diameter specified. Such price and payment shall be full compensation for the shaft excavation

(except for the additional costs included under the associated pay items for casing), removal from the site and disposal of excavated materials; restoring the site as required; cleaning and inspecting shaft excavations; using slurry as necessary; using drilling equipment; blasting procedures, special tools and special drilling equipment to excavate the shaft to the depth indicated in the plans; and furnishing all other labor, materials and equipment necessary to complete the work in an acceptable manner.

B455-12.4 Unclassified Extra Depth Excavation. Unclassified extra depth excavation shall be paid for at the contract unit price per linear foot for Unclassified Extra Depth Excavation of the diameter specified. Such price and payment shall be full compensation for all costs of excavating below the bottom of shaft elevations shown in the plans, except for the additional costs included under the associated pay items for casing. Work under Unclassified Extra Depth Excavation is the same as that described under Unclassified Shaft Excavation together with any additional work as a result of excavating below the bottom of shaft elevation shown in the plans. Compensation under this item shall be paid only when Unclassified Extra Depth Excavation is authorized.

B455-12.5 Drilled Shaft Sidewall Overreaming. Drilled Shaft Sidewall Overreaming shall be paid for at the Contract unit price per linear foot for the length of sidewall overreaming authorized, completed and accepted. Such price and payment shall be full compensation for all labor, equipment and incidentals necessary to accomplish acceptable construction.

B455-12.6 Bell Footings. Bell footings constructed to the specified dimensions or to the altered dimensions within the specified tolerance authorized and approved by the Engineer shall be paid for at the contract unit price each for Bell Footings. Such price and payment shall be full compensation for forming and excavating the bell beyond the diameter of the drilled shaft, furnishing and casting additional concrete necessary to fill the bell outside the shaft together with any extra reinforcing steel required, removing excavated materials from the site and all other expenses necessary to complete the work.

B455-12.7 Test Holes. No separate payment shall be made for Test Holes, all cost of Test Holes shall be included in the cost of Drilled Shafts.

B455-12.8 Test Bells. Test bells of the diameter and shape specified or authorized and approved will be paid for at the contract unit price each for Test Bells. Such price and payment shall be full compensation for forming the test bell, providing inspection facilities, backfilling the bell when the test hole is drilled out of position and all other expenses necessary to complete the work.

B455-12.9 Core (Shaft Excavation). Cores of the diameter and length required and authorized by the Engineer will be paid for at the contract unit price per linear foot for Core (Shaft Excavation). Such price and payment shall be full compensation for drilling and classifying the cores, delivering them to the Department, furnishing Class III or Class IV Concrete to fill the core hole and all other expenses necessary to complete the work. When SPT tests are substituted for coring as provided in B455-3.6 they shall be paid for at the price per foot for coring.

B455-12.10 Casings. Casings shall be paid for at the contract unit price per linear foot. Such price and payment shall be full compensation for additional costs necessary for

furnishing, and placing the casing in the shaft excavation above the costs attributable to the work paid for under associated pay items for Unclassified Shaft Excavation and Unclassified Extra Depth Excavation.

B455-12.11 Protection of Existing Structures. The quantity of this item, determined as provided in B455-11.11, shall be paid for at the contract lump sum price for Protection of Existing Structures.

B455-12.11A Static Load Tests. The tests shall be paid for at the contract unit price each for Test Loads, completed and accepted. Such price and payment shall include all costs related to the performance of the load test.

B455-12.11B Instrumentation and Data Collection. The quantity of this item shall be paid for at the contract lump sum price for Instrumentation and Data Collection. The price and payment shall include all labor, equipment and materials incidental to the instrumentation and data collection; and when required the load test report.

B455-12.12 Items of Payment. The prices and payments specified in B455-12.1 through B455-12.11 above, shall be full compensation for all the work specified herein.

Payment shall be made under:

Item No. 455-18	-Protection of Existing Structures - lump sum.
Item No. 455-88	-Drilled Shaft - per linear foot.
Item No. 455-90	-Bell Footings - each.
Item No. 455-92	-Test Bells - each.
Item No. 455-107	-Casing - per linear foot.
Item No. 455-111	-Core (Shaft Excavation) - per linear foot.
Item No. 455-119	-Test Loads - each.
Item No. 455-122	-Unclassified Shaft Excavation - per linear foot.
Item No. 455-124	-Drilled Shaft Sidewall Overreaming - per linear foot.
Item No. 455-125	-Unclassified Extra Depth Excavation - per linear foot.
Item No. 455-129	-Instrumentation and Data Collection - lump

sum.

STRUCTURES FOUNDATIONS - SPREAD FOOTINGS.

SECTION 455 (Pages 419-443) is deleted and the following substituted:

SECTION C455 **STRUCTURES FOUNDATIONS - SPREAD**

FOOTINGS

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- C455-14.2 Dewatering
- C455-14.3 Excavation
- C455-14.4 Reinforcing Steel
- C455-14.5 Concrete
- C455-14.6 Items of Payment

C455-1 Description.

The work specified in this Section is pertinent to the construction of reinforced concrete spread footing foundations for structures. This work includes dewatering when necessary, excavating to the limits shown in the plans or as directed by the Engineer, compacting the underlying soil as required, constructing seals when required and constructing spread footings of reinforced concrete as detailed in the plans. All work shall be done in accordance with these specifications and in conformity with the locations, elevations, dimensions and notes shown in the plans or as ordered by the Engineer.

C455-2 General Requirements.

The following requirements pertain to all spread footings:

1. Excavations shall include the removal of all material, of whatever nature, necessary for the construction of spread footings. Use herein of the term "soil" shall constitute any material, whether soil, rock or other materials.
2. Excavations shall be sloped as required or supported with sheeting, and shored if necessary, to provide a safe excavation that is adequate for construction purposes and that will adequately protect any existing adjacent structures.
3. The foundation soils shall be firm, stable and in the opinion of the Engineer shall meet or exceed the design bearing and compressibility requirements before construction of the footings or any required seals. The Department may elect to use any type of test(s) to evaluate the foundation soils that is appropriate in the opinion of the Engineer. The Contractor shall cooperate with the Engineer in the evaluation of the foundation soils and shall assist the Engineer as necessary to provide access to the site.
4. The elevation of the bottom of footings or seals and/or the depth of over-excavation shown in the plans is approximate and the Engineer may order, in writing, such changes as may be necessary to secure a satisfactory foundation.
5. All spread footing concrete shall be placed in the dry.

C455-3 Protection of Existing Structures.

When the plans require dewatering and/or excavations for construction of spread footings in close proximity to existing structures the Contractor shall take all reasonable precautions to prevent damage to such structures. The requirements described herein apply to all types of structures (on or off the right of way) that may be adversely affected by foundation

construction operations (including phase construction) due to ground loss, dewatering or vibrations. If not otherwise provided in the plans, the Contractor shall be solely responsible for evaluating the need for, design of, and providing all reasonable precautionary features to prevent damage. These measures shall include but are not limited to installation of sheet piling, shoring as necessary, maintenance of the water table beneath such structures as nearly as practical to existing conditions, and monitoring and controlling vibrations from construction activities including the driving of sheeting or from blasting. Utilities shall be protected as described in 7-11.6.

Sheeting and shoring shall be constructed according to plans provided by the Contractor except when the sheeting and shoring are detailed in the contract plans. Sheeting and shoring shall be designed by a Professional Engineer, employed by the Contractor, registered in the State of Florida and who shall sign and seal the plans and specification requirements. Plans and specifications for sheeting and shoring provided by the Contractor shall be sent to the Engineer for his record before construction begins.

Existing structures within a distance of three times the depth of excavation shall be monitored for movement. The number and location of monitoring points shall be as approved by the Engineer. Elevations shall be taken daily, read and recorded to 0.001 foot.

The Contractor shall notify the Engineer of any movements detected and immediately take any remedial measures required to prevent damaging the existing structures.

The Contractor shall install a piezometer near the right of way line and near any structures that may be affected by lowering of the ground water. The piezometer shall be monitored and the water elevation level recorded daily. The Contractor shall notify the Engineer of any ground water lowering of one foot or more.

When shown in the plans, the Contractor shall engage the services of a qualified Professional Engineer registered in the State of Florida to conduct a survey of all (except as noted herein) structures, or portions thereof, within a distance of three times the excavation depth or the distance shown in the plans before footing construction operations begin and after footing operations are completed. The Department will make the necessary arrangements for entry by the Contractor's engineer to survey. The condition of the structures shall be adequately documented with descriptions and pictures. All existing cracks shall be thoroughly documented. Two reports shall be prepared documenting the condition of the structures; one report before footing construction operations begin and a second report after footing construction operations are completed. Both reports shall become the property of the Department. Preconstruction and post-construction surveys of the condition of bridges owned by the Department will not be required except when shown in the plans or Special Provisions.

C455-4 Dewatering.

The Contractor shall be responsible for design, installation, and operation of an adequate dewatering system to dewater excavations for spread footings. A wellpoint or well system shall be used unless indicated otherwise in the plans or approved by the Engineer in writing. A dewatering plan shall be submitted to the Engineer for his records before construction

begins.

Wellpoints or wells shall be used where the piezometric water level is above an elevation two feet below the bottom of the excavation. The water table shall be maintained two feet or more below the maximum depth of excavation. Dewatering shall be continuous until construction of the footing is complete and the excavation has been backfilled at least two feet above the water table elevation before dewatering began. Dewatering shall be continued until the Engineer considers conditions safe to discontinue dewatering. In the event of a dewatering failure, the Contractor shall assist the Engineer as required in determining the effects of such a failure on the foundation soils and shall take whatever corrective measures are required at no additional cost to the Department. When the Engineer approves the discontinuing of dewatering, the Contractor shall decrease the rate of pumping allowing the water level to rise slowly. The rate in feet per hour the water table may be allowed to rise shall be the total number of feet the water table was lowered divided by ten hours or a rate of one foot per hour, whichever is less.

The Contractor shall install one piezometer well for each approximately 15 feet of footing perimeter. A minimum of two and a maximum of six piezometers shall be provided at locations within two feet from the outside of the footing perimeter. Piezometer wells shall be installed to a depth at least ten feet below the bottom of footing elevation or as directed by the Engineer. Water elevation in the piezometer wells shall be measured prior to excavation and at 12-hour intervals between excavation and discontinuation of dewatering. The piezometers shall be maintained in working condition throughout the dewatering process and shall be repaired or replaced at the Contractor's expense when damaged.

C455-5 Cofferdams.

Cofferdams shall be constructed according to plans provided by the Contractor except when the cofferdams are detailed in the contract plans. Cofferdam designs provided by the Contractor shall be sent to the Engineer for his record. Cofferdam shall be designed by a Professional Engineer, employed by the Contractor, registered in the State of Florida who shall sign and seal his plans and specification requirements.

The Contractor shall provide a qualified diver and safety diver to inspect the conditions of the foundation enclosure or cofferdam when a seal is required for construction. These divers shall be equipped with suitable voice communications and they shall inspect the foundation enclosure and cofferdam periphery inside each sheeting indentation to insure that no layers of mud or other undesirable materials were left above the bottom of seal elevation during the excavation process. They shall also assist the Engineer as required to evaluate the adequacy of the foundation soils or rock. They shall also assist the Engineer as required to assure that the seal is placed as specified. Any deficiencies found by the divers shall be corrected by the Contractor. Upon completion of inspection by the Contractor's divers, the Department may also elect to inspect the work before authorizing the Contractor to proceed with subsequent construction operations. The Contractor shall furnish the Engineer a written report by the divers indicating the results of their underwater inspection before the seal concrete is authorized to be placed.

C455-6 EXCAVATIONS.

C455-6.1 Dry Excavations. Dry excavations are excavations that can be completed without the need to lower the piezometric water level. Dry excavations shall be used when the piezometric water level at the time of construction is, and in the opinion of the Engineer, will remain two or more feet below the bottom of the authorized excavation or over-excavation. The Contractor shall demonstrate to the Engineer that a stable excavation can be made without dewatering. The Contractor shall make adequate provisions to divert surface runoff and to collect and remove any water entering the excavation.

The footing excavation shall be to the bottom of footing, to the over-excavation limits shown in the plans or as directed by the Engineer. Any suitable materials shall be saved for backfill and all unsuitable materials disposed of by the Contractor in areas provided by him in a satisfactory method. The foundation soils below the footing shall be compacted as shown in the plans or described herein before the footing is constructed.

C455-6.2 Dewatered Excavations. Dewatered excavations are excavations made after first lowering the piezometric water level with wellpoints or wells. Dewatering shall be as described in C455-4. Excavations shall be made in the dry after lowering of the water table.

When dewatering is required, the Contractor may excavate within two feet of the ground water table before dewatering begins. However, the dewatering system must be operating and the Contractor must demonstrate that the water level has been lowered to and maintained at acceptable limits before excavation may continue. Where large excavations require stage lowering of the water table (additional wellpoint systems installed at lower elevations), the Contractor may continue excavating as long as the water elevation is maintained at least two feet below the excavation.

The Contractor shall make adequate provisions to divert surface runoff from the excavation. The foundation soils shall be compacted as shown in the plans or as described herein before the footing is constructed.

C455-6.3 Wet Excavations. Wet excavations are excavations made below the existing water table without prior dewatering. When the plans show a cofferdam and seal, the excavation shall be in the wet. The water level during excavation shall be maintained at or above the water level outside the cofferdam.

Ordinarily, the seal will be placed directly upon the foundation soils or rock when wet excavations are used. No compaction of foundation soils will be required for wet excavations unless shown otherwise in the plans or Special Provisions. However, the foundation soils or rock shall be disturbed as little as practical. All materials that are determined by the Engineer to be loose or disturbed shall be removed before placing the seal concrete.

C455-7 Fill or Backfill.

All fill or backfill including over-excavations below the footing shall be clean cohesionless materials that are free of rubble, debris, or rocks that would prevent uniform placement and compaction. Backfill materials shall generally be A-1, A-2 or A-3 materials, materials as

shown in the plans, or materials approved by the Engineer.

C455-8 COMPACTION AND DENSITY REQUIREMENTS.

Compaction of the bottom of the excavation with suitable equipment will be required except for wet excavations unless otherwise shown in the plans. The soil beneath footing excavation (whether dug to the bottom of footing or over-excavated) shall be compacted to a density not less than 95 percent of the maximum density as determined by AASHTO T 180 for a minimum depth of two (2) feet below the bottom of the excavation or to the depth shown in the plans before backfilling begins. At least one density determination shall be made at each footing excavation at a depth of one to two feet below the bottom of the excavation. The backfill in footing excavations which have been over-excavated shall be compacted in twelve-inch maximum loose lifts to a density not less than 95 percent of the maximum density as determined by AASHTO T 180 to the bottom of footing elevation. At least one density determination will be made in each lift of backfill at each footing excavation.

For compaction the Contractor shall use an approved heavy vibratory roller with a static drum weight of at least four tons. Each lift shall be thoroughly compacted to the required density. The final lift below the footing shall also be compacted with a suitable sled vibratory compactor to remove any upper disturbance caused by the drum roller. When conditions require use of smaller compaction equipment, it shall be approved by the Engineer. The lift thickness shall be reduced to achieve the required density.

Backfilling to the original ground surface, finished grade or subgrade as required by the plans shall be accomplished in the immediate vicinity by approved mechanical compactors weighing less than 1000 pounds. Backfilling excavation areas located more than 15 feet away from the exterior periphery of the footing may be compacted with heavier compactors. No backfill shall be placed on the footing until the Engineer has given permission and until the concrete is at least seven days old.

No separate payment will be made for compaction, for backfilling or for suitable backfill materials. The Contractor shall include the cost for this work in his bid price for Excavation for Structures and/or Concrete (Substructure) items.

C455-9 FORMING.

Spread footings shall generally be formed unless permitted otherwise by the Engineer or if the Contractor demonstrates that the natural soil or rock is strong enough to prevent caving during construction. Forms shall meet the applicable requirements of 400-5. When forms are not required, the requirements of 400-5.4.4 shall be met.

C455-10 MATERIALS.

C455-10.1 Concrete. All concrete materials shall be in accordance with Section 346. Spread footing concrete shall be Class II or as shown in the plans. Seal concrete shall be Class III or as shown in the plans.

C455-10.2 Reinforcing steel. All reinforcing steel shall conform to the requirements of

Section 415. Spread footing reinforcing steel shall be Grade 60 or as shown in the plans.

C455-11 REINFORCING STEEL PLACEMENT.

Reinforcing steel for footings shall be placed and fastened according to the applicable provisions of 415-5.

C455-12 CONCRETE PLACEMENT.

C455-12.1 Placement. All footing concrete shall be placed in the dry and according to the applicable provisions of 400-7. No construction joints will be allowed in footings unless shown in the plans.

C455-12.2 Finish. After the concrete has been placed and consolidated, the top surface shall be struck-off to the grades shown in the plans, in a manner satisfactory to the Engineer which will leave the surface smooth and free of undesirable cavities and other defects. No special finish will be required unless shown in the plans or unless the footing will be visible after construction in which case the applicable provisions of 400-15 shall be met.

C455-12.3 Curing. Continuous-moisture-curing shall be used for footings unless permitted otherwise by the Engineer. Cover materials shall be clean sand, sawdust or other materials meeting the approval of the Engineer. The cover materials shall be kept continuously wet for a period of 72 hours.

C455-13 METHOD OF MEASUREMENT.

C455-13.1 Protection of Existing Structures. The quantity to be paid for under this item, when included in the Contract Documents, shall be at the Contract lump sum price. When the Contract Documents do not include an item for protection of existing structures and the Engineer orders work to be performed for protection of existing structures, this work shall be paid for as Unforeseeable Work.

C455-13.2 Dewatering. Dewatering of footing excavations will be paid for at the contract unit price each. Dewatering will be paid only at locations authorized by the Engineer which have been acceptably dewatered.

C455-13.3 Excavation. No separate payment will be made for backfill nor will separate payment be made for excavation above bottom of footing elevation. The cost of this work shall be included in the contract unit price for Concrete (Substructure). For footings with excavation (over-excavation) below the bottom of the footing elevation shown in the plans, the cost of this excavation, backfilling and compaction shall be included in the contract unit price for Excavation For Structures. The pay quantity shall be the volume in cubic yards bounded by vertical planes one foot outside of the limits of the footing and parallel thereto and extending from the bottom of the footing elevation to the authorized bottom of over-excavation or within the pay limits shown in the plans.

C455-13.4 Reinforcing Steel. The quantity of Reinforcing Steel shall be the total weight, in pounds, determined as described in 415-7.

C455-13.5 Concrete. The quantity of concrete to be paid for shall be the volume of Class II Concrete (Substructure) and Class III (Seal) or Class IV (Seal) or the classes shown in the

plans, in cubic yards, determined as described in 400- 20.

C455-14 BASIS OF PAYMENT.

C455-14.1 Protection of Existing Structures. When separate payment for Protection of Existing Structures is provided, the lump sum payment shall be full compensation for all work necessary to evaluate the need for, design of and to provide the necessary features to protect existing structures and also shall include all cost of work shown in the plans or described herein for protection of existing structures. When a separate payment for Protection of Existing Structures is not provided, the cost of this work shall be included in the Contract unit prices for Excavation For Structures and/or for Concrete (Substructure).

