STATE OF DELAWARE

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You must request a CD from
DelDOT in order to bid.

DEPARTMENT OF TRANSPORTATION

BID PROPOSAL

for

CONTRACT T201612101.01

FEDERAL AID PROJECT NO. STP-N029(5)

CHRISTINA RIVER BRIDGE

NEW CASTLE COUNTY

ADVERTISEMENT DATE: December 19, 2016

COMPLETION TIME: 739 Calendar Days

SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION
DELAWARE DEPARTMENT OF TRANSPORTATION
AUGUST 2001

Bids will be received in the Bidder's Room at the Delaware Department of Transportation's Administration Building, 800 Bay Road, Dover, Delaware until 2:00 P.M. local time **January 24, 2017**

Contract No.T201612101.01
Federal Aid Project No. STP-N029(5)

CHRISTINA RIVER BRIDGE
NEW CASTLE COUNTY

GENERAL DESCRIPTION

LOCATION

These improvements are located in New Castle County more specifically shown on the Location Map(s) of the enclosed Plans.

DESCRIPTION

The improvements consist of furnishing all labor and materials for the Christina River Bridge contract. This project proposes a new multi-modal bridge crossing over the Christina River in order to add another access point to the attractions at the Wilmington River Front and to improve access to and from US 13, I-495 and I-95 and other incidental construction in accordance with the location, notes and details shown on the plans and as directed by the Engineer.

COMPLETION TIME

All work on this contract must be complete within 739 Calendar Days. The Contract Time includes an allowance for 121 Weather Days. It is the Department's intent to issue a Notice to Proceed such that work starts on or about February 28, 2017.

PROSPECTIVE BIDDERS NOTES:

1. BIDDERS MUST BE REGISTERED with DelDOT and request a cd of the official plans and specifications in order to submit a bid. Contact DelDOT at dot-ask@state.de.us, or (302) 760-2031. Bids will be received in the Bidder's Room at the Delaware Department of Transportation's Administration Building, 800 Bay Road, Dover, Delaware until 2:00 P.M. local time January 24, 2017 unless changed via addendum.
2. QUESTIONS regarding this project are to be e-mailed to dot-ask@state.de.us no less than six business days prior to the bid opening date in order to receive a response. Please include T201612101.01 in the subject line. Responses to inquiries are posted on-line at http://www.bids.delaware.gov.
3. THE BID PROPOSAL incorporates a cd containing **Expedite**, **version 5.9a** and its installation file. Bidders are to use the cd provided to enter their bid amounts into the Expedite file. The Expedite bid file must be printed and submitted in paper form along with the cd and other required documents prior to the Bid due date and time.
4. SURETY BOND - Each proposal must be accompanied by a deposit of either surety bond or security for a sum equal to at least 10% of the bid.
5. DRUG TESTING - Regulation 4104; The state Office of Management and Budget has developed regulations that require Contractors and Subcontractors to implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds pursuant to 29 **Del.C.** §6908(a)(6). **Refer to the full requirements by following the below link:**
   http://regulations.delaware.gov/register/september2015/final/19%20DE%20Reg%20207%2009-01-15.htm
   Please note a few of the requirements listed below;
   * At bid submission - submit with the bid a signed affidavit certifying that the Contractor has in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for their Employees that complies with this regulation;
   * Upon DBE participation submission - submit a separate signed affidavit from each DBE Subcontractor certifying they have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for their Employees that complies with this regulation;
   * Two business days prior to contract execution - The awarded Contractor shall provide to DelDOT copies of the Employee Drug Testing Program for the Contractor and each participating DBE firm;
   * Subcontractors - Contractors that employ Subcontractors on the job site may do so only after submitting a copy of the Subcontractor's Employee Drug Testing Program along with the standard required subcontractor information. A Subcontractor shall not commence work until **DelDOT** has approved the subcontractor in writing;

* Testing Report Forms shall be submitted to DelDOT monthly (forms will be provided).
* Penalties for non-compliance are specified in the regulation.

6. SUPPLEMENTAL SPECIFICATIONS to the August 2001 Standard Specifications were issued November 24, 2014 and apply to this project. They can be viewed here. The ***Specifications Note*** document is for the use by the bidders to reference the new numbers to the past numbers used for bidding purposes on previous Department contracts.
7. DBE PROGRAM REQUIREMENTS under 49CFR §26.53(b)(3)(i)(B) change effective January 1, 2017. **Submission of DBE participation information is now required from the lowest apparent bidder no later than five (5) calendar days after bid opening *(formerly 7 days)*.**
8. No RETAINAGE will be withheld on this contract.
9. EXTERNAL COMPLAINT PROCEDURE can be viewed on DelDOT's Website at; http://www.deldot.gov/information/business/, or you may request a copy by calling (302) 760-2555.
10. BREAKOUT SHEETS MUST be submitted either with your bid documents; or within seven (7) calendar days following the bid due date by the lowest apparent bidder. Refer to instructions adjacent to the Breakout Sheets in this document.
11. PROPOSED TRAINEE PLANS - The number of trainees to be trained will be **2**, as listed in the Training Special Provisions within Contract General Notices. The program(s) must be submitted within 10 Calendar Days of notification of apparent low bidder status. Contract Award will not take place until acceptable On-the-Job (OJT) program plans are received by the Civil Rights Group of the Department. Failure of the apparent low bidder to present copies of an acceptable OJT Trainee Programs within ten (10) calendar days of notification of apparent low bidder status, shall create a rebuttable presumption that the bid is not responsive.
12. **Escrow of Bid Documentation** – This Contract requires the submittal and return of legible Bid Documentation as outlined in Section 103.09 of the Standard Specifications for Road and Bridge Construction.
13. **FUEL COST OPTION** - Bidders are advised that a "Diesel Fuel Cost Price Adjustment Option" is included as referenced in Special Provision 763626, and that the form should be completed and submitted with the bid.
14. The following documents have been posted and are part of this Proposal:
    - Health and Safety Plan
    - Deep Mixing Method (DMM)
    - Contaminated Material and Water Management Work Plan