C455-14.2 Dewatering. Dewatering, determined as provided in C455-13.2, shall be measured and paid for at the contract price each for Dewatering for Spread Footings. Such price and payment shall be full compensation for all work related to the successful dewatering of footings including installing, maintaining and monitoring piezometer wells. Dewatering will be considered Unforeseeable Work when the Engineer determines that dewatering is required and the plans do not include a Dewatering item.

C455-14.3 Excavation. Excavation, determined as provided in C455-13.3, shall be measured and paid for at the contract unit price per cubic yard for Excavation for Structures. Such price and payment shall be full compensation for all work related to over-excavating below the bottom of footing elevation, backfill and compaction as specified.

C455-14.4 Reinforcing Steel. Reinforcing steel quantities, determined as provided in C455-13.4, shall be measured and paid for at the contract unit price per pound for Reinforcing Steel. Such price and payment shall be full compensation for all work required to furnish and place the steel as shown in the plans and specified herein.

C455-14.5 Concrete. Concrete quantities, determined as specified in C455-13.5, shall be measured and paid for at the contract unit price per cubic yard of the appropriate concrete class. Such price and payment shall be full compensation for all work required to construct footings and seals as shown in the plans and described herein. No separate payment will be made for sheeting and shoring required for excavation and footing construction except when a separate pay item for sheeting and shoring is included in the plans. The cost of all work not specifically mentioned in the other footing items shall be included in the price per cubic yard for substructure Concrete .

C455-14.6 Items of Payment. The prices and payments specified in C455-14.1 through C455-14.5 above, shall be full compensation for all work specified herein .

Payment shall be made under:

- | | |
|-----------------|--|
| Item No. 125-1 | -Excavation For Structures - per cubic yard. |
| Item No. 400-2 | -Class II Concrete - per cubic yard. |
| Item No. 400-3 | -Class III Concrete - per cubic yard. |
| Item No. 400-4 | -Class IV Concrete - per cubic yard. |
| Item No. 400-91 | -Dewatering For Spread Footings - each. |
| Item No. 415-1 | -Reinforcing Steel - per pound. |
| Item No. 455-18 | -Protection of Existing Structures - lump sum. |

POLYETHYLENE SHEETING ON CONCRETE PILES.

PAGE 443. The following new Section is inserted after Section 455:

SECTION 459
POLYETHYLENE SHEETING ON CONCRETE
PILE

459-1 DESCRIPTION.

The work specified in this Section consists of furnishing and installing polyethylene sheeting and lubricant to prestressed concrete piles as required in the plans and as specified herein.

459-2 MATERIALS.

(A) Polyethylene Sheeting: Polyethylene Sheeting shall be of 6-mil thickness. The polyethylene sheeting shall be clean, new and have a smooth surface.

(B) Lubricant: The lubricant used between the two layers of sheeting shall be either a vegetable oil or other approved environmentally and functionally acceptable lubricant.

459-3 CONSTRUCTION REQUIREMENTS.

All surfaces to be wrapped with polyethylene sheeting shall be dry and thoroughly cleaned of dust and loose materials.

The sheeting shall be placed on the pile to the limits shown on the plans. The pile shall be wrapped with a minimum of 2 1/4 wraps of sheeting. A uniform coating of a lubricant shall be applied between the first and the second layer. This coating shall fully cover the entire surface of the first layer of sheeting. Once the pile has been wrapped with the minimum of 2 1/4 wraps of sheeting, the sheeting can then be secured with tape or other means that does not damage the sheeting or restrict its movement. No tape or other material other than the lubricant shall be placed between the first and second layer of sheeting. Sheeting must be protected from construction damage. Where sheeting has been damaged, the damaged sheet of polyethylene shall be completely removed and replaced at the Contractor's expense as directed by the Engineer.

Where the sheeting will not wrap the specified limits of the pile in one sheet, each subsequent sheet shall overlap the previous by 12 inches.

459-4 METHOD OF MEASUREMENT.

Polyethylene sheeting will be measured by the square yard of wrapped concrete pile surfaces. No separate payment will be made for lubricant.

459-5 BASIS OF PAYMENT.

The accepted quantities of polyethylene sheeting will be paid for at the contract unit price per square yard of pile covered, which price shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in installing the polyethylene sheeting and lubricant, as shown in the plans, and as specified in these specifications.

Payment shall be made under:

Item No. 459-71 - Polyethylene Sheeting on Concrete Piles
- per square yard.

SECTION 460
STRUCTURAL STEEL AND MISCELLANEOUS
METALS

460-6(2) Welds is deleted and the following substituted:

(2) The initial radiographic examinations, testing and inspections required by the contract, plans or specifications, exclusive of the qualifying of welders and welding procedures, will be performed by the Department or its designated Testing laboratory at no cost to the Contractor.

460-6 Welds is expanded by the following provision:

(5) Welders, welding operators or tackers shall not be permitted to perform construction or maintenance welding on Department structures, prior to documenting their qualification to perform the specific welding task in accordance with the appropriate code governing the work.

460-8.1.1(b) General is deleted and the following substituted:

(b) Number of samples in lot and lot size.

460-8.1.2 Additional Material Requirements. The first paragraph is deleted and the following substituted:

The maximum hardness for AASHTO M 164 (ASTM A 325) bolts shall be 33 Rc for bolts 1/2 to one-inch in diameter and 30 Rc for bolts 1 1/8 to 1 1/2 inches diameter.

460-8.1.3 Additional Test Requirements is revised as follows:

(a) The first paragraph is expanded as follows:

This test shall be performed by the manufacturer or distributor who combines the bolts, nut and washer into one assembly.

(b) The text of Paragraph (b) is deleted and the following substituted:

After achieving the required number of turns, the recorded tension shall be equal to or greater than 1.15 times the Required Fastener Tension, AASHTO Table 10.17A.

460-8.1.5 Packaging for Shipment. The first sentence is deleted and the following substituted:

Fastener assembly components shall be shipped in sealed, watertight containers, each labeled on the side of the container with the suppliers name and lot identification number, and marked to identify the contents and size of the component, i.e. bolt, nut or washer.

460-8.1.8.1 General is revised as follows:

(a) The following sentence is added at the beginning of the text of the first paragraph:

The rotational - capacity test described in 460-8.1.3 shall be performed on each rotational capacity lot prior to the start of bolt installation and at any other time the Engineer orders the test to be performed. Installation may proceed upon obtaining satisfactory test results.

(b) The first sentence of the seventh paragraph is deleted and the following substituted:

The Contractor shall furnish calibrated torque wrenches with dial faces to be used by the Engineer for inspection of fastener assemblies in bolted connections which have been installed and brought to "snug tight" condition.

(c) The eighth paragraph is deleted and the following substituted:

A Skidmore-Wilhelm Calibrator or other acceptable bolt tension indicating device shall be furnished by the Contractor at each job site for use during bolt installation. The accuracy of the tension measuring device shall be confirmed through calibration by an approved testing agency at least once a year. Daily testing shall be performed and witnessed by the Department's representative to ensure the installed bolt/nut/washer assembly meets the above requirements. Daily tests of a representative sample of five bolt assemblies from each combination of nut/bolt being tightened on that day shall be tightened in the tension measuring device by the same method used for the field bolt installation process to a "snug tight" tension and corresponding torque, which when the additional turns required in Table B are added will result in at least 1.05 times the minimum required bolt installation tension. There shall be a washer under the part turned in tightening the bolt. The job inspection "snug tight" torque shall be taken as the average of three test values determined after rejecting the high and low test values.

(d) The third sentence of the ninth paragraph is deleted and the following substituted:

These bolts are generally less than two inches long.

460-27 MARKING AND SHIPPING. The second and third paragraphs are deleted and

the following substituted:

Metal die stamping will be permitted in the fabrication of structural steel in conformance with the requirements specified herein. Die stamps shall not be used on fracture-critical members, nor near the edges of plate members subject to tensile stresses. Numbers, letters or combinations thereof impressed into steel components for the purpose of identifying the fabricated member is acceptable in lieu of paint, metal tags, or other methods of identification.

Marking of fabricated structural steel as required herein and in 460-12.4 may be accomplished by the use of paint, attached metal tags, or low stress dies with blunt-nosed continuous or blunt-nosed interrupted dot die stamps (i.e., dies manufactured to produce impressions that are rounded at the bottom of the impression).

The maximum allowed depth of the impression is 0.010 inch (0.3 mm). Die stamping tools shall make character sizes with corresponding face radii as shown in the following table:

Size of Steel Die Stamp Markings

Character Size Inch (mm)	Minimum Face Radii Inch (mm)
0.125 (3 mm)	0.007 (0.2 mm)
0.1875 (5 mm)	0.004 (0.1 mm)
0.250 (6 mm)	0.010 (0.3 mm)

In all cases, shop drawings submitted by the fabricator shall indicate proposed location of all low stress metal die stamping.

For bridge members, the low stress metal die stamping may be applied at the following locations:

- (1) At girder field splices or beam end (see Attachments)
 - a. Outer fourth of top flange splice plates.
 - b. Middle third of web splice plates.
 - c. Outer half of girder flange bolt hole pattern at splice.
 - d. Within six inches of bearing stiffeners in the top flange areas at end of girder.
- (2) Diaphragms (see Attachments)
 - a. The preferred location is the middle portion of a top horizontal diaphragm bracing member.
 - b. In lieu of the above, the middle of the bottom horizontal diaphragm bracing member.
- (3) Other members: The location shall be clearly indicated on shop drawings and submitted for approval.

SECTION 506
BRIDGE DRAINAGE SYSTEM

506-3 COMPENSATION is expanded as follows:

The quantities to be paid for shall also include furnishing and installing a bridge drainage system as detailed in the plans.

These items shall be paid for at the Contract unit price each for Bridge Drains and at the Contract unit price per linear foot for Bridge Drainage Piping, which prices and payments shall be full compensation for all work and materials required.

Payment shall be made under:

Item No. 506-2 - Bridge Drainage Piping - per linear foot.

Item No. 506-3 - Bridge Drains - each.

RIPRAP.

SECTION 530 (Pages 500-503) is deleted and the following substituted:

SECTION 530
RIPRAP

530-1 DESCRIPTION.

The work specified in this Section consists of the construction of riprap composed of sand-cement or rubble (consisting of broken stone or broken concrete) as called for in the plans. When called for in the plans, bedding stone in accordance with these specifications shall be placed under the rubble riprap.

530-2 MATERIALS.

530-2.1 Sand-Cement:

(1) Portland Cement: The portland cement used in sand-cement riprap will not be subject to the tests required under the provisions of Section 921, provided it is from an approved source.

(2) Fine Aggregate: Fine aggregate shall meet the requirements of 902-3.3.

(3) Sacks: Sacks shall be made of jute, cotton or scrim reinforced paper capable of holding the sand-cement mixture without significant leakage. Sack material shall be permeable and absorptive enough to permit passage of sufficient water to provide for hydration of the cement. Paper used in sacks shall be non-asphaltic laminated with a polyester fiber scrim reinforcement in a three-way directional pattern, shall have an embossed finish and shall be perforated approximately 3/32 inch in diameter on approximate one inch centers.

Perforations shall extend continuously through the entire wall.

Sacks shall be of uniform size and dimensions, in order to provide uniformity of lines in the completed work. They shall be free from holes and strong enough to withstand handling without ripping or splitting. Only one type and size of sack shall be used at any one structure.

(4) Grout: The cement and the sand used between the sacks will not be required to be tested for specification requirements, provided the cement is the product of a reputable manufacturer and of a type and quality appropriate for this work, and that the sand is a clean commercial sand meeting the approval of the Engineer for this particular use.

530-2.2 Rubble.

530-2.2.1 Rubble (Bank and Shore Protection). Rubble shall consist of broken stone with a specific gravity of at least 2.30 and shall be sound, hard, durable, and free of open or incipient cracks, soft seams, or other structural defects. Stones shall be rough and angular.

Broken stone for this application shall conform to the following gradation and thickness requirements:

Weights in Pounds		Thickness in feet	
<u>W-max</u>	<u>W-50</u>	<u>W-min</u>	<u>Minimum Blanket</u>
700	300	60	2.5

At least 97 percent of the material by weight must be smaller than W-max pounds. At least 50 percent of the material by weight shall be greater than W-50 pounds. At least 85 percent of the material by weight must be greater than W-min pounds.

530-2.2.2 Rubble (Ditch Lining). Rubble shall consist of broken stone or broken concrete with a specific gravity of at least 1.90 and shall be sound, hard, durable, and free of open or incipient cracks, soft seams, or other structural defects. Stones or broken concrete shall be rough and angular.

Broken stone or broken concrete for this application shall conform to the following gradation and thickness requirements:

Weights in Pounds			Thickness in feet
<u>W-max</u>	<u>W-50</u>	<u>W-min</u>	<u>Minimum Blanket</u>
75	30	4	1.5

At least 97 percent of the material by weight must be smaller than W-max pounds. At least 50 percent of the material by weight shall be greater than W-50 pounds. At least 90 percent of the material by weight must be greater than W-min pounds.

530-2.2.3 Physical Requirements of Broken Stone and Broken Concrete.

Broken stone and broken concrete shall meet the following physical requirements:

- Absorption Maximum 5%
- Los Angeles Abrasion (FM 1-T096) Maximum loss 45%*

Soundness (Sodium Sulphate) (FM 1-T104).....	Maximum loss 12% **
Flat and elongated pieces.....	Materials with least dimension less than one third of greatest dimension shall not exceed 10% by weight.
Dirt and Fines	Material less than one half of an inch in maximum dimension acculated from interledge layers, blasting or handling operations shall not exceed 5% by weight.

* Granite shall not have a loss greater than 55 percent.

** Rubble exceeding the soundness loss limitation may be accepted if performance history shows that the material will be acceptable for the intended use.

530-2.2.4 Source Approval and Project Control. Approval of mineral aggregate sources shall be in accordance with 6-3.3 as amended by the following:

(1) All materials placed on the project will be subject to inspection confirmation tests. Such tests shall be performed by and at the expense of the Contractor.

(2) Control of the gradation of the riprap will be by visual inspection either at the source or the project site at the Engineer's option. Any difference of opinion between the Engineer and the Contractor shall be resolved in accordance with the method provided in FM 5-538 with all equipment, labor and sorting site for this check being provided by the Contractor at his expense.

530-2.3 Bedding Stone. Bedding Stone shall be either a durable quality limestone or other quarry run stone, with a specific gravity of not less than 1.90 and shall be reasonably free from thin, flat and elongated pieces. The bedding stone shall also be reasonably free from organic matter and soft, friable particles. The gradation shall be within the following limits:

<u>Sieve Designation</u> <u>U.S. Standard Square Mesh</u>	<u>Individual Percentage</u> <u>by Weight Passing</u>
12 inch	100
10 inch	70-100
6 inch	60-80
3 inch	30-50
1 inch	0-15

Source approval and project control of bedding stone shall be as specified in 530-2.2.4. In lieu of limestone or other quarry run stone, non-reinforced concrete from existing pavement that is to be removed which meets the above requirements may be substituted for commercial bedding stone.

530-3 CONSTRUCTION METHODS.

530-3.1 Sand-Cement.

530-3.1.1 Mixing Materials. Sand and cement shall be proportioned in the ratio of five cubic feet of sand (loose volume) to 94 pounds (1 bag) of cement. If the materials are proportioned by weight, sand shall be assumed to have a unit weight of 85 pounds per cubic foot (loose volume). Sand may be batched at the moisture content occurring in the stockpile.

The sand and cement shall be mixed until the mixture is of uniform color.

530-3.1.2 Filling Sacks. The mixed material shall be accurately measured into each sack, with care being taken to place the same amount of material in each sack; at least the top six inches of the sacks shall remain unfilled to allow for proper tying or folding and to insure against breaking of the sack during placing.

530-3.1.3 Placing. The filled sacks shall be placed with their tied or folded ends all in the same direction unless otherwise shown in the plans. The sacks shall be laid with broken joints, in a regular pattern. The sacks shall be rammed or packed against each other so as to form a close and molded contact after the sand and cement mixture has set up. Sacks ripped or torn in placing shall be removed and replaced with sound, unbroken sacks. All sacks shall then be thoroughly saturated with water.

530-3.1.4 Grouting. Immediately after watering, all openings between sacks shall be filled with dry grout composed of one part portland cement and five parts sand.

530-3.1.5 Toe Walls. Toe walls of riprap for fill slopes may be constructed of poured-in-place concrete in lieu of sand-cement in sacks. This concrete shall meet the requirements specified in Section 346 for Class I Concrete. If sand-cement in sacks is used for the toe walls, the entire trench excavated for the toe walls shall be filled with sand-cement in sacks.

530-3.2 Rubble. Rubble shall be dumped in place forming a compact layer conforming to the neat lines and thickness specified in the plans. Rubble shall be placed in such a manner that the small pieces are not segregated but are evenly distributed filling the voids between the larger pieces.

530-3.3 Bedding Stone. Bedding stone shall be placed without puncturing or tearing the geotextile fabric. Geotextile fabric damaged as a result of the Contractor's operations shall be removed and replaced at the Contractor's expense.

An in-place thickness tolerance of plus or minus one inch will be permitted.

530-4 METHOD OF MEASUREMENT.

530-4.1 Sand-Cement. The quantity of Riprap (Sand-Cement) to be paid for under this Section shall be the volume in cubic yards of sand actually used in the sand-cement mixture and grout, satisfactorily placed and accepted.

If sand-cement is proportioned by volume, the sand shall be measured loose in an approved measure prior to mixing with cement. If sand-cement is proportioned by weight, approved scales shall be used for this purpose and the volume shall be calculated using a standard conversion factor for sand of 85 pounds per cubic foot. No adjustment of batch weights to allow for varying moisture content of the sand will be made.

For toe walls, the quantity of Riprap (Sand-Cement) to be paid for shall include only the volume of sand-cement in sacks or concrete placed within the neat lines shown in the plans for the toe walls.

530-4.2 Rubble and Bedding Stone. The quantities of Riprap (Rubble) and Bedding Stone shall be measured by the ton, in surface-dry natural state, by railroad scales, truck scales or barge displacement. Weights shall be determined as follows:

- (1) **Railroad Weights:** Railroad cars shall be weighed on railroad scales, before and after loading or before and after unloading. If weighed by other than the Engineer's representative a certified statement of weights will be required. Certificates of weight, furnished by the railroad company, will be acceptable without further certification.
- (2) **Truck Weights:** Truck weights shall be determined by weighing trucks loaded and empty, on certified scales, generally as prescribed above for railroad weights. Weighing shall be done in the presence of the Engineer's representative, or certificates of weights shall be furnished.
- (3) **Barge Displacement:** Each barge shall be measured by the Engineer and shall be fitted by the Contractor with gauges graduated in tenths of a foot. A gauge shall be located at each corner of the barge near the lower end of the rake. Additional gauges shall be furnished amidships if deemed necessary by the Engineer. All computations of weight will be made by the Engineer.

530-5 Basis of Payment.

530-5.1 Sand-Cement. The quantity, determined as provided in 530-4.1, shall be paid for at the contract unit price per cubic yard for Riprap (Sand-Cement), which price and payment shall be full compensation for all the work specified in this Section and shall include all materials, labor, hauling, excavation and backfill.

The cost of dressing and shaping the existing fills (or subgrade) for placing riprap shall be included in the contract unit price for Riprap (Sand-Cement).

530-5.2 Rubble. The quantity, determined as provided in 530-4.2, shall be paid for at the contract unit price per ton for Riprap (Rubble), which price and payment shall be full compensation for all the work specified in this Section and shall include all materials, hauling, excavation and backfill.

The cost of dressing and shaping the existing fills (or subgrade) for placing riprap shall be included in the contract unit price for Riprap (Rubble).

As an exception to the above, concrete which is shown to be removed from an existing structure and subsequently disposed of by being utilized in the embankment as riprap will not be paid for under this Section, but will be included in the cost of Removal of Existing Structures.

530-5.3 Bedding Stone. The quantity, determined as provided in 530-4.2, shall be paid for at the contract unit price per ton for Bedding Stone, which price and payment shall be full compensation for all the work specified in this Section and shall include all materials and hauling.

The cost of dressing and shaping the existing fills (or subgrade) for placing bedding stone

shall be included in the contract unit price for Riprap (Rubble). Geotextile fabric will be paid for separately as specified under Section 514 unless otherwise noted in the plans.

530-6 PAYMENT.

Payment shall be made under:

Item No. 530-1 - Riprap (Sand-Cement) - per cubic yard.

Item No. 530-3 - Riprap (Rubble) - per ton.

Item No. 530-74 - Bedding Stone - per ton.

SPAN WIRE ASSEMBLY.

SECTION 634 (Pages 566-569) is deleted and the following substituted:

SECTION 634 **SPAN WIRE ASSEMBLY**

634-1 SCOPE.

This Section specifies the requirements for materials and installation of a span wire assembly for supporting traffic signals, signs and/or other traffic control devices. A span wire assembly includes a catenary wire, a messenger wire, a tether wire when required, hardware and fittings for attachment to support poles or structures. Fiberglass insulators shall be provided when required.

Span wire assemblies shall be installed in accordance with the Roadway and Traffic Design Standards, Index No. 17727.

This Section also covers the measurement and payment for work performed in furnishing and/or installing Item 634-4, Span Wire Assembly, and Item 634-5, Fiberglass Insulators.

634-2 MATERIALS.

634-2.1 General Requirements. The specific components of a span wire assembly are a catenary wire, a messenger wire, and when required, a tether wire. The catenary wire is used to support the imposed dead and wind loads from the attached signs and traffic signals. For a single point attachment the messenger wire is used to support the signal conductor cables and interconnect cables, and to stabilize signal heads, signs and other traffic control devices.

For a two point attachment, the messenger wire in addition to the loads it supports in a single point attachment also resists a significant portion of the imposed wind load.

The tether wire is used for maintaining the alignment of optically programmed signal heads when installed on the span wire assembly or when specified in the plans for overhead signs.

634-2.2 Wires. All wire cables used in span wire assemblies shall be 7-wire strands manufactured and provided with a Class A zinc coating in accordance with ASTM A-475.

Unless otherwise specified in the plans, catenary wires shall be Utility Grade.

Unless otherwise specified in the plans, messenger wires shall be Utility Grade; except that Siemens - Martin Grade may be used for single point attachments only. Tether wires shall be Siemens-Martin Grade. Additional requirements for span wire assembly strands shall be as follows:

Span Wire Assembly Strand Type	Nominal Diameter	Required Minimum Breaking Strength (pounds)	
Catenary Wire *	3/8"	11,500	or
	7/16"	18,000	
Messenger Wire **	1/4"	3,150	
	3/8"	11,500	
	7/16"	18,000	
	or 1/2"	25,000	
Tether Wire	3/16"	1,900	

* Catenary wire nominal diameter shall be as specified in the plans. The diameters shown are the standard diameters to be used.

** Messenger wire nominal diameter shall be 1/4-inch for single point attachments and shall be specified on the plans for two point attachments.

634-2.3 Hardware and Fittings. For utility or Siemens-Martin Grade wires, the connection hardware shall be as specified herein and in 634-3.4(f). For installations that use other grades of wire, the hardware and fittings will be as indicated on the plans. All hardware and fittings, except fiberglass insulators specified in 634-2.4, shall be made of galvanized steel or non-corrosive metal. Hardware and fittings shall be of sufficient strength to resist the breaking strength of the wire with which they are used.

The automatic compression dead-end clamps of the catenary wire (or wires) shall be connected to the strain poles with 3/4-inch diameter oval eye bolts, except as noted in 634-3.4(f). For single point attachments, the automatic compression dead-end clamp of the messenger wire shall be attached to the same oval eye bolt as the catenary wire. For two point attachments, the messenger wire shall be connected to 3/4-inch diameter oval eye bolts at the lower attachment location, except as noted in 634-3.4(f). Thimbleye bolts will not be allowed for these connections.

All thimbleye and oval eye bolts used to connect the automatic compression dead-end clamps of tether wires to strain poles shall be 3/4-inch in diameter, minimum.

All "S" hooks used in connecting the tether wire to all poles shall be 5/16-inch in diameter,

minimum.

Other hardware and fittings, as required for the attachment of a span wire assembly to support poles or structures, shall be in accordance with the details shown in the Roadway and Traffic Design Standards.

634-2.4 Fiberglass Insulators. Fiberglass insulators are required on span wire assemblies located within six feet of overhead electric power lines. The required length of fiberglass insulators shall be specified in the plans.

The fiberglass insulator shall be of a cylindrical shape, fabricated from epoxy-resin impregnated fiberglass strands and shall have a breaking strength 50 percent greater than that of the structural support wire to which it is to be attached. The insulator shall be equipped with thimbleye fittings on each end for attachment of the wire. All fittings and hardware necessary for the complete installation shall be furnished with the insulator and shall be of at least equal strength to the insulator.

634-3 INSTALLATION REQUIREMENTS.

634-3.1 Span Wire Assembly Types. Span wire assemblies shall be of the following types:

(a) Two Wire Assembly - This type assembly requires a catenary wire and a messenger wire.

(b) Three Wire Assembly - This type assembly requires a catenary wire, a messenger wire and a tether wire.

Each of these types may be supplied for single or two point attachments.

634-3.2 Span Types. Span wire assemblies are installed on the following span types:

(a) Perpendicular Span - This type span is used at an intersection to support a single span wire assembly upon which traffic signals, signs and/or other traffic control devices are attached. The span wire assembly is attached to two support poles or structures, located on opposite sides of the roadway, and extends across the roadway at an angle of approximately 90 degrees to the roadway approach.

(b) Diagonal Span - This span type is used at an intersection to support a single span wire assembly upon which traffic signals, signs and/or other traffic control devices are attached. The span wire assembly is attached to two poles, located in opposite quadrants of the intersection, and extends across the intersection at an angle of approximately 45 degrees to the approach lanes of the intersection. Traffic control devices for all approaches are located at appropriate locations on the span wire assembly.

(c) Box Span - This span type is used at an intersection to support a perimeter system of four span wire assemblies upon which traffic signals, signs and/or other traffic control devices for each approach to the intersection are attached. The span wire assemblies are attached to four poles, one located in each quadrant of the intersection, and each span wire assembly extends between two poles at an angle of approximately 90 degrees to the roadway approaches. Traffic control devices for an approach are located on the span wire assembly on the far side of the intersection.

(d) Special Design Span - This span type is used to support two or more span wire

assemblies upon which traffic signals, signs and other traffic control devices for one or more roadway approaches are attached. The span wire assemblies are attached to three or more poles.

634-3.4 General Requirements.

(a) The catenary messenger and tether wires of a span wire assembly shall be of one continuous length of wire cable with no splices except when an insulator is required by 634-2.4. The insulator, if required, shall be connected to the cable with automatic compression dead-end clamps.

(b) The span wire assemblies shall be attached to the support poles or structures by means of automatic compression clamps and accessory hardware.

(c) The washer and nut on the oval eye bolt shall be assembled with the flat washer next to the pole. The nut shall be tightened sufficiently to prevent the oval eye bolt from rotating.

(d) For single point attachment, the messenger wire with the signal conductor cables attached shall be tensioned to eliminate any appreciable sag.

For two point attachments, the messenger wire shall be installed with the following tensions per 100 feet. Cable tensions for other lengths may be linearly prorated from these values:

<u>Cable Size</u>	<u>Wire Tension (lbs.)</u>
3/8 " dia.	340.0
7/16" dia.	500.0
1/2" dia.	645.0

(e) The catenary wire shall be installed to the following initial wire tensions:

For 3/8-inch diameter:

<u>Span in Feet</u>	<u>Initial Wire Tension (lb.)</u>
0 to 100	50.0
101 to 125	75.0
126 to 150	85.0
151 to 175	100.0
176 to 200	115.0
201 to 225	125.0
226 to 250	140.0
251 to 275	150.0
276 to 300	175.0
over 300	200.0

For 7/16-inch in diameter:

<u>Span in Feet</u>	<u>Initial Wire Tension (lb.)</u>
0 to 100	75.0
101 to 125	100.0
126 to 150	125.0
151 to 175	150.0
176 to 200	175.0
201 to 225	175.0
226 to 250	200.0
251 to 275	225.0
276 to 300	250.0
over 300	275.0

(f) A maximum of two 3/8-inch diameter catenary wires may be connected to strain pole with one 3/4-inch diameter oval eye bolt. A maximum of one 7/16-inch diameter catenary wire may be connected to a strain pole with one 3/4-inch diameter oval eye bolt.

A 3/4-inch diameter alloy steel eyebolt (ASTM F 541, Type 2) and a 3/4-inch heavy hex nut (ASTM A 563, Grade C or D), both zinc coated in accordance with ASTM A 153, Class C, may be used to connect more than one 7/16-inch diameter catenary wire or one 1/2-inch diameter messenger or catenary wire to a single strain pole. Alternatively, the Engineer may design a special connection for this case.

(g) The span wire assemblies shall be installed at a height on the support poles which will provide a clearance from the roadway to the bottom of the signal head assemblies as specified in 650-4.

(h) All span wires shall be connected to the pole grounding system in accordance with Section 620.

(i) The Contractor shall obtain and comply with all provisions of the National Electric Safety Code (ANSI-C2) in regards to clearance from electric lines, contacting of utility owners and safety requirements prior to span wire installation.

(j) Prior to installation of the span wire assembly, the Contractor's method of providing the required tension in the catenary wire and the messenger wire in two point attachments shall be submitted to the Engineer for approval.

634-4 METHOD OF MEASUREMENT.

634-4.1 General. Span wire assemblies as specified in this Section shall include all hardware (except fiberglass insulators) and services necessary to make a complete assembly furnished and installed; furnished; or installed in accordance with the work required in this Section and other Contract documents.

Fiberglass insulators as specified in this Section, shall include all hardware and services necessary to make a complete installation; furnished and installed; furnished; or installed in accordance with the work required in this Section and other Contract documents.

Measurement for payment shall vary according to the following work tasks.

634-4.2 Furnish and Install. The contract unit price per intersection for Span Wire Assembly and per linear foot for Fiberglass Insulator, furnished and installed between supporting poles and structures shall include furnishing all materials and hardware as required in 634-2, all labor, equipment and miscellaneous materials necessary for a complete and accepted installation.

634-4.3 Furnish. The contract unit price per intersection for Span Wire Assembly and per linear foot for Fiberglass Insulator, furnished shall include the cost of the required materials and hardware as required in 634-2, and handling and delivery of these items to the site designated by the Department in the Contract documents.

634-4.4 Installed. The contract unit price per intersection for Span Wire Assembly and per linear foot for Fiberglass Insulator, installed shall include all labor, equipment and miscellaneous materials necessary to make a complete and accepted installation. All materials and hardware as required in 634-2 for the span wire assembly shall be supplied by others.

634-5 BASIS OF PAYMENT.

The contract unit price per intersection for Span Wire Assembly and per linear foot for Fiberglass Insulator shall be full compensation for all work specified in this Section.

Payment shall be made under:

Item No. 634-4-ABC - Span Wire Assembly - per intersection.

A. Operation to be Performed.

1. Furnish and Install.
2. Furnish.
3. Install.

B. Type Assembly.

1. Two Wire.
2. Three Wire.

C. Type Span.

1. Perpendicular.
2. Diagonal.
3. Box.
4. Other (as shown in plans).

Item No. 634-5-A - Fiberglass Insulator - per linear foot.

A. Operation to be Performed.

1. Furnish and Install.
2. Furnish.
3. Install.

SECTION 635

PULL AND JUNCTION BOXES

635-4 PULL AND JUNCTION BOXES - GENERAL REQUIREMENTS is expanded as follows:

All metal covers shall be grounded to a ground rod driven in the pull box. A number 6 stranded copper wire shall be connected from the cover to the ground rod. The ground rod shall be a 5/8-inch diameter copper-clad rod ten feet long or a length required to achieve a resistance to ground of 25 ohms or less. The connection to the cover shall be per the manufacturer's recommendation. Grounding and compensation shall be in accordance with Section 620.

When so noted in the plans, pull and junction boxes used for traffic monitoring devices powered strictly by battery or a combination of battery and solar energy will be exempt from the grounding requirements specified herein.

CONCRETE STRAIN POLES.

SECTION 641 (Pages 574 and 575) is deleted and the following substituted:

SECTION 641 CONCRETE STRAIN POLES

641-1 SCOPE.

This Section specifies the requirements for concrete poles used for service pole applications (pole type N-II), luminaire support (pole type N-III), and the span wire support of traffic signals, signs, and other devices (pole types N-IV, N-V, N-VI, and N-VII). Figures 641-1, 641-2, 641-3, 641-4 and 641-5 are attached to this Specifications Package.

641-2 DESIGN REQUIREMENTS.

641-2.1 General. All concrete poles shall be designed to meet the requirements of the latest revision of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. They shall also be provided with a minimum area of non-prestressed reinforcing (minimum ultimate tensile strength of 60 ksi) equal to 0.33 percent of the concrete area.

641-2.2 Service Poles and Luminaire Supports. Pole types N-II and N-III shall be designed to meet the applicable requirements of Figures 641-1, 641-2, 641-3, and 641-5, and the following structural requirements:

(a) Allowable unit stresses shall conform to Section 6 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, 1985.

(b) The prestressing shall be symmetrically placed. The amount of prestressing shall be sufficient to provide a calculated compressive stress of 2,200 psi for type N-II and 2,900 psi for type N-III at the top of pole after all losses.

641-2.3 Strain Poles. Pole types N-IV through N-VII shall be designed to meet the requirements of Figures 641-3, 641-4 and 641-5, and the following structural requirements:

(a) Allowable unit stresses shall conform to Section 6 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 1985.

(b) Service Conditions; poles must be designed to carry the "Minimum Required Moment Capacity", as given in Figure 641-4. Since these moments are based on a dead load plus wind load combination, the allowable stresses are those for normal exposure conditions given in Section 6 multiplied by the applicable factor from Section 2 of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 1985.

(c) Ultimate Conditions; the ultimate moment capacity of each pole must be at least 1.3 times the "Minimum Required Moment Capacity" given in Figure 641-4.

641-2.4 Strain Pole Fabricators. Only strain poles listed on the Department's Qualified Products List, current at the time of the poles proposal for use shall be used. The Department's Qualified Products List is available from the Office of Construction, Florida Department of Transportation, 605 Suwannee Street, Mail Station 31, Tallahassee, Florida 32399-0450.

Manufacturers or fabricators seeking approval of their strain poles in accordance with this Specification shall contact the State Structural Value Engineer.

641-2.5 Points of Attachment. Span wire assemblies (consisting of the catenary wire, the messenger wire, and the tether wire) shall be attached to the concrete poles in accordance with Section 634, Span Wire Assembly.

The eyebolt hole for the attachment of the catenary wire to the concrete pole shall be provided by the manufacturer at a distance of one foot from the top of the pole. If a two point attachment is required by the plans, an eye bolt hole for the messenger wire shall be provided by the manufacturer or field drilled by the Contractor at the location indicated in the plans. The eyebolt hole for the tether wire, when required, shall be field drilled prior to installation (see Figure 641-3).

641-2.6 Cable Entrance Hole. The cable entrance hole shall consist of a two-inch diameter galvanized conduit nipple (no threads) fabricated in the pole. The conduit shall extend beyond the surface of the pole as shown in Figure 641-3. The cable entrance hole shall be located three feet from the top of the pole or at the location designated in the plans and placement shall not be less than 45 degrees to the face of the pole as shown in Figure 641-3.

641-2.7 Handholes and Service Holes. The handhole of the installed pole shall be

located on the load face, 3' 6" above final grade (see Figures 641-1 and 3). The minimum inside dimensions of the handhole shall be four inches wide and six inches high. A noncorrosive cover plate shall cover the handhole and shall be attached to the pole by lead anchors or threaded inserts embedded in the pole and round head chrome plated screws.

For pole types N-III through N-VII, two conduit entry holes, each three inches wide and five inches high, shall be cut 90 degrees to the handhole and shall be located 2' 6" below finish grade (see Figure 641-3). Conduit entry holes shall be centered on the sides of the pole.

A two-inch diameter galvanized conduit, for use with pole mounted cabinets, shall be fabricated into the pole at the same elevation as the handhole, in the face opposite the load face of the pole. The conduit shall be provided with a noncorrosive cover or plug. Field drilling is not allowed on concrete strain poles unless approved by the Resident Engineer.

641-2.8 Grounding. A number 8 stranded copper ground wire shall be embedded in the concrete during the fabrication of the pole.

The ground wire shall be placed in the pole from a point not more than five feet from the bottom of the pole to a point not more than three feet from the top of the pole, as shown in Figures 641-1, 641-2 and 641-3. The ground wire shall be attached to the reinforcing steel in the member as necessary to prevent the ground wire from being displaced during concreting operations.

The ground wire, as measured from the exit point on the face of the pole, shall have a minimum length of 24 inches at the top and 48 inches at the bottom.

641-2.9 Identification Markings. Concrete poles shall be identified as to pole manufacturer, Department's pole type, length, and Department's Qualified Product List qualification number by inset numerals one inch in height inscribed on the same face of the pole as the handhole and ground wire. This identification shall be placed approximately four feet above final grade (a minimum of seven feet from the bottom) for Pole Type N-II (see Figures 641-1 and 641-2), and approximately one foot above the handhole cover plate of Pole Types N-III through N-VII.

641-2.10 Surface Finish. The surface finish shall be a Class 3 Surface Finish as specified in 400-15.2.4.

641-3 INSTALLATION REQUIREMENTS.

641-3.1 Scope. This Article specifies the installation requirements for concrete poles for service pole applications, luminaire support, and the span wire attachment of traffic signals, signs and other devices.

641-3.2 General. All strain poles shall be furnished according to the type and length called for in the plans. The size of the catenary cable shall be as called for in the plans. Grounding of strain poles shall be in accordance with Section 620, Grounding. Span wire assemblies shall be installed in accordance with Section 634, Span Wire Assembly.

The poles will not be acceptable for use if the camber of the pole, measured as the maximum deviation between the centerline of the pole and a straight line connecting the centroids of the cross sections at each end of the pole, is greater than the total pole length in

inches divided by 140.

641-3.3 Footings. The footings for concrete strain poles used for span wire support of traffic signals (types N-IV through N-VII) shall be 3'6" in diameter and the depth shall be as specified in the plans. The footings for all other concrete pole applications shall be as specified in the plans. The footings are to be constructed with Class I concrete as specified in Section 345.