CONSTRUCTION ITEMS UNITS OF MEASURE

English Code	English Description	Multiply By	Metric Code	Metric Description	Suggested CEC Metric Code
ACRE	Acre	0.4047	ha	Hectare	HECTARE
BAG	Bag	N/A	Bag	Bag	BAG
C.F.	Cubic Foot	0.02832	m^3	Cubic Meter	M3
C.Y.	Cubic Yard	0.7646	m^3	Cubic Meter	M3
EA-DY	Each Day	N/A	EA-DY	Each Day	EA-DY
EA-MO	Each Month	N/A	EA-MO	Each Month	EA-MO
EA/NT	Each Night	N/A	EA-NT	Each Night	EA/NT
EACH	Each	N/A	EA	Each	EACH
GAL	Gallon	3.785	L	Liter	L
HOUR	Hour	N/A	h	Hour	HOUR
INCH	Inch	25.4	mm	Millimeter	MM
L.F.	Linear Foot	0.3048	m	Linear Meter	L.M.
L.S.	Lump Sum	N/A	L.S.	Lump Sum	L.S.
LA-MI	Lane Mile	1.609	LA-km	Lane-Kilometer	LA-KM
LB	Pound	0.4536	kg	Kilogram	KG
MFBM	Thousand Feet of Board Measure	2.3597	m^3	Cubic Meter	M3
MGAL	Thousand Gallons	3.785	kL	Kiloliter	KL
MILE	Mile	1.609	km	Kilometer	KM
S.F.	Square Foot	0.0929	m^2	Square Meter	M2
S.Y.	Square Yard	0.8361	m^2	Square Meter	M2
SY-IN	Square Yard-Inch	0.8495	m^2-25 mm	Square Meter-25 Millimeter	M2-25 MM
TON	Ton	.9072	t	Metric Ton (1000kg)	TON
N.A.*	Kip	4.448	kN	Kilonewton	N.A.*
N.A.*	Thousand Pounds per Square Inch	6.895	MPa	Megapascal	N.A.*

*Not used for units of measurement for payment.

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GENERAL NOTICES

SPECIFICATIONS:

The specifications entitled "Delaware Standard Specifications for Road and Bridge Construction, August, 2001", hereinafter referred to as the Standard Specifications; Supplemental Standard Specifications; the Special Provisions; notes on the Plans; this Bid Proposal; and any addenda thereto, shall govern the work to be performed under this contract.

CLARIFICATIONS:

Under any Section or Item included in the Contract, the Contractor shall be aware that when requirements, responsibilities, and furnishing of materials are outlined in the details and notes on the Plans and in the paragraphs preceding the " Basis of Payment" paragraph in the Standard Specifications or Special Provisions, no interpretation shall be made that such stipulations are excluded because reiteration is not made in the "Basis of Payment" paragraph.

ATTESTING TO NON-COLLUSION:

The Department requires as a condition precedent to acceptance of bids a sworn statement executed by, or on behalf of, the person, firm, association, or corporation to whom such contract is to be awarded, certifying that such person, firm, association, or corporation has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with such contract. The form for this sworn statement is included in the proposal and must be properly executed in order to have the bid considered.

QUANTITIES:

The quantities shown are for comparison of bids only. The Department may increase or decrease any quantity or quantities without penalty or change in the bid price.

EQUALITY OF EMPLOYMENT OPPORTUNITY ON PUBLIC WORKS:

Delaware Code, Title 29, Chapter 69, Section 6962, Paragraph (d), Subsection (7) states;

a. As a condition of the awarding of any contract for public works financed in whole or in part by State appropriation, such contracts shall include the following provisions:

   During the performance of this contract, the contractor agrees as follows:

   1. The contractor will not discriminate against any employee or applicant for employment because of race, creed, color, sex, sexual orientation, gender identity or national origin. The contractor will take positive steps to ensure that applicants are employed and that employees are treated during employment without regard to their race, creed, color, sex, sexual orientation, gender identity or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places available to employees and applicants for employment notices to be provided by the contracting agency setting forth this nondiscrimination clause.

   2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, creed, color, sex, sexual orientation, gender identity or national origin.

   3. The contractor will ensure employees receive equal pay for equal work, without regard to sex. Employee pay differential is acceptable if pursuant to a seniority system, a merit system, a system which measures earnings by quantity or quality of production, or if the differential is based on any other factor other than sex.

TAX CLEARANCE:

As payments to each vendor or contractor aggregate $2,000, the Division of Accounting will report such vendor or contractor to the Division of Revenue, who will then check the vendor or contractor's compliance with tax requirements and take such further action as may be necessary to insure compliance.

LICENSE:

A person desiring to engage in business in this State as a contractor shall obtain a license upon making application to the Division of Revenue. Proof of said license compliance to be made prior to, or in conjunction with, the execution of a contract to which he has been named.

SUBCONTRACTOR LICENSE: 29 DEL. C. §6967:

(c) Any contractor that enters a public works contract must provide to the agency to which it is contracting, within 30 days of entering such public works contract, copies of all occupational and business licenses of subcontractors and/or independent contractors that will perform work for such public works contract. However, if a subcontractor or independent contractor is hired or contracted more than 20 days after the contractor entered the public works contract the occupational or business license of such subcontractor or independent contractor shall be provided to the agency within 10 days of being contracted or hired.