The excavation and backfill requirements for the footing shall be in accordance with 125-4 and 125-8.2 with the exception of the backfill density. In lieu of the requirements for obtaining the specified density, the backfill may be hand tamped in four-inch maximum layers or machine tamped in six-inch maximum layers and the material should not be dry nor saturated. As an option, the backfilling may be constructed with concrete.

Forms, when required, shall be in accordance with 700-8.3. If the footing is cast in an oversize hole, the concrete in the top six inches shall be placed in a form. All exposed surfaces shall be troweled to a smooth finish.

641-3.4 Orientation of Poles. For poles supporting one catenary wire, the pole shall be oriented so that the load face is perpendicular to the catenary wire. For poles supporting two catenary wires, the pole shall be oriented so that the load face is perpendicular to a line bisecting the angle between the two catenary wires.

641-4 METHOD OF MEASUREMENT.

641-4.1 Scope. This Article specifies the provisions for the measurement and payment of concrete strain poles as described in the plans or other Contract documents.

641-4.2 General Requirements. Strain poles shall include all materials and services necessary to make a complete unit furnished and installed; furnished; or installed in accordance with the work described in the plans and other Contract documents.

Measurement for payment shall be in accordance with the work tasks described hereinafter.

641-4.3 Furnish and Install. The contract unit price for Concrete Strain Poles (Furnished and Installed) shall consist of the strain pole plus all labor, concrete for the foundation and other materials necessary for a complete and accepted installation as specified in the plans or Contract documents.

641-4.4 Furnish. The contract unit price for Concrete Strain Poles (Furnished) shall include the cost of the strain pole plus shipping, handling, and delivery of the pole to the site designated by the Department in the Contract documents.

641-4.5 Install. The contract unit price for Concrete Strain Poles (Installed) shall include all labor, concrete for the foundation and other materials necessary for a complete and accepted installation as specified in the plans or Contract documents.

641-4.6 Basis of Payment. The contract unit price for each type of strain pole shall be full compensation for all work as specified by plans or Special Provisions.

Payment shall be made under:

Item No. 641-AB-CDD -Concrete Strain Poles (Type "X") - each.

A. Operation to be Performed.

1. Furnish and Install (with Foundation).
 2. Furnish.
 3. Install (with Foundation).
 4. Furnish and Install (Direct Burial).
 5. Install (Direct Burial).
- B. Pole Type.
1. Type N-II (Service Pole).
 2. Type N-III (Service Pole).
 3. Type N-IV.
 4. Type N-V.
 5. Type N-VI.
 6. Type N-VII.
- C. Pole Design Change.
1. 1991 Design Change.
- DD. Pole Length.

(Note: Pole lengths are to be specified in even numbers only.)

SECTION 700 HIGHWAY SIGNING

700-2.3.1 Frangible Supports. The first paragraph is deleted and the following substituted:

Posts for all frangible sign assemblies shall consist of aluminum tubes up to 3 1/2" outside diameter with 3/16" wall thickness, or galvanized steel U-Channel up to three pounds per foot as listed on the Department's Qualified Products List, and in accordance with Indexes 11860 through 11865 for frangible sign supports.

700-2.3.2 Breakaway Supports is expanded as follows:

Alternate proprietary and non-proprietary breakaway assemblies are listed on the Department's Qualified Products List. An acceptable non-proprietary breakaway lap splice for U-Channel steel posts is shown on the U-Channel Lap Splice Detail. Other alternate breakaway designs may be accepted if satisfactorily tested in accordance with the current AASHTO requirements, and subsequently approved by the Department.

700-2.3 Steel Posts is expanded by the following new Subarticle:

700-2.3.3 Steel Posts. Steel Flanged U-Channel used as the structural member in a full length support or breakaway base installation for a small roadway sign shall consist of rerolled rail steel or an equivalent billet steel, conforming to the mechanical requirements of ASTM A 499, Grade 60 and conforming to the chemical requirements of ASTM A 1. Each U-Channel shall have 3/8-inch diameter holes on one-inch centers punched or drilled through the center of the post, starting approximately one inch from the top and extending

the full length of the U-post. The weight per foot of a particular manufacturer's U-Channel size shall not vary more than plus or minus 3 1/2 percent of its specified weight per foot. The bottom end of the U-Channel post shall be tapered for easier installation. The U-Channel shall be machine straightened to a tolerance of 1/2-inch per ten feet of length. Post configuration shall generally comply with the dimensions for Type F or Type M flanged U-Channel, as shown on Standard Index 11865.

All steel components shall be galvanized after fabrication in accordance with ASTM A 123 and have a smooth uniform finish, free from defects affecting strength, durability and appearance.

All hardware used for the attachment of the sign to the structural member shall be in accordance with the manufacturer's recommendations and as specified in the Standard Index Drawings. All attachment hardware (nuts, bolts, clamps, brackets, braces, etc.) shall be of a non-corrosive metal, aluminum, or galvanized steel, meeting the requirements specified on Indexes 11860 through 11865.

700-2.5 Sign Background. The text is deleted and the following substituted:

Background sheeting and white legends, borders, and shields on all signs, excluding STOP, DO NOT ENTER and WRONG WAY, shall be Type III-A, III-B, or III-C sheeting. STOP, DO NOT ENTER and WRONG WAY signs shall be Type III-D.

700-5.5 Stenciling. The first sentence is deleted and the following substituted:

The back of all finished panels shall be marked at the bottom edge with the date of fabrication, fabricator's initials, name of sheeting and name of sheeting manufacturer.

SECTION 705 **HIGHWAY DELINEATORS**

705-2 MATERIALS AND CONSTRUCTION METHODS is expanded as follows:

In addition to the requirements specified in Section 993, flexible delineator post and reflector assemblies will be permitted as an alternate to Type A, Type B or Type C post and reflector assemblies. However, at certain locations shown in the plans, only flexible delineator post and reflector assemblies will be permitted.

The flexible delineator post and reflector assembly shall meet the following requirements:

I. Specific Requirements for Flexible Delineator Posts: These Specifications define requirements for drivable flexible plastic delineator posts which are designed for installation with a post driver.

A. Material: The material shall be made of a durable white plastic or poly resin material which will withstand impacts by vehicles and return to a functional delineator position. The material shall be UV (ultraviolet) stabilized and inert to all normal atmospheric elements.

B. Workmanship: The post shall exhibit good workmanship and shall be free of burns, discoloration, contamination, and other objectionable marks or defects which affect appearance or serviceability.

C. Marking: The top of the post on the side away from traffic shall be date stamped showing the month and year of fabrication. The numerals shall be at least one-half inch in height and shall be either die stamped or legibly stamped with permanent ink.

D. Dimensions: The post shall have a minimum width of three-inches facing traffic and of such length to provide a height of 48-inches above the ground surface unless otherwise specified, and to provide the required anchoring depth specified herein.

E. Base Anchoring: The post shall be designed to facilitate a permanent installation which shall resist overturning, twisting and displacement from wind and impact forces. The post shall be designed for an anchoring depth of 18 to 24-inches. Installation shall be in accordance with the manufacturer's instructions.

F. Color: The post shall be opaque white. The yellowness index shall not exceed 12 when tested in accordance with ASTM designation: D 1925 or E 313. The daylight 45 Degree, 0 Degree luminous directional reflectance shall be a minimum of 70 when tested in accordance with ASTM Designation: E97.

G. Physical Properties and Performance:

a. Heat Resistance: The post shall be conditioned a minimum of two hours in an oven at 140 ± 30 Degrees F. The conditioned post shall be capable of straightening itself within 30 seconds when bent 180 Degrees at the midpoint for each of four bends. The test on each post shall be completed within two minutes of removal from oven.

b. Cold Resistance: The post shall be conditioned a minimum of two hours at -5 ± 3 Degrees F in an environmentally controlled test chamber. Testing shall be performed in the environmental chamber.

(1) The post shall not be adversely affected when a device approximately at the center of the post, bends the free half of the post to a 90 Degree angle with the remaining section being held stationary. The post shall return to its original shape within 60 seconds for each of four separate bends.

(2) A steel ball weighing two pounds shall be dropped a distance of five feet through a virtually frictionless vertical guide to impact the surface of the post. The surface of the post being struck by the steel ball shall be in a horizontal position with the post supported and held in position at both ends. The post shall be subjected to five impact tests concentrated near the middle of the post. Fracturing, cracking or splitting of the post shall constitute failure.

c. Colorfastness: The post shall be exposed for 1000 hours in an Atlas Type B or BH Xenon Arc Weatherometer (ASTM G 260) with no significant yellowing or darkening.

d. Impact Resistance: The post shall be manufactured from an impact resistant material and be so designed that an installed post is capable of self erecting and remaining serviceable after being subjected to a series of direct impacts by a typical passenger sedan at temperatures of 40 Degrees F or above. The posts to be tested shall be installed in accordance with the recommendations of the manufacturer. The posts shall be furnished

complete with attached reflectors proposed for use. Posts shall be capable of withstanding a series of 10 impacts head on (90 Degrees) into the traffic face of the post at a speed of 35 mph. Posts shall also be capable of withstanding a series of 5 impacts at an angle of 75 Degrees to the traffic face of the post at a speed of 55 mph. The impacting vehicle shall suffer little or no damage during the impact test series.

e. Resistance to Herbicides: The posts shall be sprayed or receive a coating of the herbicide(s) currently being used by the Department and this coating shall remain on the posts for a minimum of 48 hours and then thoroughly rinsed. The posts shall show no significant change in color, flexibility, nor integrity when subjected to this herbicide exposure.

II. Reflectors for Flexible Posts:

A. Description: The delineator shall be of impact resistant retroreflective sheeting which shall be subject to approval by the Department. The reflector shall have a nominal size of three inches by twelve inches with a five percent allowable tolerance. The minimum projected area of the reflector shall be 36 square inches. The reflector shall be of sheeting as specified in 994-3.

B. Mounting: The reflector shall be mounted on the top 14 inches of the post with the reflector facing in the direction of the oncoming traffic. The reflector shall be mounted by an approved positive means which has adequate strength to prevent loss of the reflector during the life of the post.

The reflector shall be free from scratches, abrasions, and other physical damage prior to mounting.

III. Material Test and Certification: Before any manufacturer's post can be placed on Qualified Products List, the manufacturer shall submit a certified test report and test data, developed by an approved testing laboratory which attests to the fact that their marker post complies in all respects with the requirements covered in this specification. Test data submitted by the manufacturer may be subject to verification by suitable tests conducted by the Department.

SECTION 706

REFLECTIVE PAVEMENT MARKERS

~~706-4 REPLACEMENT REQUIREMENTS~~ is deleted and the following substituted:

If more than two percent of the markers fail in adhesion within the first 30 days under traffic, the Contractor shall replace all failed markers at his expense.

SECTION 710

PAINTING TRAFFIC STRIPES

710-2(1) MATERIALS is deleted and the following substituted:

(1) Traffic Paint. The paint material used for this work shall conform with the requirements for traffic paint of Section 971.

PREFORMED PAVEMENT STRIPES AND MARKINGS.

PAGE 630. The following new Section is inserted after Section 711:

SECTION 713
PREFORMED PAVEMENT STRIPES AND
MARKINGS

713-1 DESCRIPTION.

The work under this Section consists of furnishing and placing preformed reflectorized plastic pavement symbols, legends, stripes and markings in substantial compliance with the MUTCD, these specifications, and details shown on the plans.

The retro-reflective pliant polymer reflectorized plastic pavement marking material used for any of the applications described in this specification shall be one of the products included on the Qualified Products List, current at the time of the materials proposal for use.

Any marked variation from the original test values for a material or evidence of inadequate field performance of a material will be considered to be sufficient evidence that the properties of the material have changed. At that time, the material will be removed from the Qualified Products List and retesting will be required.

713-2 MATERIALS.

The preformed materials for pavement stripes and markings shall conform to the requirements of 971-18.

713-3 INSTALLATION REQUIREMENTS.

The preformed retro-reflective plastic pavement symbols, legends, stripes and marking shall be applied to the asphaltic and/or portland cement concrete pavement at the locations shown on the plans or as approved by the Engineer.

The asphaltic and/or portland cement concrete pavement surface shall be clean and free of moisture, soil or other deleterious substances. A brooming or compressed air method shall be utilized to clean the pavement surface. A primer shall be used as required by the manufacturer.

713-5 MEASUREMENT AND PAYMENT.

When preformed pavement stripes and markings are used as an alternate to extruded or sprayed thermoplastic traffic stripes and markings, the quantities to be paid for will be those quantities which would be paid for if extruded or sprayed thermoplastic traffic stripes and markings were utilized. Such prices and payments shall be full compensation for all work specified herein.

SECTION 715
HIGHWAY LIGHTING SYSTEM

HIGHWAY LIGHTING SYSTEM - ALTERNATE FOUNDATION.

715-6 Concrete Bases For Light Poles is expanded as follows:

Screw type foundation detailed on Roadway and Traffic Design Standards, Index No. 17503 is deleted.

Screw type foundations meeting the following requirement may be used in lieu of cast-in-place concrete bases:

(a) Design: In general, steel screw type foundations shall conform to the latest edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and the requirements herein. The steel shall equal or exceed those of ASTM A 53, Type E, Grade B for the pipe and ASTM A 36 for the plates and bars. Screw type foundations shall be designed to be installed by auguring into the ground using a right hand turning movement with a working installation torque of up to 20,000 foot-pounds. The minimum base plate thickness shall be 1-3/8 inches. Base plates shall be provided with holes to match the number and location of the light pole anchor bolts. Holes shall be 1/16 inch larger in diameter than the light pole anchor bolts. Base plates shall be of sufficient size to provide the required bolt edge distances and shall be notched to indicate the orientation of the shaft cableways. Pipes for these screw type foundations as a minimum shall be Standard ten-inch pipes with an outer diameter of 10.75 inches and a wall thickness of 0.365 inch. An opening shall be provided at the bottom of the pipe for drainage purposes. The whole foundation shall be hot-dip galvanized after fabrication in accordance to ASTM A 123. Drawings shall be submitted to the Department by the Contractor as specified in Section 5 for approval.

(b) Limits of Use: Screw type foundations may be used only with roadway light poles whose maximum working load reactions at their base do not exceed the following:

moment	=	30,600 foot pounds
shear	=	1,020 pounds
torsion	=	3,000 foot pounds

axial = 400 pounds

Soil properties for these installations shall meet the following minimum requirements:

cohesionless:

friction angle = 30 degrees

unit weight = 100 pounds per cubic foot

cohesive:

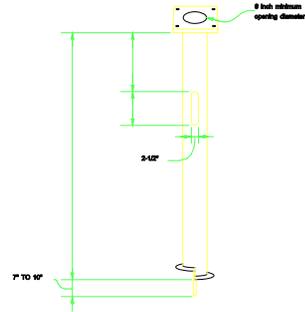
cohesion = 1000 pounds per square foot

The entire screw type foundations must be located above the water table.

(c) Installation: Prior to installation, pole reaction and soil property data shall be submitted to the Engineer for approval.

Install by auguring into the ground. Only a small amount of downward pressure, sufficient to insure engagement of the augers, should be used. Installation into pre-excavated hole is not permitted. Bolts for connecting the pole to the foundation shall be provided by the pole manufacturer and shall be installed complete with nuts and lockwashers. The top of the installed base plate shall not protrude more than two inches above the ground surface.

(d) Sketch:



715-16 BASIS OF PAYMENT. The text is deleted and the following substituted:
The work specified under this Section shall be paid for under the following items and items under other Sections when so indicated in the plans. Such prices and payments shall be full compensation for all the materials, equipment and work specified, including tests; completed

and accepted.

(a) Conductor: The contract unit price for Conductor shall include conductors as indicated in the plans and the Roadway and Traffic Design Standards. Payment shall be made based on linear foot of single conductor.

Item No. 715-1 - Conductor - per linear foot.

(b) Conduit: The contract unit price for Conduit shall include conduit, elbows, sweeps, connecting hardware, trenching and backfill as indicated in the plans and the Roadway and Traffic Design Standards. The linear foot price for conduit shall also include the cost of restoring cut pavement, sidewalks, sod and etc., to its original condition.

Item No. 715-2 - Conduit - per linear foot.

(c) Lighting Pole Complete: The contract unit price for Lighting Pole Complete shall include the pole, bracket arm, luminaire with lamp, anchor bolts with lock nuts and washers, frangible base, foundation, surge protector, fuse holders with fuses, and the No. 10 copper risers as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-4 - Lighting Pole Complete - each.

(d) Luminaire and Bracket Arm: The contract unit price for Luminaire and Bracket Arm shall include the bracket arm, luminaire with lamp and all necessary mounting hardware as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-5 - Luminaire and Bracket Arm - each.

(e) Load Center: The contract unit price for Load Center shall include the service pole, insulators, weatherheads, transformers, enclosures, panel boards, breakers, safety switches, H.O.A. switches, lightning protectors, fuses, photo electric assembly, meter base and all external and internal conduit and conductors for the service as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-7 - Load Center - each.

(f) High Mast Lighting Pole Complete: The contract unit price for the High Mast Lighting Pole Complete shall include the Pole, luminaires with lamps, lowering system, surge protector, breakers and anchor bolts with lock nuts and washers as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-9 - High Mast Lighting Pole Complete - each.

(g) Light Pole Foundation: The contract unit price for a Light Pole Foundation shall include the foundation and anchor bolts with lock nuts and washers as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-10 - Light Pole Foundation - each.

(h) Luminaire: The contract unit price for Luminaire shall include the Luminaire with lamp and necessary mounting hardware as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-11 - Luminaire - each.

(i) Pull Box: The contract unit price for a Pull Box shall include the pull box and cover as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-14 - Pull Box - each.

(j) High Mast Parts: The contract unit price for High Mast Parts shall include the part specified with all mounting hardware as indicated in the plans, specifications, and the Roadway and Traffic Design Standards.

Item No. 715-15 - High Mast Parts - each.

(k) Frangible Base for Light Pole: The contract unit price for Frangible Base for Light Poles shall include the Frangible Base, attachments, bolts and washers as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-36 - Frangible Base for Light Pole - each.

(l) Photo Electric Control Assembly: The contract unit price for Photo Electric Control Assembly shall include the photo electric control, transformers, conduit and conductors as indicated in the plans and the Roadway and Traffic Design Standards.

Item No. 715-37 - Photo Electric Control Assembly - each.

(m) Pre-Fab Pilaster: The contract unit price for Pre-Fab Pilaster shall include the pilaster and all mounting hardware as indicated in the plans.

Item No. 715-38 - Pre-Fab Pilaster - each.

SECTION 901 COARSE AGGREGATE

901-1.1 Composition. The last paragraph is deleted. Approval of mineral aggregate sources shall be in accordance with 6-3.3.

901-1.2 Deleterious Substances. The last sentence of the first paragraph is deleted and the following substituted:

The weight of deleterious substances shall not exceed the following percentages:

Coal and lignite (AASHTO T-113).....	1.00
Soft and friable particles (AASHTO T-112).....	2.00*
Clay lumps (AASHTO T-112).....	2.00*
Cinders and clinkers.....	0.50
Free shell.....	1.00**
Material passing the No. 200 Sieve (FM 1-T 011)	
At Source.....	1.75***
At Point of Use.....	3.75***
Organic Matter (wet).....	0.03
Chert (less than 2.40 Sp. Gr. SSD) (AASHTO T-113).....	3.00****

* The maximum percent by weight of soft and friable particles and clay lumps together shall not exceed 3.00.

901-1.3 Physical Properties. The maximum soundness loss requirement is changed to 15 percent in lieu of 12, and the following exclusion is added:

The soundness loss requirement will not apply to aggregates used in asphaltic concrete

mixtures.

901-1.4 Gradation. In the second sentence, reference to "Standard Operating Procedure" is changed to "production requirements contained in 6-3.3".

SECTION 902 **FINE AGGREGATE**

902-1.1 Fine Aggregate - Composition. The second paragraph is deleted and the following substituted:

Approval of mineral aggregate sources shall be in accordance with 6-3.3.

902-5.2.2 Fine Aggregate - Screenings From Other Sources. The addition general requirement for the Modified Los Angeles Abrasion is deleted and the following substituted:

Modified Los Angeles Abrasion.95 percent statistical
..... probability of meeting
maximum loss of 23
percent.

902-6 LOCAL MATERIALS. The last paragraph is deleted and the following substituted.

Local materials will not be required to be produced under the requirements of 6-3.3, provided they can meet the above requirements.

SECTION 911 **LIMEROCK MATERIAL FOR BASE** **AND STABILIZED BASE**

911-2 FURNISHING OF MATERIAL. The second sentence is deleted and the following is substituted:

Approval of mineral aggregate sources shall be in accordance with 6-3.3.

SHELL MATERIAL.

SECTION 913 (Pages 647-648) is deleted and the following substituted:

SECTION 913

SHELL MATERIAL

913-1 GENERAL.

913-1.1 Composition.

Shell materials to be used for shell base or shell stabilized base, shall consist of naturally occurring deposits formed essentially of broken mollusk shell, corals and the skeletal remains of other marine invertebrates. Live or steamed shell, or man-made deposits as a by-product of the shellfish industry will not be permitted.

Approval of mineral aggregate sources shall be in accordance with 6-3.3.

913-1.2 Deleterious Substances.

Shell materials shall be reasonably free of lumps of clay, organic matter, and other substances not defined which may possess undesirable characteristics. The material shall not contain silica sand in sufficient quantity to prevent bonding.

913-1.3 Physical and Chemical Properties.

Shell materials shall meet the following physical and chemical requirements:

Limerock Bearing Ratio (FM 5-515)—The material shall have an average LBR value of not less than 100. Material represented by any individual LBR value of less than 90 is unacceptable.

Plasticity (FM 1-T 089 and 090)——That portion of the material passing the No. 40 sieve shall be non-plastic.

Carbonates (FM 5-514)——The minimum percentage of carbonates of calcium and magnesium shall be 50.

913-2 DREDGED SHELL.

913-2.1 Definition.

Dredged shell shall be defined as those shell materials meeting the requirements of 913-1, which are dredged from ocean, bay or lake deposits.

913-2.2 Gradation Requirements.

Materials classified as Dredged Shell shall meet the following gradation requirements:

Passing 3 1/2-inch sieve.....97% (maximum dimension not to exceed six-inch)

Passing No. 4 sieveMaximum 50%

Passing No. 200 sieveMaximum 7.5% (by weight)

913-3 BANK-RUN SHELL.

913-3.1 Definition.

Bank-run Shell shall be defined as those shell materials meeting the requirements of 913-1 which are presently found as "dry land" deposits.

913-3.2 Gradation Requirements.

Materials classified as Bank-run Shell shall meet the following gradation requirements:

Passing 3 1/2-inch sieve.....97% (maximum dimension not to exceed six-inch)

Passing No. 4 sieveMaximum 80%

Passing No. 200 sieve.....Maximum 20% (washed)

913-4 EXCEPTIONS, ADDITIONS AND RESTRICTIONS.

Other specification modifications, based on material usage, may be found in applicable Sections of the Standard Specifications or revisions thereto.

SHELL - ROCK MATERIAL.

The following new Section is inserted after Section 913:

SECTION 913A
SHELL - ROCK MATERIAL

913A-1 GENERAL.

Shell-rock materials to be used for shell-rock base shall be defined as naturally occurring heterogeneous deposits of limestone with interbedded layers or lenses of loose and cemented shell, to include cemented sands (calcitic sandstone). This material shall be mined and processed in a manner which will result in a reasonably homogenous finished product.

Approval of mineral aggregate sources shall be in accordance with 6-3.3.

913A-2 DELETERIOUS SUBSTANCES.

Shell-rock materials shall not contain lumps of clay, organic matter, cherty or other extremely hard materials, or other substances not defined, in sufficient quantity as to be detrimental to the finishing, strength, or performance of the base. The material shall not contain loose, free silica sand in sufficient quantity to prevent bonding of the base, or to result in a surface which is susceptible to distortion under construction traffic, or accumulation of loose sand on the finished surface which precludes bonding of the bituminous tack coat with the base, nor shall the material contain more than 50 percent loose, free shells, corals or skeletal remain of other marine invertebrates (retained on the No. 4 sieve). Materials shall contain no water sensitive clay minerals.

913A-3 PHYSICAL AND CHEMICAL PROPERTIES.

Shell-rock material shall meet the following physical and chemical properties:

Limerock Bearing Ratio (LBR) (FM 5-515)—Production of this material shall be controlled so as to meet the following requirements for LBR value:

The average of test values shall not be less than 100.

No individual test value shall be less than 90.

No two consecutive test values between 90 and 100.

Plasticity (FM 1-T 089 and 090)—That portion of the material passing the No. 40 sieve shall be non-plastic.

Carbonates (FM-5-514)—The average percentage of carbonates of calcium and magnesium shall be 60. Material represented by any individual carbonate lot average of less than 54.0 percent is unacceptable.

Gradation Requirements—Materials classified as shell-rock shall be graded uniformly down to dust and in addition, meet the following specific requirements:

Passing 3 1/2-inch sieve—minimum 97% (maximum dimension not to exceed six-inch).

Passing No. 4 sieve—maximum 70%.

Passing No. 200 sieve—maximum 20% (washed).

SECTION 914

MATERIALS FOR SUBGRADE STABILIZATION

914-3.1.1 General. The text is deleted and the following substituted:

Materials designated as commercial materials may be either limerock, limerock overburden or crushed shell from limerock, cemented coquina or shell base sources approved by the Department, with materials produced under the requirements of 6-3.3.

914-3.2 Local Materials. The last paragraph is deleted and the following substituted:

Local materials will not be required to be produced under the requirements of 6-3.3.

CEMENTED COQUINA SHELL MATERIAL.

SECTION 915 (Pages 649 and 650) is deleted and the following substituted:

SECTION 915

CEMENTED COQUINA SHELL MATERIAL

915-1 COMPOSITION.

Cemented Coquina Shell Material to be used as base or stabilized base shall be defined as

naturally occurring deposits formed essentially of broken mollusk shell, corals and the skeletal remains of other marine invertebrates and silica sands which are presently found as dry land deposits and have been cemented together by carbonates or other natural cementing agents.

Approval of mineral aggregate sources shall be in accordance with 6-3.3.

915-2 DELETERIOUS SUBSTANCES.

Cemented Coquina Shell Material shall be reasonably free of lumps of clay, organic matter, and other substances not defined which may possess undesirable characteristics. The material shall not contain loose, free silica sand in sufficient quantity to prevent bonding.

915-3 PHYSICAL AND CHEMICAL PROPERTIES.

Cemented Coquina Shell Material shall meet the following physical and chemical properties:

Limerock Bearing Ratio (FM-515) - The material shall have an average LBR value of not less than 100. Material represented by any individual LBR value of less than 90 is unacceptable.

Plasticity (FM 1-T-089 and 090) - That portion of the material passing the No. 40 sieve shall be non-plastic.

Carbonates (FM-5-514) - The average percentage of carbonates of calcium and magnesium shall be 45. Material represented by any individual carbonate and magnesium lot average of less than 40.5 percent is unacceptable.

915-4 GRADATION REQUIREMENTS.

Cemented Coquina Shell Material shall have the following gradation requirements:

Passing 3 1/2-inch sieve - 97 Percent Minimum (Maximum dimension not to exceed six inches).

Passing No. 4 sieve - 70 Percent Maximum.

Passing No. 200 sieve (dry weight) - 20 Percent Maximum (by washing).

915-5 EXCEPTIONS, ADDITIONS AND RESTRICTIONS.

Other specification modifications, based on material usage, may be found in applicable Sections of the Standard Specifications, Special Provisions, or revisions thereto.

BITUMINOUS MATERIALS.

SECTION 916 (Pages 650-657) is deleted and the following substituted:

SECTION 916

BITUMINOUS MATERIALS

916-1 ASPHALT CEMENT.

The grades of asphalt cement shall conform to the requirements given in the following Table 1:

Table 1
ASPHALT CEMENT

Test	Conditions	Viscosity Grade
		Min/Max Value
<hr/>		
AC-5		
<hr/>		
Viscosity- P	140°F (60°C)	(500 ± 100)
Viscosity- cSt	275°F (135°C)	min 175
Penetration	77°F (25°C), 100g, 5 sec	min 140
Flash Point- °F	COC	min 350
Solubility- %	in Trichloroethylene	min 99.0

Tests on Residue from Thin Film Oven Test:

$$ViscosityRatio = \frac{Visc.140^{\circ}F \text{ after } TFOT}{Visc.140^{\circ}F \text{ before } TFOT} \text{ max } 4$$

Loss on Heating- %		max 1.0
Ductility- cm	77°F (25°C), 5 cm/min	min 100
<hr/>		
AC-10		
<hr/>		
Viscosity- P	140°F (60°C)	(1000 ± 200)
Viscosity- cSt	275°F (135°C)	min 250
Penetration	77°F (25°C), 100g, 5 sec	min 80
Flash Point- °F	COC	min 425
Solubility- %	in Trichloroethylene	min 99.0

Tests on Residue from Thin Film Oven Test:

$$\text{ViscosityRatio} = \frac{\text{Visc.140}^\circ\text{F after TFOT}}{\text{Visc.140}^\circ\text{F before TFOT}}^9 \max 4$$

Loss on Heating- % max 0.5
Ductility- cm 77°F (25°C), 5 cm/min min 90

AC-20

Viscosity- P 140°F (60°C) (2000 ± 400)
Viscosity- cSt 275°F (135°C) min 300
Penetration 77°F (25°C), 100g, 5 sec min 60
Flash Point- °F COC min 450
Solubility- % in Trichloroethylene min 99.0

Tests on Residue from Thin Film Oven Test:

$$\text{ViscosityRatio} = \frac{\text{Visc.140}^\circ\text{F after TFOT}}{\text{Visc.140}^\circ\text{F before TFOT}}^{10} \max 4$$

Loss on Heating- % max 0.5
Ductility- cm 77°F (25°C), 5 cm/min min 80

AC-30

Viscosity- P 140°F (60°C) (3000 ± 600)
Viscosity- cSt 275°F (135°C) min 350
Penetration 77°F (25°C), 100g, 5 sec min 50
Flash Point- °F(°C) COC min 450 (232)
Solubility- % in Trichloroethylene min 99.0

Tests on Residue from Thin Film Oven Test:

$$\text{ViscosityRatio} = \frac{\text{Visc.140}^\circ\text{F after TFOT}}{\text{Visc.140}^\circ\text{F before TFOT}}^{11} \max 4$$

Loss on Heating- % max 0.5
Ductility- cm 77°F (25°C), 5 cm/min min 50

Spot Test (when and as specified). (See Note below.)

Standard with Naphtha Solvent-Negative for all grades.

Naphtha-Xylene Solvent-percent Xylene-Negative for all grades.

Heptane-Xylene Solvent-percent Xylene-Negative for all grades.

Note: The use of the spot test is optional. When it is specified, the Engineer shall indicate whether the standard naphtha solvent, the naphtha-xylene solvent or the heptane-xylene solvent will be used in determining compliance with this requirement, and also, in the case of xylene solvents, the percentage of xylene to be used.

All hot bituminous mixtures (except recycled mixtures) must contain Viscosity Grade AC-30 as specified above.

For Viscosity Grade AC-30, silicone shall be added to the asphalt cement at the rate of 25 cubic centimeters of silicone mixed to each 5,000 gallons of asphalt cement. If a dispersing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cubic centimeters shall be added, in accordance with the manufacturer's recommendation. The blending of silicone mixture with the asphalt cement shall be done by the producer prior to shipment.

Viscosity Grade AC-30 used in friction course mixes shall contain 0.5 percent heat-stable antistripping additive by weight of asphalt from an approved source. The antistripping additive shall be introduced and mixed into the asphalt cement at the asphalt terminal during loading or by the Contractor at the asphalt plant in a manner satisfactory to the Engineer.

Material failing to meet the viscosity requirements (140°F) shown above will be paid for at reduced rates as shown in Table 2 below:

Table 2

AC-5:

Viscosity in poises, at 140°F	Percentage of Original Payment
400-600	100
375-399 or 601-625	90
340-374 or 626-660	80
Less than 340 or greater than 660	* 50

AC-10:

Viscosity in poises, at 140°F	Percentage of Original Payment
800-1200	100
750-799 or 1201-1250	90
680-749 or 1251-1320	80
Less than 680 or greater than 1320	* 50

AC-20:	
Viscosity in poises, at 140°F	Percentage of Original Payment
1600-2400	100
1500-1599 and 2401-2500	90
1375-1499 and 2501-2625	80
Less than 1375 or greater than 2625	*50

AC-30:	
Viscosity in poises, at 140°F	Percentage of Bid Price (Square yard or Ton)
2400-3600	100
2250-2399 or 3601-3750	97
2075-2249 or 3751-3925	94
Less than 2075 or greater than 3925	*86

* May be removed and replaced at the discretion of the Engineer.

916-1.2 Sampling and Certification. The supplier shall furnish a certification indicating compliance with the above specifications, including silicone and antistripping when required, for all asphalt cements delivered to the project.

For each shipment delivered to the asphalt terminal, the asphalt supplier shall submit a certified test report to the State Materials Office to include all properties specified for a particular grade of asphalt cement. The test results may be from a sample taken from the storage tank(s) after delivery or from a random sample taken from the barge or rail car(s).

All materials delivered to the project shall be identified by viscosity grade.

916-2 RECYCLING AGENTS.

916-2.1 Requirements. The asphalt recycling agent shall be an asphalt cement or an asphalt cement blended (as necessary) with a softening agent or flux oil, and shall meet the following requirements:

TABLE I

Absolute Viscosity, (V60) after TFOT (Thin Film Oven Test).....	3:1 Ratio Max
Smoke Point	260°F min
Flash Point	400°F min
Solubility	97.5% min

Emulsified recycling agent shall meet the following requirements:

TABLE II

Storage Stability-24 hr.....	1.0% max
Sieve Test.....	0.1% max
Residue by Evaporation	65.0% min

Residue from the emulsified recycling agent shall meet the requirements in Table I.

Recycling Agents may also be standard grade asphalt cements meeting the requirements of Table 1 in 916-1.1.

Silicone shall be added to the recycling agent at a rate of 25 cubic centimeters for each 5,000 gallons of recycling agent. For emulsified recycling agent the silicone shall be added to the residue at the stated rate prior to emulsification. If a dispersing fluid is used in conjunction with the silicone, the resultant mixture containing the full 25 cubic centimeters shall be added, in accordance with the manufacturer's recommendation. The blending of silicone mixture with the residue shall be done by the supplier prior to shipment.

The recycling agent, or emulsified asphalt recycling agent, shall contain 0.5 percent heat-stable antistrip additive by weight of asphalt from an approved source. The antistrip additive shall be introduced and mixed into the recycling agent, or emulsified recycling agent, at the terminal.

916-2.2 Sampling and Certification. The supplier shall furnish a certification indicating compliance with the above specification for all recycling agents or emulsified recycling agents delivered to the project.

For each shipment delivered to the asphalt terminal, the asphalt supplier shall submit a test report to the State Materials Office to include all properties specified for a particular recycling agent or emulsified recycling agent. The test results may be from a sample taken from the storage tank(s) after delivery or from a random sample taken from the barge or rail car(s).

916-3 CUT-BACK ASPHALTS.

916-3.1 Requirements. Rapid-curing, cut-back asphalt shall conform with the requirements of AASHTO M 81 except that the penetration range shall be from 60-120 instead of 80-120.

For Grade RC-3000, in addition to the requirements shown in Table I of AASHTO M 81 the following values shall be added to the requirements for Distillation Test:

Distillate, Percentage by Volume of Total Distillate to 680°F	Grade RC-3000 Max
to 320°F	0
to 374°F	10
to 437°F	40

All other requirements for the distillation test (and for other properties included in the

table) shall be as shown in Table I of AASHTO M 81.

Medium-curing, cut-back asphalt shall conform with the requirements of AASTHO M 82.

916-3.2 Sampling and Certification. For each tank of cut-back asphalt delivered to or prepared at the asphalt terminal, the asphalt supplier shall submit a sample to the State Materials Office for testing before use. A pretest number will then be assigned by the State Materials Office which shall be furnished with all cut-back asphalt delivered to the project.

916-4 EMULSIONS.

916-4.1 Requirements. Anionic Emulsified Asphalt shall meet the requirements of AASHTO M 140 with the exception that the cement mix test will be waived when the asphalt is used in non-mix application, such as tack coats and primes. Cationic Emulsified Asphalt shall meet the requirements of AASHTO M 208. Additional emulsions permitted by specifications shall meet the following requirements:

HIGH FLOAT EMULSIONS

Test	Conditions	Asphalt Emulsion	
		Grade AE-60	
		Min/Max	
Tests on Emulsion:			
Saybolt Furol Visc.-sec	122°F	75/400	
Settlement- %	5 days (a)	max 5	
Storage Stability- %	24 hr (b)	max 1	
Sieve Test- %		max 0.10	
Demulsibility- %	50ml CaCl ₂ 0.10N min	75	
Residue by Distillation- %		min 65	
Oil Portion- % by Volume	(500°F Dist.)	max 1	
Tests on Residue:			
Penetration	77°F, 100g, 5 sec	min 40	
Absolute Viscosity- P	140°F	min 3200	
Ductility- cm	77°F, 5 cm/min	min 40	
Float Test- sec	140°F	min 1200	
Solubility- %	in Trichlorethylene	min 97.5	

		Asphalt Emulsion Grade AE-90
Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	122°F	75/400
Settlement- %	5 days (a)	max 5
Storage Stability- %	24 hr (b)	max 1
Sieve Test- %		max 0.10
Demulsibility- %	50ml CaCl ₂ 0.10N min 75	
Residue by Distillation- %		min 65
Oil Portion- % by Volume	(500°F Dist.)	max 2
Tests on Residue:		
Penetration	77°F, 100g, 5 sec	min 70
Absolute Viscosity- P	140°F	min 1600
Ductility- cm	77°F, 5 cm/min	min 40
Float Test- sec	140°F	min 1200
Solubility-%	in Trichlorethylene	min 97.5

		Asphalt Emulsion Grade AE-150
Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	122°F	75/400
Settlement- %	5 days (a)	max 5
Storage Stability- %	24 hr (b)	max 1
Sieve Test- %		max 0.10
Demulsibility- %	50ml CaCl ₂ 0.10N min 75	
Residue by Distillation- %		min 65
Oil Portion- % by Volume	(500°F Dist.)	max 3
Tests on Residue:		
Penetration	77°F, 100g, 5 sec	min 125
Absolute Viscosity- P	140°F	min 800
Ductility- cm	77°F, 5 cm/min	min 40
Float Test- sec	140°F	min 1200
Solubility- %	in Trichlorethylene	min 97.5

		Asphalt Emulsion Grade AE-200
Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	122°F	min 45
Settlement- %	5 days (a)	max 5
Storage Stability- %	24 hr (b)	max 1
Sieve Test- %		max 0.10
Demulsibility- %	50ml CaCl ₂ 0.10N min 75	
Residue by Distillation- %		min 62
Oil Portion- % by Volume	(500°F Dist.)	max 8
Tests on Residue:		
Penetration	77°F, 100g, 5 sec	min 150
Absolute Viscosity- P	140°F	min 400
Ductility- cm	77°F, 5 cm/min	-
Float Test- sec	140°F	min 1200
Solubility- %	in Trichlorethylene	min 97.5

(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than five days.