DIFFERING SITE CONDITIONS,

SUSPENSIONS OF WORK and SIGNIFICANT CHANGES IN THE CHARACTER OF WORK:

Differing site conditions: During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the contract of if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the contract are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before they are disturbed and before the affected work is performed.

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

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

No contract adjustment will be allowed under their clause for any effects caused on unchanged work.

Suspensions of work ordered by the engineer: If the performance of all or any portion of the work is suspended or delayed by the engineer in writing for an unreasonable period of time (not originally anticipated, customary or inherent to the construction industry) and the contractor believes that additional compensation and/or contract time is due as a result of such suspension or delay, the contractor shall submit to the engineer in writing a request for adjustment within 7 calendar days of receipt of the notice to resume work. The request shall set fourth the reasons and support for such adjustment.

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

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

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

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

If the alterations or changes in quantities significantly change the character of the work under the contract, whether or not changed by any such different quantities or alterations, an adjustment, excluding loss of anticipated profits, will be made to the contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the contractor in such amount as the engineer may determine to be fair and equitable.

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

(A) When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or

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

CONFLICT WITH FEDERAL STATUTES OR REGULATIONS:

Delaware Code, Title 29, Chapter 69, Section 6904, Paragraph (a):

"If any provision of this subchapter conflicts or is inconsistent with any statute, rule or regulation of the federal government applicable to a project or activity, the cost of which is to be paid or reimbursed in whole or in part by the federal government, and due to such conflict or inconsistency the availability of federal funds may be jeopardized, such provision shall not apply to such project or activity."

FEDERAL LABOR AND EMPLOYMENT REQUIREMENTS

Federal Regulation 23 CFR § 635.117(b) Labor and employment, states:

"No procedures or requirement shall be imposed by any State which will operate to discriminate against the employment of labor from any other State, possession or territory of the United States, in the construction of a Federal-aid project."

CONVICT PRODUCED MATERIALS:

(a) Materials produced after July 1, 1991, by convict labor may only be incorporated in a Federal-aid highway construction project if such materials have been:

(1) Produced by convicts who are on parole, supervised release, or probation from a prison or

(2) Produced in a qualified prison facility and the cumulative annual production amount of such materials for use in Federal-aid highway construction does not exceed the amount of such materials produced in such facility for use in Federal-aid highway construction during the 12-month period ending July 1, 1987.

(b) Qualified prison facility means any prison facility in which convicts, during the 12-month period ending July 1, 1987, produced materials for use in Federal-aid highway construction projects.

TO REPORT BID RIGGING ACTIVITIES:

The U. S. Department of Transportation (DOT) operates the below toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

TO REPORT BID RIGGING ACTIVITIES
CALL 1-800-424-9071

NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 11246)

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.

2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

Goals for Minority Participation In Each Trade	Goals for Female Participation In Each Trade
12.3% (New Castle County) 14.5% (Kent & Sussex Counties)	6.9% (Entire State)

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the Executive Order and the regulations in CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4.3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order, and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address, and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed.

4. As used in this Notice, and in the contract resulting from this solicitation, the "covered area" is NEW CASTLE County.

REV. 11-3-80

STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS (EXECUTIVE ORDER 11246)

1. As used in these specifications:

   a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
   b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
   c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
   d. "Minority" includes:
      i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
      ii. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
      iii. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
      iv. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.

3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register in notice form, and such notices may be obtained from any Office of Federal Contract Compliance Program Office or from the Federal procurement contracting offices. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.

5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:

   a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
   b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
   c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.
   d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
   e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
   f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
   g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foreman, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
   h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
   i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
   j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's work force.
   k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

n. Ensure that all facilities and company activities are nonsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.

o. Document and maintain a record of all solicitations of offers for subcontractors from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female work force participating, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is under utilized).

10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.

12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Order of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

13. The Contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director shall proceed in accordance with 41 CFR 60-4.8.

14. The Contractor shall designate a responsible official to monitor all employment-related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government, and to keep records. Records shall at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate

of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, contractors shall not be required to maintain separate records.

15. Nothing herein provided shall be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

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TRAINING SPECIAL PROVISIONS

This Training Special Provision supersedes subparagraph 7b of the Special Provision entitled "Specific Equal Employment Opportunity Responsibilities", (Attachment 1), and is in implementation of 23 U.S.C. 140(a). As part of the contractor's equal employment opportunity affirmative action program, training shall be provided as follows:

The contractor shall provide on-the-job training aimed at developing full journeyman in the type of trade or job classification involved.

The number of trainees to be trained under the special provision will be **2**. In the event the contractor subcontracts a portion of the contract work, he shall determine how many, if any, of the trainees are to be trained by the subcontractor, provided however, that the contractor shall retain the primary responsibility for meeting the training requirements imposed by this special provision. The contractor shall also insure that this Training Special Provision is made applicable to such subcontract. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year apprenticeship or training.

The number of trainees shall be distributed among the work classification on the basis of the contractor's needs and the availability of journeymen in the various classifications within a reasonable area of recruitment. Prior to commencing construction, the contractor shall submit to the Department of Highways and Transportation for approval the number of trainees to be trained in each selected classification and training program to be used. Furthermore, the contractor shall specify the starting time for training in each of the classifications. The contractor will be credited for each trainee employed by him on the contract work who is currently enrolled or becomes enrolled in an approved program and will be reimbursed for such trainees as provided hereinafter.