(b) The 24-hour (1 day) storage stability test may be used instead of the 5-day settlement test.

SPECIAL MS-EMULSION

Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	77°F	min 45
Storage Stability- %	24 hr	max 1
Sieve Test, %		max 0.10
Demulsibility- %	50ml CaCl ₂ 0.10N min 65	
Residue by Distillation- %		min 62
Naphtha Content- % by Volume	(500°F Dist.)	max 8
Tests on Residue:		
Penetration	77°F, 100g, 5 sec	min 50
Ductility- cm	77°F, 5 cm/min	min 40
Absolute Viscosity- P	140°F	min 800
Solubility- %	in Trichlorethylene	min 97.5

Maximum application temperature shall be 170°F.

EMULSIFIED ASPHALT GRADE CRS-2H

Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	122°F	100/400
Settlement- %	5 days (a)	max 5
Storage Stability- %	24 hr (b)	max 1
Demulsibility- %	35ml 0.8% Sodium Dioctyl Sulfosuccinate (c)	min 40
Particle Charge		Positive
Sieve Test- %		max 0.1
Residue- %		min 65
Tests on Residue:		
Penetration	77°F, 100g, 5 sec	80/140
Ductility- %	77°F, 5 cm/min	min 40
Solubility- %	in Trichloroethylene	min 97.5

(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days.

(b) The 24-hour (1-day) storage stability test may be used instead of the 5-day settlement test.

(c) The demulsibility test shall be made within 30 days from date of shipment.

ASPHALT EMULSION PRIME (AEP)

Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	77°F	20/150
Settlement- %	5 days (a)	max 5
Storage Stability- %	24 hr (b)	max 1
Sieve Test- %		max 0.1
Residue- %		min 55
Naphtha Content- % by Volume	(500°F. Dist.)	max 12

Tests on Residue:

Penetration	77°F, 100g, 5 sec	40/200
Ductility- cm	77°F, 5 cm/min	min 40
Solubility- %	in Trichloroethylene	min 97.5

(a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than 5 days.

(b) The 24-hour (1-day) storage stability test may be used instead of the 5-day settlement test.

ASPHALT EMULSION GRADE RS-1

Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	77°F	20/100
Storage Stability- %	24 hr	max 1
Demulsibility-%	35ml 0.02N CaCl ₂ (a)	min 60
Sieve Test- %		max 0.10
Residue by Distillation- %		min 55
Naphtha Portion- % by Volume	(500°F Dist.) (b)	max 3

Tests on Residue From Distillation Test:

Penetration	77°F, 100g, 5 sec	min 60
Viscosity -P	140°F	min 1600
Ductility- cm	77°F, 5 cm/min	min 40
Solubility- %	in trichloroethylene	min 97.5

(a) The demulsibility test shall be made within 30 days from the date of shipment.

(b) When RS-1 has been modified to include naphtha, the 24-hour storage stability test will be waived.

EMULSION PRIME (RS TYPE)

Test	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	77°F	min 75
Storage Stability- %	24 hr	max 1.0
Sieve Test- %		max 0.1
Naphtha Content- % by volume		5 / 15
Residue- %		min 55

Tests on Residue:

Penetration	77°F, 100g, 5 sec	min 50
Viscosity- P	140°F	min 800
Solubility-%	in trichloroethylene	min 97.5

*Residue by distillation shall be in accordance with AASHTO T 59 except that the maximum temperature shall be 329°F ± 10°F (165°C ± 5°C) and the sample shall be maintained at this temperature for 20 minutes.

EPR-1 PRIME

Tests	Conditions	Min/Max
Tests on Emulsion:		
Saybolt Furol Visc.- sec	77°F	6 / 24
Sieve Test- % (a)		max 0.1
Residue by Distillation- % (b)		min 15
Particle Charge Test (c)		Positive
Tests on Residue: (d)		
Flash Point- °F	COC	min 410
Viscosity- cSt	140°F	190/350
Aniline Point- °F		85/110

- (a) Distilled water shall be used in place of 2% sodium oleate solution.
- (b) Residue by distillation shall be in accordance with AASHTO T 59 with the exception that a 50 g sample is heated to 149°C (300°F) until foaming ceases, then cooling immediately and calculating results.
- (c) Caution: this material has a positive particle charge, and therefore should not be mixed with materials having a negative particle charge.
- (d) Residue by distillation shall be in accordance with AASHTO T 59 except that the maximum temperature shall be 329°F ± 10°F (165°C ± 5°C) and the sample shall be maintained at this temperature for 20 minutes.

916-4.2 Sampling and Certification. For each tank of emulsified asphalt delivered to or prepared at the asphalt terminal, the asphalt supplier shall submit a sample to the State Materials Office for testing before use. A pretest number will then be assigned by the State Materials Office which shall be furnished with all emulsified asphalt delivered to the project.

For all emulsion prime (EPR-1) delivered directly to the project for use, the supplier shall furnish a certification indicating compliance with all the specification requirements for EPR-1 Prime. When the EPR-1 is shipped to the Contractor in concentrated form, the supplier shall furnish a certification indicating compliance with all the specification requirements for EPR-1 Prime for each batch of material when blended with the appropriate amount of water. The Contractor shall blend the concentrate EPR-1 with the appropriate amount of

water indicated by the supplier prior to use as a prime coat, and for each distributor load of material delivered to the project, shall furnish a certification indicating compliance with the supplier's requirements for blending along with a copy of the supplier's certification for the concentrate. In the event that the diluted EPR-1 Prime is not used in a 12-hour period, the material shall be thoroughly mixed by circulation or other suitable means prior to its use.

ASPHALTIC CONCRETE - LATEX ADDITIVE.

PAGE 658. The following new Section is inserted after Section 917:

SECTION 918 **ASPHALTIC CONCRETE - LATEX ADDITIVE**

918-1 Description.

This work involves the placing of asphaltic concrete mixtures using a latex modified asphalt binder in accordance with all applicable requirements of the Standard Specifications and the Special Provisions. Asphaltic concrete mixtures using a latex modified asphalt binder shall be placed in areas as shown on the plans.

918-2 Materials.

Latex Additive: The Latex additive shall conform to the following specifications:

Ionic Character	Anionic
Total Solids (wt. percent)	69 ± 0.5
pH	10.5 ± 0.5
Viscosity (Brookfield RVT No. 3 Spindle, 20 rpm)cp	1000-2500
Pound/Gallon	7.95 ± 0.5
Monomer Ratio percent (Styrene/Butadiene)	$24/76 \pm 1.0$

The Contractor shall furnish vendor's certified test reports for each transport, or equivalent, of latex additive shipped to the project. The report shall be delivered to the Engineer before permission is granted for the use of the material. The furnishing of the vendor's certified test report for the latex additive shall not be interpreted as a basis for final acceptance. All such reports shall be subject to verification by testing sample materials as received for use on the project.

Three percent Latex Solids (4.3 percent Latex Emulsion), by weight of asphalt cement binder material, shall be added to the asphaltic concrete mixture in accordance with the following:

Batch and continuous mix plants: The introduction of the latex shall begin within five seconds of the wet mix portion of the mixing cycle, and be continued

simultaneously with the asphalt spray operation. The minimum wet mixing time shall be 50 seconds.

Drum mix plant: The latex shall be introduced into the drum mixer along with the asphalt or at a point just downstream from the point where the asphalt cement is introduced.

The metering device for the latex additive must be accessible to the plant operator and the accuracy of the meter must be approved by the Engineer prior to the start of production.

The target temperature established for the latex modified asphaltic concrete mixture shall be 290 degrees F for FC-2 and 320 degrees F for FC-3 and Type S Asphaltic Concrete mixtures. Any change in this target temperature must be approved by the District Bituminous Engineer.

NOTE:

- 1) Every effort shall be made to minimize hand work.
- 2) Rolling shall be completed before the mat has cooled to a temperature that will prevent proper compaction. A small amount of liquid detergent may be added to the water in the roller to reduce adhesion to the drum.
- 3) At intersections and in other areas where the pavement may be subjected to cross traffic before it has had a chance to cool, the pavement shall be cooled by spraying water onto the surface immediately after rolling is completed. The method of artificial cooling shall be done in the shortest possible time to minimize a disruption of traffic.

918-3 Payment.

The quantity of latex material will not be paid for directly, but shall be included in the asphaltic items of the contract.

When the approved mix design of a mix containing latex indicates that the asphalt content is different from that shown in 331-6.4, a price adjustment will need to be made not only to compensate for the variation in the amount of asphalt cement used, but also to compensate for the variation in the amount of latex used. Adjustments to the bid prices of the mix by the square yard or by the ton will be based on the Unit Cost/lb. of Latex Residue plus ten percent.

Latex Adjustment:

$$\$/s.y. = \frac{(AC_{Design} - AC_{Table})}{100} \times t(inch) \times \frac{100 lb.}{s.y. inch} \times 0.03 \times UCLR \left(\frac{\$}{lb.} \right) \times 1.1012$$

$$\$/s.y. (FC-2) = \frac{(AC_{Design} - AC_{Table})}{100} \times Avg.Spread \left(\frac{lb.}{s.y.} \right) \times 0.03 \times UCLR \left(\frac{\$}{lb.} \right) \times 1.10$$

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$$\$/ton = \frac{(AC_{Design} - AC_{Table})}{100} \times 2000 \frac{lbs.}{ton} \times 0.03 \times UCLR \left(\frac{\$}{lb.} \right) \times 1.1014$$

Where:

- AC_{Design} - AC Content as shown on approved mix design (%).
- AC_{Table} - AC Content shown in 331-6.4 (%)
- t - Plan thickness (in.).
- UCLR - Unit Cost of Latex Residue (\$/lb.)
- Avg. Spread - Average Spread Rate for Project (lb./s.y.)

The Unit Cost/lb. of Latex Residue is based on the Contractor's invoice.

GROUND TIRE RUBBER FOR USE IN RUBBER MODIFIED ASPHALT BINDER.

PAGE 6.58. The following new Section is inserted after Section 917:

SECTION 919
GROUND TIRE RUBBER FOR USE IN RUBBER MODIFIED ASPHALT BINDER

919-1 DESCRIPTION.

This specification governs ground tire rubber for use in rubber modified asphalt binders for use in a variety of paving applications.

919-2 GENERAL REQUIREMENTS.

The ground tire rubber shall be produced by ambient grinding methods. The rubber shall be sufficiently dry so as to be free flowing and to prevent foaming when mixed with asphalt cement. The rubber shall be substantially free from contaminants including fabric, metal, mineral, and other non-rubber substances. Up to four percent (by weight of rubber) of talc (such as magnesium silicate or calcium carbonate) may be added to prevent sticking and caking of the particles.

919-3 PHYSICAL REQUIREMENTS.

919-3.1 Gradation. The sample shall be tested in accordance with FM 1-T 027 (AASHTO T 27) with the following exceptions: a 100g sample size and up to 25% dusting agent (talc). (Rubber balls may also be used to aid in the sieving of finely ground rubber.) The resulting rubber gradation shall meet the gradation limits shown in Table 919-1 for the type of rubber specified.

919-3.2 Specific Gravity. The specific gravity of the rubber shall be 1.15 ± 0.05 when tested in accordance with ASTM D-297, pycnometer method.

919-3.3 Moisture Content. The moisture content shall be determined in accordance with AASHTO T 255 with the exception that the oven temperature shall be 140 ± 5 °F and the weight of the sample shall be 50 ± 0.1 g. The moisture content shall not exceed 0.75% by weight.

919-3.4 Metal Contaminants. No more than 0.01% metal particles shall be detected when thoroughly passing a magnet through a 50g sample.

919-4 CHEMICAL REQUIREMENTS.

The chemical composition of the ground tire rubber shall be determined in accordance with ASTM D 297 and shall meet the following requirements:

Acetone Extract - Maximum 25 percent.

Rubber Hydrocarbon Content - 40 to 55 percent.

Ash Content - Maximum 8 percent.

Carbon Black Content - 20 to 40 percent.

Natural Rubber - 16 to 34 percent.

10 percent for Type A rubber.

919-5 PACKAGING AND IDENTIFICATION REQUIREMENTS.

The ground tire rubber shall be supplied in moisture resistant packaging such as either disposable bags or other appropriate bulk containers. Each container or bag of ground tire rubber shall be labeled with the manufacturer's designation for the rubber and the specific type, maximum nominal size, weight and manufacturer's batch or lot designation.

919-6 CERTIFICATION REQUIREMENTS.

The manufacturer of the ground rubber shall furnish the Engineer certified test results covering each shipment of material to each project. These reports shall indicate the results of tests required by this specification. They shall also include a certification that the material conforms with the specification, and shall be identified by manufacturer's batch or lot number.

**Table 919-1
Gradations Of Ground Tire Rubber**

Sieve Size % Passing	Type A	Type B	Type C
10	-	-	100
20	-	100	85-100
30	-	95-100	40-65
40	100	85-100	20-45
60	98-100	30-60	-
80	90-100	15-40	5-20
100	70-90	5-25	-
200	35-60	-	-

**SECTION 921
PORTLAND CEMENT**

921-2 BASIC SPECIFICATIONS. The text is deleted and the following substituted:

The cement used shall conform to the requirements of the AASHTO Designations and additional requirements as stated below:

Acceptance of cement shall be based on manufacturer's certified mill analysis of test results meeting the specification limits of the AASHTO Designation for the particular type.

Certification of these test values shall be provided to the District Materials Office and corresponding samples for independent assurance shall be provided upon request.

The term "Purchaser", as contained in the AASHTO Specifications, shall be taken to mean the Department.

ADMIXTURES FOR CONCRETE.

SECTION 924 (Pages 661-663) is deleted and the following substituted:

**SECTION 924
ADMIXTURES FOR CONCRETE**

924-1 DEPARTMENT'S LIST OF PREVIOUSLY QUALIFIED ADMIXTURES.

The Department maintains listings of qualified admixtures for air-entraining, water reducing, and water-reducing and retarding, which have previously been determined as meeting the requirements for use with the Department's work. Admixtures included in such

listing (current at the time of use) will be permitted without further testing at the time. Such listings are on file with Product Evaluation in the Office of Construction at Tallahassee.

The including of any specific product on the Qualified Products List indicates that the product has been given contingent approval, as evidenced by previous tests and apparent effectiveness under field conditions.

Except as specified in Section 346, for any product contained on the Qualified Products List, no further testing will be required at the time of use unless there is indication in actual field use of inadequate or unreliable results, or for other reasons a re-test is considered necessary.

924-2 QUALIFICATION OF ADMIXTURES NOT INCLUDED IN DEPARTMENT'S LISTINGS.

924-2.1 Certification. Manufacturer's of admixtures shall provide certified test results, from an approved laboratory, meeting the specification limits of AASHTO M 154 for air-entraining and AASHTO M 194 for water reducing (Type A) or water reducing and retarding (Type D).

924-2.2 For Air-Entraining. Air-entraining admixtures not on the Department's current listing (as described above) shall meet the requirements of AASHTO M 154 except for the following modifications and exceptions:

- 1.The coarse aggregate shall be grade 57 meeting the requirements of Section 901.
- 2.The fine aggregate shall meet the requirements of Section 902.
- 3.The cement shall meet the requirements of Section 921.
- 4.The flexural strengths, resistance to freezing and thawing, and length change are waived.

924-2.3 For Type A (Water-Reducing) and Type D (Water-Reducing and Retarding). Water-reducing and water-reducing and retarding admixtures not on the Department's current listing shall meet the requirements of AASHTO M 194 for Type A and D, respectively, except for the following modifications and exceptions:

- 1.The coarse aggregate shall be grade 57 meeting the requirements of Section 901.
- 2.The fine aggregate shall meet the requirements of Section 902.
- 3.The cement shall meet the requirements of Section 921.
- 4.The flexural strengths in Table I (AASHTO M 194) and compressive strength at six months and one year are waived.

924-2.4 Contingency of Continued Approval. The continued approval of admixtures allowed for use, as based on the above specification requirements, will also be subject to the contingencies specified in 924-1.

924-3 PERFORMANCE TEST ON AIR-ENTRAINING ADMIXTURES, FOR EFFECT ON STRENGTH OF CONCRETE.

924-3.1 Conditions under which Test is Required. For any air-entraining admixture selected for use the Engineer may call for a performance test (either prior to or at any time during construction), for determining its effect on the strength of the concrete. In general, this check-test will be required only when there is indication that such admixture is giving erratic results or is unduly reducing the strength of the concrete. Testing shall be in accordance with 924-3.2 and 924-3.3.

924-3.2 Permissible Reduction in Strength of the Concrete. For concrete composed of the same cement and aggregates (and in the same proportions) to be used in the work, and containing the admixture under test, in an amount sufficient to produce between three and five percent entrained air in the plastic concrete, the compressive strength at seven days shall be at least 90 percent of the strength of the same concrete without the admixture.

924-3.3 Method of Test for Strength Reduction. The percentage reduction in strength shall be calculated from the average strength of at least three standard 6-inch by 12-inch cylinders of each class of concrete. Specimens shall be made and cured in the laboratory in accordance with AASHTO T 126, and shall be tested in accordance with AASHTO T 22. The percentage of entrained air shall be determined in accordance with AASHTO T 152 or AASHTO T 196.

924-4 RETESTING.

For approved water-reducing, and water-reducing and retarding admixtures which, due to indication of giving erratic results, are required to be retested, as specified in 924-1, such retesting shall be in accordance with the following procedure. The admixture shall be checked for comparison between infrared spectrophotometry, pH value and solids content. Any marked variation from the original curve, pH value or solids content will be considered sufficient evidence that the chemistry of the original material has been changed and, therefore, the use of this material will be rejected and the material removed from the Qualified Products List.

SECTION 925 **CURING MATERIALS FOR CONCRETE**

925-2 MEMBRANE CURING COMPOUND. The text is deleted and the following substituted:

925-2.1 General. Membrane curing compound shall conform to requirements of AASHTO M 148 (Type 1 for clear compound and Type 2 for white-pigmented compound), and the following additional requirements:

The membrane curing compound shall be of a consistency suitable for spraying at

temperatures prevalent at the time of construction operations, and which forms a continuous, uniform film. It shall be free from precipitated matter caused by conditions of storage or temperature. The compound shall be relatively nontoxic.

Curing compound delivered to the job in drums shall be in the manufacturer's original container, labeled with the manufacturer's name, plant location, grade designation of compound, lot number, and quantity.

Curing compound delivered in bulk shall be supplied from and delivered to storage tanks designed to provide thorough agitation by means of compressed air. Thorough agitation shall be performed prior to shipment from manufacturer's plant and prior to use at job site.