Training and upgrading of minorities and women toward journeyman status is a primary objective of this Training Special Provision. Accordingly, the contractor shall make every effort to enroll minority trainees and women (e.g., by conducting systematic and direct recruitment through public and private sources likely to yield minority and women trainees) to the extent that such persons are available within a reasonable area of recruitment. The contractor will be responsible for demonstrating the steps that he has taken in pursuance thereof, prior to a determination as to whether the contractor is in compliance with this Training Special Provision. This training commitment is not intended, and not be used, to discriminate against any applicant for training, whether a member of a minority group or not.

No employee shall be employed as a trainee in any classification in which he has successfully completed a training course leading to journeyman status or in which he has been employed as a journeyman. The contractor should satisfy this requirement by including appropriate questions in the employee application or by other suitable means. Regardless of the method used the contractor's records should document the findings in each case.

The minimum length and type of training for each classification will be as established in the training program selected by the contractor and approved by the Department of Highways and Transportation and the Federal Highway Administration. The Department of Highways and Transportation and the Federal Highway Administration shall approve a program if it is reasonably calculated to meet the equal employment opportunity obligations of the contractor and to qualify the average trainee for journeyman status in the classification concerned by the end of the training period. Furthermore, apprenticeship programs registered with the U.S. Department of Labor, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau and training programs approved but not necessarily sponsored by the U.S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training shall also be considered acceptable provided it is being administered in a manner consistent with the equal employment

obligations of Federal-aid highway construction contracts. Approval or acceptance of a training program shall be obtained from the State prior to commencing work the classification covered by the program. It is the intention of these provisions that the training is to be provided in the construction crafts rather than clerk-typists or secretarial-type positions. Training is permissible in lower level management positions such as office engineers, estimators, timekeepers, etc., where the training is oriented toward construction applications. Training in the laborer classification may be permitted provided that significant and meaningful training is provided and approved by the division office. Some off-site training is permissible as long as the training is an integral part of an approved training program and does not comprise a significant part of the overall training.

Except as otherwise noted below, the contractor will be reimbursed 80 cents per hour of training given an employee on this contract in accordance with an approved training program. As approved by the engineer, reimbursement will be made for training persons in excess of the number specified herein. This reimbursement will be made even though the contractor receives additional training program funds from other sources, provided such other sources does not specifically prohibit the contractor from receiving other reimbursement. Reimbursement for off-site training indicated above may only be made to the contractor where he does one or more of the following and the trainees are concurrently employed on a Federal-aid project; contributes to the cost of the training; provides the instruction of the trainee; or pays the trainee's wages during the off-site training period.

No payment shall be made to the contractor if either the failure to provide the required training, or the failure to hire the trainees as a journeyman, is caused by the contractor and evidences a lack of good faith on the part of the contractor in meeting the requirements of this Training Special Provision. It is normally expected that a trainee will begin his training on the project as soon as feasible after start of work utilizing the skill involved and remain on the project as long as training opportunities exist in his work classification or until he has completed his training program. It is not required that all trainees be on board for the entire length of the contract. A contractor will have fulfilled his responsibilities under this Training Special Provision if he has provided acceptable training to the number of trainees specified. The number trained shall be determined on the basis of the total number enrolled on the contract for a significant period.

Trainees will be paid a least 60 percent of the appropriate minimum journeymen's rate specified in the contract for the first half of the of the training period, 75 percent for the third quarter of the training period, and 90 percent for the last quarter of the training period, unless apprentices or trainees is an approved existing program are enrolled as trainees on this project. In fact case, the appropriate rates approved by the Department of Labor or Transportation in connection with the existing program shall apply to all trainees being trained for the same classification who are covered by this Training Special Provisions.

The contractor shall furnish the trainee a copy of the program he will follow in providing the training.

The contractor shall provide each trainee with a certification showing the type and length of training satisfactorily completed.

The contractor will provide for the maintenance of records and furnish periodic reports documenting his performance under this Training Special Provision.

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INTERMODAL SURFACE TRANSPORTATION EFFICIENCY ACT & TRANSPORTATION EQUITY ACT

Recipients of Federal-aid highway funds authorized under Titles I (other than Part B) and V of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), or Titles I, III, and V of the Transportation Equity Act for the 21st Century (TEA-21) are required to comply with the regulations of 49 Code of Federal Regulations (CFR) Part 26 - Participation by Disadvantaged Business Enterprises in Department of Transportation Financial Assistance Programs.

DISADVANTAGED BUSINESS ENTERPRISE (DBE) PROGRAM SPECIFICATION

The U.S. Department of Transportation (DOT) requires that the Delaware Department of Transportation continue the established Disadvantaged Business Enterprise (DBE) Program for participation in U.S. DOT programs and that the program follow the final rules as stated in 49 CFR Part 26 and the Department's approved DBE Program plan.

The following definitions apply to this subpart:

Disadvantaged Business Enterprise or DBE means a for-profit small business concern (1) that is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged or, in the case of a corporation, in which 51 percent of the stock is owned by one or more such individuals; and, (2) whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

DOT-assisted contract means any contract between a recipient and a contractor (at any tier) funded in whole or in part with DOT financial assistance, including letters of credit or loan guarantees, except a contract solely for the purchase of land.

Good Faith Efforts means efforts to achieve a DBE goal or other requirement of this part which, by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement.

Joint Venture means an association of a DBE firm and one or more other firms to carry out a single, for-profit business enterprise, for which the parties combine their property, capital, efforts, skills and knowledge, and in which the DBE is responsible for a distinct, clearly defined portion of the work of the contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

Race-conscious measure or program is one that is focused specifically on assisting only DBEs, including women-owned DBEs.

Race-neutral measure or program is one that is, or can be, used to assist all small businesses. For the purposes of this part, race-neutral includes gender neutrality.

Small Business concern means, with respect to firms seeking to participate as DBEs in DOT-assisted contracts, a small business concern as defined pursuant to section 3 of the Small Business Act and Small Business Administration regulations implementing it (13 CFR part 121) that also does not exceed the cap on average annual gross receipts specified in 49 CFR §26.65(b).

Socially and economically disadvantaged individuals means any individual who is a citizen (or lawfully admitted permanent resident) of the United States and who is - (1) any individual who a recipient finds to be a socially and economically disadvantaged individual on a case-by-case basis; (2) any individual in the following groups, members of which are rebuttably presumed to be socially and economically disadvantaged:

(i) Black Americans which includes persons having origins in any of the Black racial groups of Africa;
(ii) Hispanic Americans which includes persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;
(iii) Native Americans which includes persons who are American Indians, Eskimos, Aluets, or Native Hawaiians;
(iv) Asian-Pacific Americans which includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands (Republic of Palau), the Commonwealth of the Northern Marianas Islands, Macao, Fiji, Tonga, Kirbati, Juvalu, Nauru, Federated States of Micronesia, or Hong Kong;
(v) Subcontinent Asian Americans which includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka;
(vi) Women;
(vii) Any additional groups whose members are designated as socially and economically disadvantaged by the SBA, at such time as the SBA designation becomes effective.

DelDOT will establish specific goals for each particular DOT-assisted project which will be expressed as a percentage of the total dollar amount of contract bid. The specific contract goals for this contract are:

Disadvantaged Business Enterprise 7 % Percent

DelDOT continues to reserve the right to approve DBE subcontractors and all substitutions of DBE subcontractors prior to award and during the time of the contract.

Bidders are required to submit with their bids the completed DBE Program Assurance portion of the Certification document which will state the bidders intent of meeting the goals established for this contract; or in the instance where a contractor cannot meet the assigned DBE Goals for this contract, he/she shall at the time of bid submit documentation required to verify that he/she has made a Good Faith Effort to meet the

DBE Goals. Guidance for submitting a Good Faith Effort is identified in the next section and in the DBE Program Plan. Further, the apparent low bidder must submit to DelDOT within five (5) calendar days after the bid opening, executed originals of each and every DBE subcontract to satisfy contract goals consistent with the DBE Program Assurance submitted as part of the bid package.

No contract work shall be performed by a DBE subcontractor until the executed DBE subcontract is approved in writing by DelDOT and the Department has issued the required Notice to Proceed. Any DBE subcontract relating to work to be performed pursuant to this contract, which is submitted to DelDOT for approval, must contain all DBE subcontractor information, the requirements contained in this contract, and must be fully executed by the contractor and DBE subcontractor.

Each contract between the prime contractor and each DBE subcontractor shall at the minimum include the following:

1. All pertinent provisions and requirements of the prime contract.
2. Description of the work to be performed by the DBE subcontractor.
3. The dollar value of each item of work to be completed by the DBE subcontractor and the bid price of each item of work to be completed by the DBE subcontractor.

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CRITICAL DBE REQUIREMENTS

A bid may be held to be non-responsive and not considered if the required DBE information is not provided. In addition, the bidder may lose its bidding capability on Department projects and such other sanctions as the Department may impose. It is critical that the bidder understands:

1. In the event that the bidder cannot meet the DBE goal as set forth in this specification, he/she shall at the time of bid submit to the Department that percentage of the DBE Goal that will be met, if any, on the written and notarized assurance made a part of this contract. The contractor shall also at the time of bid submit all documentation that the contractor wishes to have the Department consider in determining that the contractor made a Good Faith Effort to meet contract DBE Goals. The Department will not accept Good Faith Effort documentation other than on the scheduled date and time of the bid opening. However, the Department may ask for clarification of information submitted should the need arise.
2. A bid which does not contain either a completely executed DBE Program Assurance and/or Good Faith Effort documentation, where appropriate, shall be declared non-responsive and shall not be considered by the Department.
3. Failure of the apparent low bidder to present originals of all DBE subcontracts to substantiate the volume of work to be performed by DBE's as indicated in the bid within five (5) calendar days after the bid opening shall create a rebuttable presumption that the bid is not responsive.
4. Bidders are advised that failure to meet DBE Goals during the term of the contract may subject them to Department sanctions as identified in the DBE Program Plan.
5. In the execution of this contract, the successful bidder agrees to comply with the following contract clauses:

   Prompt Payment: The prime contractor/consultant receiving payments shall, within 30 days of receipt of any payment, file a statement with the Department on a form to be determined by the Department that all subcontractors furnishing labor or material have been paid the full sum due them at the stage of the contract, except any funds withheld under the terms of the contract as required by Chapter 8, Title 17 of the Delaware Code, annotated and as amended. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of DelDOT. This clause applies to both DBE and non-DBE subcontractors.

   Retainage: The prime contractor agrees to return retainage to each subcontractor within 15 calendar days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of DelDOT. This clause covers both DBE and non-DBE subcontractors. As guidance, once a subcontractor has satisfactorily completed the physical work, and has given to the prime contractor a certified statement that all laborers, lower tier contractors, and materialmen who have furnished labor and materials to the subcontractor have been paid all monies due them, the prime contractor shall return retainage to the subcontractor within 15 calendar days.