925-2.2 Sampling. Samples shall be obtained as specified in AASHTO M 148. Filled containers, represented by the sample(s) shall be sealed and marked by the sampling agency for later identification and correlation. Each sample shall be at least one quart. If the compound has been pretested, only an information card need be submitted. Fourteen days shall be allowed after arrival of the sample at the laboratory for completion of the tests.

925-2.2.1 Drum Shipment. At least one sample representing each 40 drums (2200 gal.), or fraction thereof, shall be taken for testing.

925-2.2.2 Bulk Shipment. At least three samples representing 6000 gallons, or fraction thereof, shall be taken for testing.

925-2.2.3 Storage. Curing compound that has been tested and stored for longer than six months but less than one year shall be retested prior to use. Compound that has been stored longer than one year shall not be incorporated into the work.

SECTION 926 EPOXY COMPOUNDS

926-1 TYPES OF COMPOUNDS. The subparagraph headed "Type J" is deleted and the following substituted:

Type J - An epoxy for installing rebar and anchor bolts into hardened concrete.

926-11 SPECIFIC REQUIREMENTS FOR TYPE J COMPOUNDS. The text is deleted and the following substituted:

926-11.1 General. Epoxies for installing rebar and anchor bolts into the hardened concrete may be either capsule, cartridge or pourable type. These adhesives will be approved on the basis of satisfactory performance contained in the field test reports provided by the manufacturer.

The manufacturer of the epoxy compound shall certify that the product intended for use meets all requirements for pull out and shear in accordance with 926-19.

926-11.2 Option Permitted without Submittal Data. Unless otherwise prohibited by the plans or specifications and where the embedment is specified, an adhesive anchor system (Epoxy Bonding Compound Type J), listed on the Qualified Products List as Class IV, may be used for installing reinforcing bars or anchor bolts. This adhesive anchor system may be provided without submittal data, subject to the Engineer's approval. The bars or bolts shall be installed in strict accordance with the manufacturer's requirements with the exception that the diameter of the hole shall not be more than 1/8 inch larger than the outside diameter of the bar or bolt.

**FLY ASH, SLAG AND OTHER POZZOLANIC
MATERIALS FOR PORTLAND CEMENT CONCRETE.**

PAGE 672. The following new Section is inserted after Section 927:

SECTION 929
FLY ASH, SLAG AND OTHER POZZOLANIC
MATERIALS FOR PORTLAND CEMENT
CONCRETE

929-1 GENERAL REQUIREMENTS.

929-1.1 Fly Ash. Fly ash shall meet the requirements of ASTM C 618 for Class C or Class F. Sampling and testing shall follow the requirements of ASTM C 311.

929-1.2 Slag. Slag shall meet the requirements of ASTM C 989. Sampling and testing procedures shall follow the requirements of ASTM C 989.

929-2 BASIS FOR SOURCE APPROVAL.

929-2.1 Fly Ash. The fly ash supplier shall submit certified test reports from an approved laboratory certifying that the fly ash conforms to this Specification and was obtained from the residue of an electric generating plant using only ground or powdered coal. The fly ash supplier shall utilize a Quality Control Plan approved by the State Materials Office.

The approved laboratory shall be inspected by Cement and Concrete Reference Laboratory as a fly ash testing laboratory and shall have corrected any deficiencies noted at the time of inspection. The laboratory must authorize Cement and Concrete Reference Laboratory to send a copy of the inspection report to the State Materials Office.

929-2.2 Slag. The slag manufacturer shall furnish, at the time of shipment, certification of test results from samples of the material taken during production or transfer, and certifying compliance to applicable requirements of ASTM C 989. The slag manufacturer shall also state in writing the nature, amount and identity of any processing or other additions made to the slag.

929-3 SPECIAL REQUIREMENTS.

929-3.1 Fly Ash (Class C). When a Class C fly ash is used in moderately or extremely aggressive environments, tests made by the supplier shall verify improved sulfate resistance, according to ASTM C 1012, and improved corrosion protective properties, measured by Florida test method FM 5-522, of the concrete as compared to similar concrete without the fly ash. No mix designs will be approved in advance of satisfactory completion of such test.

929-3.2 Slag. Only Ground Granulated Blast-Furnace Slag Grade 100 or better (28 day Index) will be permitted.

929-4 EXCEPTIONS.

Fly ashes shall not be used in conjunction with Type IP or Type IS cements. Slag shall not be substituted for a portion of the Type IP or IS cements or for Portland Cement in high early strength concrete.

929-5 ACCEPTANCE TESTING.

929-5.1 Fly Ash. Acceptance of fly ash shall be based on certified test reports meeting the chemical (Supplementary Optional included) and physical requirements of ASTM C 618. When the loss on ignition exceeds five percent, the Uniformity Requirements in the Supplementary Optional Physical Requirements shall be mandatory. These tests shall be made for each lot, not to exceed 400 tons per lot.

929-5.2 Slag. Acceptance of slag shall be based on certified test reports meeting the chemical and physical requirements of ASTM C 989. Reference Cement used for determination of Slag Activity shall meet the requirements of ASTM C 989.

Certification of these tests shall be provided to the District Materials Office and corresponding samples for independent assurance tests shall be provided upon request. These tests shall be made for each lot, not to exceed 400 tons per lot.

SECTION 931
METAL ACCESSORY MATERIALS
FOR CONCRETE PAVEMENT AND
CONCRETE STRUCTURES

931-1.1 Steel Bars is expanded by the following:

Acceptance of reinforcing steel shall be based on test samples taken by the Department and manufacturer's certified mill analysis of test results meeting the specification limits of the ASTM or AASHTO designation for the particular size, grade and any additional

requirements. Test samples and certification of these test values, representing each production lot of reinforcing steel, shall be provided to the Engineer for each Contract prior to use.

SECTION 932
NONMETALLIC ACCESSORY MATERIALS FOR
CONCRETE PAVEMENT AND CONCRETE
STRUCTURES

932-1.2 Joint Sealer for Pavement and Structures. The text is deleted and the following substituted:

932-1.2.1 General.

This specification covers joint sealer intended for use in sealing joints in asphalt and concrete pavements. These materials may also be used to seal joints in concrete bridges and other structures.

932-1.2.2 Material.

The material shall meet the requirements of either ASTM D 1190 (Concrete Joint Sealer, Hot-Poured Elastic Type), ASTM D 1850 (Concrete Joint Sealer, Cold-Application) or ASTM D 3405 (Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements).

932-1.2.3 Sampling and Certification.

The manufacturer shall furnish, directly to the State Materials Engineer at Gainesville, six certified copies of his test reports for each lot of material furnished to each project. These reports shall indicate the results of test required by this specification. They shall include a certification that the materials conform with this specification, and shall be identified by project number and manufacturer's batch number.

Each certification shall cover only one type of material. Due to the wide range of application of the products within some types, the manufacturer shall additionally certify that his product is recommended for that stated use for that specific project.

Samples shall be furnished for testing in such size and number as directed by the Engineer.

932-1.2.4 Qualified Products List.

The joint sealant used shall be one of the products included on the Qualified Products List on file with the Office of Construction current at the time of the sealant's proposal for use.

Manufacturers or distributors seeking approval of their material in accordance with this specification shall demonstrate the performance of their products in accordance with Florida Test Methods FM 5-532 or FM 5-533.

932-1.2.5 Shipment.

The material shall be delivered in containers plainly marked with the manufacturer's name or trademark product name, lot number and date of expiration.

932-1.2.6 Bond Breaker Rod.

The bond breaker rod shall be a closed cell, expanded polyethylene foam rod of the size and dimensions shown on the plans. It shall be compatible with the joint sealant and no bond or reaction shall occur between the rod and the sealant.

All bond breaker rods installed shall be covered by a sealant at the end of each work day.

Bond breaker tape approved by the sealant manufacturer may be used in lieu of bond breaker rod when sealing random cracks.

932-2.2.3 Neoprene Pads. The last sentence of the second paragraph is deleted and the following substituted:

The steel reinforcement in the composite pads shall satisfy the requirements of AASHTO M 251.

932-2.2.11 Bearing Tests and Acceptance Criteria. The first sentence of the twelfth paragraph is deleted and the following substituted.

After completion of pad production, the Contractor shall allow the Department 14 days for selecting the pads to be tested after notification.

SECTION 933 ACCESSORY MATERIALS FOR PRESTRESSED CONCRETE

933-1 CABLES FOR PRETENSIONING is expanded by the following:

The stabilized strand (low-relaxation strand) shall have identification marks applied at the manufacturing plant. The identification marks shall be color coded and applied at intervals not exceeding 100 feet.

933-5.2 Cables, Wires and Wire Anchorages. The first paragraph is deleted and the following substituted:

Acceptance of cables, wires and wire anchorages shall be based on manufacturer's certified mill analysis of test results meeting the specification limits of ASTM or AASHTO as specifically designated.

WIRE ROPE FOR FENDER PILE CLUSTER.

PAGE 692. The following new Section is inserted after Section 933.

SECTION 936
WIRE ROPE FOR FENDER PILE CLUSTER

936-1 DESCRIPTION.

This Section covers the material requirements for wire rope for Fender Pile Clusters.

936-2 SPECIFIC REQUIREMENTS.

Unless otherwise shown on the plans, galvanized aircraft quality wire rope with ultraviolet ray resistant polypropylene impregnation shall be used. The polypropylene plastic shall form a wall of protection by using spacer wires in the outer gallery of each strand and shall be effectively bonded to the outer plastic jacket. The rope diameter shall be 1/2 inch and the outside diameter of the covering 5/8 inch. The rope construction shall be 6x19 independent wire rope core with nominal strength of 22,800 pounds. All ends shall be protected with heat shrinkable end caps, compatible with the rope's polypropylene. The caps shall provide an effective water-tight seal and shall be installed in accordance with the manufacturer's instructions. The rope shall conform to Federal Specifications W83420 for aircraft quality and the protective coating shall conform to ASTM A 475 (Type 1 coating).

SECTION 941
CONCRETE PIPE
(For Culvert and Underdrains)

941-1.2 Specific Requirements. The first paragraph is deleted and the following substituted:

Standard Concrete Pipe shall meet the design requirements of Class II (of ASTM C-76), unless otherwise specified in the plans. Special Concrete Pipe shall meet the requirements Class III, Class IV or Class V as specified.

941-1.3(a) Modifications to ASTM C 76. The text is deleted and the following substituted:

The materials used in concrete must be certified from the source and shall conform to the following:

- (1) Portland Cement..... Section 921
- (2) Fine Aggregate..... Section 902

- (3) Coarse Aggregate..... Section 901
- (4) Water..... Section 923
- (5) Admixtures.....ASTM C 494
- (6) Fly Ash..... Section 929
- (7) Blended Hydraulic Cements.....AASHTO M 240

The gradation requirements for concrete aggregates as set forth in Sections 901 and 902 shall not apply.

941-1.6 Special Requirements for Pipe Joints when Profile Rubber Gaskets are used:

When profile rubber gaskets are to be installed in the pipe joints, the gaskets shall be considered to be the sole element relied on to maintain a tight joint. However, a filter fabric jacket shall also be used as specified in 430-7.1.1. The joint design shall meet the requirements set forth in article 7 of ASTM C 443.

941-2 ELLIPTICAL CONCRETE PIPE - PROFILE RUBBER GASKETS is expanded by the following:

When profile rubber gaskets are to be installed in the pipe joints, the gaskets shall be considered to be the sole element relied on to maintain a tight joint. However, a filter fabric jacket shall also be used as specified in 430-7.3. The joint design shall meet the requirements set forth in article 7 of ASTM C 443.

SECTION 942 PIPE GASKETS

942-1 ROUND RUBBER GASKETS FOR PIPE JOINTS. In the third line of the first paragraph, reference to "Article 5.9 of ASTM C 361" is changed to "Article 6.9 of ASTM C 361".

SECTION 942 is expanded by the following new ARTICLES:

942-3 RESILIENT CONNECTORS FOR SEALING PRECAST STRUCTURES TO PIPE JOINTS.

942-3.1 General. Resilient connectors shall meet the requirements of ASTM C 923 with the modification that a hydrostatic pressure test up to 6.0 psi without leakage will suffice. The connectors shall also be compatible with the precast structure and pipe.

942-3.2 Certification Requirements. The Contractor shall provide three certified copies of test reports and certification from the manufacturer that the material furnished meets all requirements of ASTM C 923 with the modification that a hydrostatic pressure test up to 6.0 psi without leakage will suffice. Certifications shall be sent directly to the State Materials

Engineer at Gainesville.

942-3.3 Qualified Products List (QPL). The resilient connector used shall be one of the products included on the Qualified Products List maintained by the Office of Construction, current at the time of the products proposal for use.

942-4 PROFILE RUBBER GASKETS FOR PIPE JOINTS.

(a) Round Pipe: The gaskets shall meet the requirements specified in Article 6.9 of ASTM C 361.

(b) Elliptical Pipe: The gaskets shall meet the requirements specified in Article 6.1.1 of ASTM C 443.

Additionally, the gaskets used shall be of such cross sectional area and perimeter as to properly fit the space provided in the pipe joint in which it is to be used.

The gaskets shall be stored in as cool a place as practicable prior to use.

SECTION 943
CORRUGATED STEEL PIPE
AND PIPE ARCH
(Including Underdrain)

943-2 ROUND CULVERT PIPE is expanded as follows:

In addition to the 2 rib pattern, a 3 rib pattern will be permitted in accordance with the following revisions to AASHTO M 36:

Section 7.2.2: For Type IR (Spiral Rib) Pipe, both 2 and 3 rectangular ribs per sheet width will be accepted. When a 3 rib pattern is furnished, the ribs shall be a nominal 3/4 inch deep and 3/4 inch wide at approximate 7 1/2 inch spacing.

SECTION 948
MISCELLANEOUS TYPES OF PIPE

948-1.5 Underdrain. The text is deleted and the following substituted:

Polyvinyl-chloride pipe for use as underdrain shall conform to the requirements of ASTM F 758 or ASTM F 949. Also, PVC underdrain manufactured from PVC pipe meeting ASTM D 3034, perforated in accordance with the perforation requirements given in ASTM F 758 and ASTM F 949 will be permitted.

948-1.6 Edgedrain. The text is deleted and the following substituted:

Polyvinyl-chloride pipe for use as edgedrain shall conform to the requirements of ASTM F 758, ASTM F 949, or ASTM D 3034. PVC edgedrain pipe manufactured from PVC pipe meeting ASTM 3034 shall be perforated in accordance with the perforation requirements given in ASTM F 758 or ASTM F 949. Additional perforations will be required as indicated on Roadway and Traffic Design Standards, Index No. 286.

948-2.4 Filter Fabric Sock. The third paragraph is deleted and the following substituted:

The knitted fabric sock shall comply with the physical properties described on Standard Index Drawing 199.

SECTION 949
BRICK AND CONCRETE MASONRY
UNITS FOR MANHOLES, INLETS
AND OTHER STRUCTURES

949-2 CONCRETE BRICK. Reference to concrete brick Grade P-II is changed to Grade S-II.

SECTION 954
TIMBER FENCE POSTS AND BRACES

954-1 TIMBER FENCE POSTS AND BRACES. The first paragraph is deleted and the following substituted:

Timber fence posts and braces shall be of southern yellow pine and shall be treated in accordance with Section 955.

SECTION 962
STEEL AND OTHER FERROUS
METALS AND METAL ITEMS

962-7 GALVANIZING STRUCTURAL STEEL AND ACCESSORIES is deleted and the following substituted:

962-7.1 Fasteners. Bolts, nuts, washers and other fastener items shall be galvanized in accordance with the requirements of ASTM A 153. When zinc coating is required by the plans or special provisions for high strength bolts, nuts and washers, the supplier has the option of furnishing either hot-dip galvanized (Class C of ASTM A 153) or mechanically deposited zinc coated (Class 50 of ASTM B 695) products unless the specific process is called for in the plans or specifications. The bolt, nut and washer used in the fastener assembly shall be coated by the same process, i.e., hot-dip or mechanically deposited. After erection, the bolts, nuts, and washers shall be cleaned of all oil and deleterious material and then painted according to the written recommendations of the manufacturer of the structural steel zinc primer paint.

962-7.2 Shapes, Plates, Bars and Strips. Zinc coatings applied by dipping in a molten bath of zinc onto structural steel articles or products fabricated from structural steel shapes, plates, bars, and strips 1/8 inch thick and heavier, shall conform to the requirements of ASTM A 123, A 143 and A 384, except as follows:

(a) When dipping in a molten bath of zinc produces detrimental effects such as distortion, warpage and embrittlement to the steel which has been designated in the plans to be used, the Contractor shall select an alternate grade of steel suitable for fabrication and galvanizing without detrimental effect.

(b) When the Contractor selects an alternate grade of steel to that designated in the plans he shall submit his selection together with appropriate redesign computations to the Engineer for approval.

(c) Redesign computations to accommodate the substitution of an alternate grade steel shall demonstrate that the finished product is equal to or better, in all respects, than the original design.

Mechanical galvanizing shall be permitted when the materials specified in the plans or specifications are of the type which can be mechanically galvanized with no detrimental effects on the material. When mechanical galvanizing is utilized, the process shall be in accordance with ASTM B 695 unless otherwise required by the plans and specifications. Chromate treatment shall not be used unless specifically required in the plans or special provisions.

962-8 GRAY-IRON CASTINGS (INCLUDING FRAMES AND GRATES). The second sentence is deleted.

SECTION 965
GENERAL PROVISIONS FOR
ALUMINUM ITEMS
(Including Welding)

965-3 WELDING ALUMINUM SIGN STRUCTURES. In the second line of the text, reference to "Section 10" is changed to "Section 5".

SECTION 966
METAL FENCING MATERIALS

966-1.2 METAL FENCING MATERIALS. The first paragraph is expanded as follows:

An alternate coating of 0.9 ounce per square foot of zinc-five percent aluminum-mischmetal meeting the requirements of ASTM F 1234, Type C, may be used on steel "C" posts.

INDEX NO. 452 (Sheet 1 of 2, Roadway and Traffic Design Standards, dated January 1992). General Note No. 4.A. (6) is deleted and the following substituted:

(6) Steel C - 1 7/8" x 1 5/8" : Gal. 1.8 oz/sf or 0.9 oz/sf zinc-aluminum-mischmetal: AASHTO M 111 and Detail.

966-2.1 Fabric. The first paragraph is deleted and the following substituted:

The fabric for Type A fencing shall be woven-wire, either galvanized steel, meeting the requirements of ASTM A 116, No. 9 Farm, Design Number 1047-6-9, with Class 3 zinc coating, or aluminum coated steel, meeting the requirements of ASTM A 584, No. 9 Farm, Design Number 1047-6-9, with a minimum coating weight of 0.40 ounce per square foot.

SECTION 967
RAIL ELEMENTS FOR GUARDRAIL

967-1 STEEL GUARDRAIL is expanded by the following:

Acceptance of steel guardrail materials shall be based on manufacturer's certified mill analysis of test results meeting the specification limits of the ASTM or AASHTO designation as stated above. Certification of these test values, representing each shipment of

guardrail materials, shall be provided to the Engineer for each project.

SECTION 971 PAINT MATERIALS

971-8 SHOP COAT AND TOUCH-UP PRIMER FOR GRATING is deleted and the following substituted:

971-8.1 General. The coating used to paint gratings and frames shall be one of the products included on the Qualified Products List maintained by the Office of Construction, current at the time of the products proposal for use.

971-8.2 Composition. The composition of the paint shall be left to the discretion of the manufacturer with the exception of the following requirements:

- a. Lead or chromium pigments shall not be used in the manufacture of the paint.
- b. The volatile organic content (V.O.C.) of the paint shall not exceed 2.8 lbs./gal.

971-8.3 Corrosion Tests. Products submitted for inclusion on the Qualified Products List shall comply with the requirements listed below. Clean cold rolled steel panels (3: x 8: @ 0.032: thick) with two dip coats of paint applied shall be used to conduct the tests.

	Exposure Time	ASTM D 610 Minimum Rust Grade
a. 100% Relative Humidity (75° F to 90° F, ASTM D 2247)	600 hours 8	
b. Inland Test Rack	12 months 8	

Material Safety Data Sheets shall accompany all products submitted for testing.

971-8.4 Samples and Certification of Tests. Paint samples will be obtained in accordance with the Department's sampling, testing and reporting guide schedule. For each batch of paint used, the Contractor shall furnish to the State Materials Engineer three certified copies of test reports that show the following paint analysis data:

- a. Weight per gallon at 77° F (ASTM D 1475).
- b. Volatile organic content (V.O.C.-ASTM D 3960).
- c. Viscosity in Krieb Units at 77° F (ASTM D 562).

- d. Weight percent pigment (ASTM D 3723).
- e. Weight percent total solids (ASTM D 2369).
- f. Drytime to handle and topcoat.
- g. Shelf life.

971-13.11 FAST DRY TRAFFIC PAINT - COMPOSITIONS. The fourth paragraph is deleted and the following substituted:

The yellow pigmented binder shall not contain any lead or chromium compounds. The minimum percent content of yellow pigment shall be provided by the manufacturer.

971-13.15 Test Samples. The text is deleted and the following substituted:

The Contractor or Maintenance Engineer shall submit to the Materials Office, at Gainesville, a one quart sample per color per batch. A batch shall not be less than 3,000 gallons unless requested by the Department. Additional samples may be obtained as deemed necessary by the Engineer. The Department reserves the right to conduct in-plant sampling during the manufacturing of the paint. A batch is defined as the amount of paint manufactured in one mixing operation.

971-14 GLASS SPHERES (for Reflective Traffic Paint). The text is deleted and the following substituted:

971-14.1 General Requirements. This specification is intended to cover glass spheres for use with traffic paint for the production of a reflective surface creating night visibility of the painted markings without altering day visibility of the markings. The spheres shall be of a composition designed to be highly resistant to traffic wear and to the effects of weathering.

The glass spheres shall conform to the requirements of AASHTO M 247, Type I with moisture resistant coating.

971-14.2 Rate of Application. The glass spheres shall be applied at the rate of six pounds of glass spheres per gallon of pigmented binder.

971-14.3 Sampling. A random 50 pound sample of glass spheres shall be obtained for each 10,000 pounds shipped. Upon arrival, the quantity of material will be reduced in a sample splitter to a size of approximately one quart by the Project Engineer.

971-14.4 Containers. The spheres shall be furnished in new 50 pound moisture-proof bags. All containers shall be of the type that will not permit loss of spheres through normal package failure, and shall meet I.C.C. requirements for strength and type.

971-14.5 Certification. Three certified copies of test results showing that the glass spheres will meet the above specifications shall be submitted to the Department's State Materials Engineer, by the manufacturer or the supplier.

SECTION 971 is expanded by the following new ARTICLES:

971-17 THERMOPLASTIC BINDER.

971-17.1 Composition:

	<u>Component</u>	<u>White</u>	<u>Yellow</u>
Min.	Binder	18.0% Min.	18.0% Min.
	Tio2 (ASTM D 476 Type II Ructile)	10.0% Min.	N/A
	Glass Spheres	35.0% Min.	35.0%
	Yellow Pigment	N/A % Minimum	per
Max.	Calcium Carbonate and Inert Filler (-200 Mesh)	37.0% Max.	44.5%
		Manufacturer	

971-17.2 Binders. The manufacturer shall have the option of formulating the material according to his own specifications. However, the physical and chemical properties contained in this specification shall apply regardless of the type of formulation used. The material upon heating to application temperatures shall not exude fumes which are toxic, or injurious to persons or property. The pigment, beads and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt and foreign objects.

971-17.3 Pigment. The yellow pigment used shall not contain any lead or chromium compounds.

971-17.4 Physical Requirements. The meltdown procedure for thermoplastic materials described in this specification shall be done in accordance with ASTM D 4960 and shall have the following requirements:

- (a) Color: The white thermoplastic binder shall be pure white and free from any tint. Using a colorimeter, such as a Gardner Color Difference Meter, the material shall not show deviations from magnesium oxide color standard greater than the following:

Scale <u>Definition</u>	Magnesium Oxide	
	<u>Standard</u>	<u>Sample</u>
RD Reflectance	100	75% Min.
a. Red-Green	0	-5 to +5
b. Yellow-Blue	0	-10 to +10

The color of the yellow thermoplastic binder shall visually match that of Federal Test Standard Number 595-color 13538. The daytime reflectance values and chromaticity coordinates, shall fall within the following limits:

Reflectance	45% Min.			
Chromaticity	Coordinates X,Yshall fall in an area			
X	0.4700	.510	0.490	0.537
y	0.455		0.489	0.432 0.462

bordered by these coordinates:

(b) Water Absorption: When tested in accordance with ASTM D 570, the thermoplastic binder shall contain no more than 0.5 percent by weight of retained water.

(c) Softening Point: When tested in accordance with ASTM D 36, the material shall have a softening point of not less than 90 degrees C.

(d) Low temperature Stress Resistance: A test sample shall not crack or fail to adhere to a concrete substrate when tested in accordance with AASHTO T 250.

(e) Safety: The thermoplastic binder shall not emit fumes which are toxic or otherwise injurious to persons when heated at the manufacturer's recommended application temperature.

(f) Specific Gravity: The specific gravity of the binder, measured by water displacement, shall be between 1.9 and 2.3.

(g) Set Time: When applied at the manufacturer's recommended temperature and thickness of 0.060 inch to 0.125 inch, the binder shall set to bear traffic in not more than two minutes when the temperature is 50 degrees F. \pm 3 degrees and not more than ten minutes when the air temperature is 90 degrees \pm 3 degrees.

(h) Indentation Resistance: The hardness shall be measured by a Shore Durometer, Type A2, as described in ASTM D 2240. The durometer and the panel shall be at 45 degrees C with a two kilogram load applied, the reading shall be between 40 and 75 units after 15 seconds.

(i) Impact Resistance: When tested in accordance with Method A ASTM D 256, the average impact resistance of four separate samples shall not be less than ten-inch pounds.

(j) Flash Point: The thermoplastic binder shall have a flash point not less than 475 degrees F when tested in accordance with ASTM D 92 "Flash and Fire Points by Cleveland Open Cup."

971-17.5 Glass Spheres:

(a) Glass Spheres (Pre-mix) - The glass spheres shall be uncoated and conform to the requirements of AASHTO M 247, Type I.

(b) Glass Spheres (Surface Application) - The glass spheres shall conform to the requirements of AASHTO M 247, Type I with moisture resistant coating.

971-17.6 Application Properties. The thermoplastic binder shall readily apply and adhere to the pavement at temperatures as recommended by the manufacturer from equipment approved by the Engineer to produce a line which shall be continuous and uniform in shape having clear and sharp dimensions at a minimum thickness as identified in the plans. No

signs of moisture shall be visible on the pavement surface as determined in accordance with the binder manufacturer's recommendations.

The binder shall not exude fumes which are toxic, noxious or injurious to persons or property when heated during applications. The manufacturer shall provide material safety data sheets (msds) for the product.

The application of surface glass spheres shall be at a uniform minimum rate of one pound of glass spheres for every ten square feet of line with 50 to 60 percent bead embedment.

The binder, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of the same material. Such new material shall bond itself to the old line in a manner such that no splitting or separation occurs.

971-17.7 Packing and Marking. The thermoplastic binder shall be packed in suitable bio or thermo degradable containers which will not adhere to the product during shipment and storage. The container of thermoplastic binder shall weigh approximately 50 pounds. Each container shall designate the color, binder (alkyd or hydrocarbon), user information manufacturer's name and address, batch number and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall be heated in the range as recommended by the manufacturer.

971-17.8 Storage Life. The thermoplastic binder shall meet the requirements of this specification for a period of one year. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for the one year time period. Any material not meeting these requirements shall be replaced.

971-17.9 Certification of Test. For initial product approval, the producer of the thermoplastic binder shall furnish to the State Materials Engineer a certified test report from an approved independent test laboratory that shows the material meets all the requirements specified. After initial product approval, the producer shall submit copies of this certified test report that are relative to ongoing Contracts. The producer shall submit copies of this test report to both the Contractor and the State Materials Engineer. Final acceptance, however, will be based on tests and verification by the State Materials Office after receipt of thermoplastic compound and glass spheres.

971-19 FAST DRY TRAFFIC PAINT - WATER BORNE.

971-19.1 General. Fast dry traffic paints intended for use under this specification shall include water reducible products that are single packaged and ready mixed. The water reducible traffic paint shall have the capability of being cleaned and flushed from the striping machines using regular tap water and any required rust inhibitors. The water reducible traffic paint shall contain not more than 1.0 pound of volatile organic compounds per gallon (excluding water).

In a dried condition, all of the products designated in this specification with the exception of the leaded yellows shall pass the E.P.A. Toxicity Leaching Test for hazardous waste (40 CFR, Section 261, Appendix II).

971-19.2 No-Tracking Time. The pigmented binders upon actual application to the

pavement surface shall dry to a no-tracking condition for the time intervals, spray orifice paint temperature, and application rates listed below. The no-tracking condition shall be determined by passing over the applied line in a simulated passing maneuver with a passenger car. A line showing no visual deposition of the paint to the pavement surface when viewed from a distance of fifty feet shall be considered non-tracking and conforming to the requirement for field drying conditions.

Paint Type	White	Yellow	Black
Ambient Temp:	10 min.	10 min.	10 min.
120 - 160 °F:	5 min.	5 min.	5 min.
Film Application:	12±2 mils	12±2 mils	10±2 mils
Pavement Surface			
Temp °F:	40 - 140	40 - 140	40 - 140
Relative Humidity:	Less than 85%	Less than 85%	Less than 85%
Glass Bead -per gallon:	6 lbs.	6 lbs.	—

The pigmented binders when applied to the pavement surface at a minimum 12 mil wet film thickness, without glass spheres, shall yield a minimum dry film thickness of 6 mils.

971-19.3 Characteristics of Finished Paint.

<u>Property</u>	<u>Test Method</u>	<u>Min</u>	<u>Max</u>
a. Weight per gallon, lbs	Fed Std 141a	12.0	—
Batch Variation, ± 0.3 lb/gal	Method 4184.1		
b. Consistency, Krebs Units at 77°F	ASTM D 562	85	100
c. Total Solids, % by Weight	ASTM D2369	70	—
d. Pigments, % by Weight	ASTM D3723 Fed Std 141a Method 4041.1	45	55
e. Fineness of Grind, Hegman Units	ASTM D 1210	3.0	—
f. Dry to No Pickup (Minutes) Water reducible Paint (No Beads)	ASTM D 711	—	10
g. Vehicle Solids Percent on Vehicle	—	40	—

$$\frac{\text{total solids \% - pigment \%}}{100 - \text{pigment \%}}$$

h.	Dry Opacity (5 mils wet)	Fed Std 141a Method 4121	.96	--
i.	Bleed Ratio TT-P-85D	Fed Spec	.95	--
j.	Flexibility	Fed Spec TT-P-115D Pass		--
k.	Directional Reflectance After 4 hr. ambient dry and 24 hr. oven dry at 150 °F	Fed Std 141a	84 (white)	
l.	Color, Visual Match	Fed Std 595a White - Color No. 37875 Fed Std 595a Yellow - Color No. 33538 Fed Std 595a Black - Color No. 37038		

971-19.4 Composition. With the exception of the pigment requirements listed below, the composition of the paint shall be left to the discretion of the manufacturer as long as the finished products meet the requirements of all applicable Federal or State regulations. The composition of paint products sold to the Department shall not deviate from the composition of products initially approved per the requirements of this specification. The Department may utilize x-ray analysis, gas chromatography, infrared or ultra violet spectral analysis of the paint or its components to determine conformance.

Pigment Requirements:

- a. The water reducible traffic paint shall contain not less than 1.5 lbs of titanium dioxide pigment (ASTM D 476 type II Rutile) per gallon.
- b. The water reducible traffic paint shall contain not less than 1.0 lb of medium chrome yellow pigment (ASTM D 211 Type III) per gallon. The water reducible (nonleaded yellow) traffic paint shall employ the use of appropriate organic yellow pigments that do not contain lead or chromium.

971-19.5 Abrasion Resistance. Abrasion resistance shall be tested in accordance with and meet all requirements of 971-13.7.

971-19.6 Glass Bead Adhesion. Glass bead adhesion shall be tested in accordance with and meet all requirements of 971-13.8.

971-19.7 Certification of Test. The Contractor or manufacturer shall furnish to the State Materials Engineer three certified copies of test reports for the material described in this specification indicating the material meets all requirements specified.

971-19.8 Qualified Products List (QPL). The materials used for any of the applications described herein shall be one of the products included on the Qualified Products List current at the time of the products proposal for use.

Samples of these materials will be taken in accordance with the Department's Sampling, Testing and Reporting Guide Schedule, and on a random basis at the discretion of the Engineer. If the results of tests performed on these samples indicate failure or significant inconsistencies in material properties, new qualification tests as appropriate for the particular material, and a comparison with original infrared spectrophotometry values will be required.

Any marked variation from original test values for a material or evidence of inadequate field performance of a material will be considered to be sufficient evidence that the properties of the material have changed and the material will be removed from the Qualified Products List.

Manufacturers seeking approval of their product in accordance with this specification shall demonstrate the performance of their products in accordance with Florida Test Method FM 5-40.

GEOTEXTILE FABRICS (PLASTIC FILTER FABRIC).

SECTION 985 (Pages 754-757) is deleted and the following substituted:

SECTION 985 **GEOTEXTILE FABRICS** **(PLASTIC FILTER FABRIC)**

985-1 FABRIC.

985-1.1 General. Geotextiles shall be woven or nonwoven fabrics which allow the passage of water. Impermeable liners and biodegradable fabrics are not included in this specification. Fabrics used in pavement rehabilitation and waterproofing are included in Sections 518 and 356.

985-1.2 Application. The applications of geotextile fabrics are divided into the following three main classes:

1. Drainage under all rubble riprap, including cyclopean stone and under gabions; wrapped around drains, pipe joints, and edge-drains; filter behind walls, etc.
2. Erosion Control silt fence and staked silt barrier.
3. Stabilization separator between embankment and soft subsoil, reinforcement and

pipe bedding.

985-2 PHYSICAL REQUIREMENTS.

Except when restricted in the plans or Special Provisions, the geotextile fabric shall be a woven or non woven fabric consisting of long-chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamides or polyvinylidenechloride formed into a stable network such that the filaments or yarns retain their relative position to each other. The base plastic shall contain stabilizers and/or inhibitors to make the filaments resistant to deterioration due to ultra-violet light (except for subsurface and stabilization classification), heat exposure and potential chemically damaging environment. The fabric shall be free of any treatment which may significantly alter its physical properties. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer yarn from pulling away from the fabric. The fabric shall conform to the physical requirements on Roadway and Traffic Design Standard Index No. 199 according to its application.

In addition to the physical requirements, the fabric shall be wrapped in a protective covering which is sufficient to protect it from sunlight, dirt, and other debris during shipment and storage.

985-3 OVERLAPS AND SEAMS.

Overlaps shall be as specified in the plans, Special Provisions or Roadway and Traffic Design Standards for each particular application. In order to reduce overlaps, the geotextile fabric may be sewn together. Seams of the fabric shall be sewn with thread meeting the chemical requirements and minimum seam strength requirements given for the fabric and application as shown on Roadway and Traffic Design Standard Index No. 199.

985-4 CERTIFICATION.

The Contractor shall furnish two certified copies of a test report from the manufacturer certifying that the geotextile to be incorporated into the completed project meets the requirements of this specification. The certified test reports shall be attested by a person having legal authority to bind the manufacturing company. The Contractor shall also furnish two (four-inch by eight-inch) samples of the geotextile for product identification. In addition, the manufacturer shall maintain test records as required by this specification. These records shall be made available to the Department upon request.

SECTION 994 **REFLECTIVE SHEETING**

994-1.2 REFLECTIVE SHEETING - CLASSIFICATION - TYPE III-D

is expanded as follows:

Type III-D: A high performance grade reflective sheeting which contains prismatic lenses which are formed in a transparent, synthetic resin, sealed, and backed with a pressure-sensitive adhesive and liner.

994-2.2 Reflective Intensity. Table 1 is expanded as follows:

Table 1
Minimum SIA Values for Type III-D Reflective Sheeting

Observation Angle (deg.)	Entrance Angle (deg.)	Minimum SIA Candelas per foot - candle per square foot		
		White	Orange	Fluorescent Orange at 90°
0.2	-4	800	450	200
0.2	+30	400	250	120
0.5	-4	200	120	80
0.5	+30	100	70	50

994-2.4 REFLECTIVE SHEETING-COLOR. In the second sentence, reference to AASHTO M 268 is deleted and ASTM D 4956 substituted.

The following CIE Chromaticity Coordinate Limits for Type III-D Reflective Sheeting is added:

Color	1		2		3		4		Reflectance Limit Y (%)	
White	x	.305	x	.355	x	.335	x	.285	min.	40
	y	.305	y	.355	y	.375	y	.325	max.	--
Orange*	x	.583	x	.523	x	.560	x	.631	min.	14
	y	.416	y	.397	y	.360	y	.369	max.	30

*Also for Fluorescent Orange

994-2.15 Reflective Sheeting - Heat Resistance is expanded by the following:

Under no circumstances shall the forced oven drying time exceed two hours for Type III-D Reflective Sheeting.

994-3.2 Reverse Silk-Screen Processing is expanded by the following:

TABLE 2

Minimum SIA Values fo Finished Signs
(Reverse Silk-Screening Process)

Observation Angle (Degree)	Entrance Angle (Degree)	Minimum SIA (Candelas per Foot candle per Square Foot) RED
TYPE III-D		
0.2	-4	160
0.2	+30	80
0.5	-4	40
0.5	+30	20

994-5.2 In-Service Minimum Reflective Intensity is expanded by the following:

TABLE 3

End of Service Life

Color Reflective Sheeting/ Transparent Ink	Minimum SIA		Minimum Predicted Performance Life Years
	Reflective Sheeting	Transparent Ink	
TYPE III-D			
White	640.0	--	7
Orange	360.0	--	3

Fluorescent Orange	160.0	--	3
Red	--	128	7

994-8 REFLECTIVE SHEETING-CONTRACTOR'S LIABILITY is expanded as follows:

After final acceptance of the Contract, the Contractor's liability for the minimum predicted performance life shall be assumed by the Reflective Sheeting Manufacturer and such responsibility for liability shall be contained in the manufacturer's certification.