6. In the execution of this contract, the successful bidder agrees to comply with the following contract assurance and will include this same language in each subcontractor contract:

   "The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such remedy as the recipient deems appropriate." 49 CFR Section 26.13

7. In addition to this specification, bidders must comply with all provisions of the rules and regulations adopted by the U.S. Department of Transportation for DBE participation in U.S. DOT and DelDOT Programs (49 CFR Part 26) and the Delaware Department of Transportation Disadvantaged Business Enterprise Program Plan; each of which is hereby incorporated and made part of this specification. Bidders are also reminded that they must be responsible and responsive bidders in all other aspects aside from the DBE Program in order to be awarded the contract.

8. In accordance with 49 CFR 26.53(f)(1), DelDOT requires that a prime contractor not terminate a DBE subcontractor without prior written consent from the DelDOT Civil Rights Office. This includes, but is not limited to, instances in which a prime contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

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GUIDANCE FOR GOOD FAITH EFFORT

When the DBE Goals established for a contract by DelDOT are not met, the contractor shall demonstrate good faith efforts to meet the DBE contract goals. The contractor shall demonstrate that the efforts made were those that a contractor actively and aggressively seeking to meet the goals established by DelDOT would make, given all relevant circumstances. Evidence of this good faith effort will be submitted with the bid at the time of the bid opening.

The contractor is expected to demonstrate good faith efforts by actively and aggressively seeking out DBE participation in the project to the maximum extent, given all relevant circumstances. Following are the kinds of efforts that may be taken but are not deemed to be exclusive or exhaustive and DelDOT will consider other factors and types of efforts that may be relevant:

1. Efforts made to select portions of the work proposed to be performed by DBEs in order to increase the likelihood of achieving the stated goal. Selection of portions of work are required to at least equal the goal for DBE utilization specified in this contract.

2. Written notification at least ten (10) calendar days prior to the opening of a bid soliciting DBE interest in participating in the contract as a subcontractor or supplier and for specific items of work.

3. Efforts made to obtain and negotiate with DBE firms for specific items of work:
   a. Description of the means by which firms were solicited (i.e. by telephone, e-mail, written notice, advertisement).
   b. The names, addresses, telephone numbers of DBE's contacted, the dates of initial contact; and whether initial solicitations of interest were followed-up by contacting the DBEs to determine with certainty whether the DBEs were interested.
   c. A description of the information provided to DBE firms regarding the plans, specifications and estimated quantities for portions of the work to be performed.
   d. A statement of why additional agreements with DBE's were not reached in order to meet the projected goal.
   e. Listing of each DBE contacted but not contracted and the reasons for not entering a contract.

4. Efforts made to assist DBEs that need assistance in obtaining bonding, insurance, or lines of credit required by the contractor.

5. Reasons why certified DBEs are not available or not interested.

6. Efforts to effectively use the services of available disadvantaged community organizations; disadvantaged contractor's groups; local, state and federal DBE assistance offices; and other organizations that provide assistance in recruitment and placement of DBEs.

The following are examples of actions that may not be used as justification by the contractor for failure to meet DBE contract goals:

1. Failure to contract with a DBE solely because the DBE was unable to provide performance and/or payment bonds.
2. Rejection of a DBE bid or quotation based on price alone.
3. Rejection of a DBE because of its union or non-union status.
4. Failure to contract with a DBE because the contractor normally would perform all or most of the work in the contract.

Administrative reconsideration:

Within five (5) days of being informed by DelDOT that it is not responsive because it has not documented sufficient good faith efforts, a bidder may request administrative reconsideration. Bidder should make this request in writing to the following reconsideration official: Director of Administration, DelDOT, P. O. Box 778, Dover, Delaware 19903. The reconsideration official will not have played any role in the original determination that the bidder did not document sufficient good faith efforts.

As part of this reconsideration, the bidder will have the opportunity to provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so. The bidder will have the opportunity to meet in person with the reconsideration official, explaining the basis for finding that the bidder did or did not meet the goal or make adequate good faith efforts to do so. The final decision made by the reconsideration official will be communicated to the bidder in writing. The result of the reconsideration process is not administratively appealable to the U.S. Department of Transportation.

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REQUIRED CONTRACT PROVISIONS - FEDERAL-AID CONSTRUCTION CONTRACTS
(Exclusive of Appalachian Contracts)

FHWA-1273 -- Revised May 1, 2012 http://www.fhwa.dot.gov/programadmin/contracts/1273/1273.docx

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I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under Title 23 (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services).

   The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

   Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services). The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

   Contracting agencies may reference Form FHWA-1273 in bid proposal or request for proposal documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors.

II. NONDISCRIMINATION

The provisions of this section related to 23 CFR Part 230 are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR 60, 29 CFR 1625-1627, Title 23 USC Section 140, the Rehabilitation Act of 1973, as

amended (29 USC 794), Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR 60, and 29 CFR 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with Title 23 USC Section 140, the Rehabilitation Act of 1973, as amended (29 USC 794), and Title VI of the Civil Rights Act of 1964, as amended, and related regulations including 49 CFR Parts 21, 26 and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR 230, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630, 29 CFR 1625-1627, 41 CFR 60 and 49 CFR 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

    a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract.

    b. The contractor will accept as its operating policy the following statement:
    "It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

    a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

    b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

    c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

   a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

   b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

   c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

   a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.
   b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

   c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

   d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

   a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

   b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

   a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

   b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

   c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

   d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin, age or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established there under. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

   a. The contractor shall notify all potential subcontractors and suppliers and lessors of their EEO obligations under this contract.

   b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurance Required by 49 CFR 26.13(b):

    a. The requirements of 49 CFR Part 26 and the State DOT's U.S. DOT-approved DBE program are incorporated by reference.

    b. The contractor or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the contracting agency deems appropriate.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

    a. The records kept by the contractor shall document the following:

        (1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

        (2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

        (3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women;

    b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more.

The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size). The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. Contracting agencies may elect to apply these requirements to other projects.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 “Contract provisions and related matters” with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages

    a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b. (1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

   (i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

   (ii) The classification is utilized in the area by the construction industry; and

   (iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

   (2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

   (3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. The Wage and Hour Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

   (4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b. (1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g. , the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency.

(2) Each payroll submitted shall be accompanied by a “Statement of Compliance,” signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under §5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under §5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).
Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

9. Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility.

    a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

    b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

    c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

The following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (1.) of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (1.) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (1.) of this section.

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (2.) of this section.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (1.) through (4.) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (1.) through (4.) of this section.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price,

excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term "perform work with its own organization" refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions:

   (1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;

   (2) the prime contractor remains responsible for the quality of the work of the leased employees;

   (3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and

   (4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

5. The 30% self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements.

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C.3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

By submission of this bid/proposal or the execution of this contract, or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any person who is or will be utilized in the performance of this contract is not prohibited from receiving an award due to a violation of Section 508 of the Clean Water Act or Section 306 of the Clean Air Act.
2. That the contractor agrees to include or cause to be included the requirements of paragraph (1) of this Section X in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200.

1. **Instructions for Certification – First Tier Participants:**

   a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

   b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

   c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default.

   d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

   e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

   f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

   g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

   h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

2. **Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants**:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency;

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. Instructions for Certification - Lower Tier Participants:

(Applicable to all subcontracts, purchase orders and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180 and 1200. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a grantee or subgrantee of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction

(such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a grantee or subgrantee of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the Excluded Parties List System website (https://www.epls.gov/), which is compiled by the General Services Administration.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000 (49 CFR 20).

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

   a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.
3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

* * * * *

CARGO PREFERENCE ACT (NEW)

Requirements in the Federal-aid Highway Program

(a) Agreement Clauses. "Use of United States-flag vessels:

(1) Pursuant to Pub. L. 664 (43 U.S.C. 1241(b)) at least 50 percent of any equipment, materials or commodities procured, contracted for or otherwise obtained with funds granted, guaranteed, loaned, or advanced by the U.S. Government under this agreement, and which may be transported by ocean vessel, shall be transported on privately owned United States-flag commercial vessels, if available.

(2) Within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (a)(1) of this section shall be furnished to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(b) Contractor and Subcontractor Clauses. "Use of United States-flag vessels: The contractor agrees—

(1) To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

(2) To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, 'on-board' commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

(3) To insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

NOTE:

This requirement applies to material or equipment that is acquired for a specific Federal-aid highway project. It is not applicable to goods or materials that come into inventories independent of an FHWA funded-contract.

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BUY AMERICA (NEW)

Requirements in the Federal-aid Highway Program

By signing and submitting this proposal, the bidder certifies that:

In accordance with 23 U.S.C, 313 and 23 CFR 635.410, all iron and steel materials permanently incorporated into this project will be produced in the United States and that all manufacturing processes involving these materials will occur in the U.S, except that a minimal amount of foreign steel or iron materials may be used, provided the cost of the foreign materials does not exceed 0.1 percent of the total Contract cost or $2,500.00, whichever is greater. If such minimal amount of foreign steel is used, the Contractor shall maintain a record of the costs to ensure that the allowable limit is not exceeded. This documentation shall be presented to the Department upon request.

At the Department's request, I/we will provide manufacturer's/supplier's documentation verifying domestic origin as defined in the Specifications. All Materials accepted on the basis of such Certificate of Compliance may be sampled by the Department and tested at any time. Use of Material on the basis of Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating Material in the Project conforming to the requirements of the Contract. Any Material not conforming to such requirements will be subject to rejection whether in place or not. The Department reserves the right to refuse to permit the use of Material on the basis of Certificate of Compliance.

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APPENDICES TO THE TITLE VI ASSURANCE

APPENDIX A

During the performance of this contract, the contractor, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations: The contractor (hereinafter includes consultants) will comply with the Acts and the Regulations relative to Non-discrimination in Federally-assisted programs of the U.S. Department of Transportation, (Federal Highway Administration (FHWA), or Federal Transit Authority (FTA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this contract.
2. Non-discrimination: The contractor, with regard to the work performed by it during the contract, will not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations, including employment practices when the contract covers any activity, project, or program set forth in Appendix B of 49 CFR Part 21.
3. Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations, either by competitive bidding, or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the contractor of the contractor's obligations under this contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, or national origin.
4. Information and Reports: The contractor will provide all information and reports required by the Acts and the Regulations, and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA) to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish the information, the contractor will so certify to the Recipient or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA), as appropriate, and will set forth what efforts ithas made to obtain the information.
5. Sanctions for Noncompliance: In the event of a contractor's noncompliance with the Non-discrimination provisions of this contract, the Recipient will impose such contract sanctions as it or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA) may determine to be appropriate, including, but not limited to:
   withholding payments to the contractor under the contract until the contractor complies;
   and/or cancelling, terminating, or suspending a contract, in whole or in part.
6. Incorporation of Provisions: The contractor will include the provisions of paragraphs one through five in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts and the Regulations . The contractor will take action with respect to any subcontract or procurement as the Recipient or the Federal Highway Administration (FHWA), or Federal Transit Authority (FTA) may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the contractor may request the Recipient to enter into any litigation to protect the interests of the Recipient. In addition, the contractor may request the United States to enter into the litigation to protect the interests of the United States.

APPENDIX E

During the performance of this contract, the contractor or consultant, for itself, its assignees, and successors in interest (hereinafter referred to as the "contractor") agrees to comply with the following nondiscrimination statutes and authorities; including but not limited to:

Pertinent Non-Discrimination Authorities:

Title VI of the Civil Rights Act of 1964 (42 U.S.C. $ 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 CFR Part 21.

The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970,(42 U.S.C. $ 460 I), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);

Federal-Aid Highway Act of 1973, (23 U.S.C. $ 324 et seq.), (prohibits discrimination on the basis of sex);

Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. $ 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 CFR Part27;

The Age Discrimination Act of 1975, as amended, (42 U.S.C. $ 6101 et seq.), (prohibits discrimination on the basis of age);

Airport and Airway Improvement Act of 1982,(49 USC $471, Section 47123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);

The Civil Rights Restoration Act of 1987,(PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of l964,The AgeDiscrimination Act of 1975and Section 504 of the Rehabilitation Act of l973,by expanding the defrnition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub-recipients and contractors, whether such programs or activities are Federally funded or not);

Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. $$ 12131 - 12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;

The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. S 41123) (prohibits discrimination on the basis of race, color, national origin, and sex);

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures nondiscrimination against minority populations by discouraging programs; policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;

Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);

Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

* * * * *

PREVAILING WAGES

Included in this proposal are the minimum wages to be paid various classes of laborers and mechanics as determined by the Department of Labor of the State of Delaware in accordance with Title 29 Del.C. §6960, relating to wages and the regulations implementing that Section.

REQUIREMENT BY DEPARTMENT OF LABOR FOR SWORN PAYROLL INFORMATION

Title 29 Del.C. §6960 stipulates;

> (b) Every contract based upon these specifications shall contain a stipulation that the employer shall pay all mechanics and laborers employed directly upon the site of the work, unconditionally and not less often than once a week and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment, computed at wage rates not less than those stated in the specifications, regardless of any contractual relationship which may be alleged to exist between the employer and such laborers and mechanics. The specifications shall further stipulate that the scale of wages to be paid shall be posted by the employer in a prominent and easily accessible place at the site of the work, and that there may be withheld from the employer so much of accrued payments as may be considered necessary by the Department of Labor to pay to laborers and mechanics employed by the employer the difference between the rates of wages required by the contract to be paid laborers and mechanics on the work and rates of wages received by such laborers and mechanics to be remitted to the Department of Labor for distribution upon resolution of any claims.
>
> (c) Every contract based upon these specifications shall contain a stipulation that sworn payroll information, as required by the Department of Labor, be furnished weekly. The Department of Labor shall keep and maintain the sworn payroll information for a period of 6 months from the last day of the work week covered by the payroll.

Bidders are specifically directed to note the Department of Labor's prevailing wage regulations implementing §6960 relating to the effective date of the wage rates, at Part VI., Section C., which in relevant part states:

> "Public agencies (covered by the provisions of 29 Del.C. §6960) are required to use the rates which are in effect on the date of the publication of specifications for a given project. In the event that a contract is not executed within one hundred twenty (120) days from the date the specifications were published, the rates in effect at the time of the execution of the contract shall be the applicable rates for the project."

PREVAILING WAGE REQUIREMENTS

It is DelDOT's understanding that the Davis-Bacon Act is not a preemptive statute in the broad sense, and does not preempt or displace State of Delaware prevailing wage requirements.

When a contract for a project contains both Federal Davis-Bacon and State of Delaware prevailing wage standards because of concurrent Federal and State coverage, the employer's minimum wage obligations are determined by whichever standards are higher.

STATE OF DELAWARE
DEPARTMENT OF LABOR
DIVISION OF INDUSTRIAL AFFAIRS
OFFICE OF LABOR LAW ENFORCEMENT
PHONE: (302) 451-3423

Mailing Address:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

Located at:
225 CORPORATE BOULEVARD
SUITE 104
NEWARK, DE 19702

PREVAILING WAGES FOR **HIGHWAY CONSTRUCTION** EFFECTIVE MARCH 15, 2016

CLASSIFICATION	NEW CASTLE	KENT	SUSSEX
BRICKLAYERS	50.49	50.49	14.98
CARPENTERS	52.81	52.81	41.97
CEMENT FINISHERS	31.10	30.96	26.79
ELECTRICAL LINE WORKERS	23.23	44.82	21.94
ELECTRICIANS	65.10	65.10	65.10
IRON WORKERS	43.56	24.64	26.17
LABORERS	33.59	39.35	38.63
MILLWRIGHTS	16.63	16.14	13.93
PAINTERS	63.14	63.14	63.14
PILEDRIVERS	68.57	24.52	27.82
POWER EQUIPMENT OPERATORS	41.90	40.89	29.07
SHEET METAL WORKERS	23.49	20.97	18.99
TRUCK DRIVERS	34.02	29.14	35.50

CERTIFIED: 11/9/16 BY: _____
ADMINISTRATOR, OFFICE OF LABOR LAW ENFORCEMENT

NOTE: THESE RATES ARE PROMULGATED AND ENFORCED PURSUANT TO THE PREVAILING WAGE REGULATIONS ADOPTED BY THE DEPARTMENT OF LABOR ON APRIL 3, 1992.

CLASSIFICATIONS OF WORKERS ARE DETERMINED BY THE DEPARTMENT OF LABOR. FOR ASSISTANCE IN CLASSIFYING WORKERS, OR FOR A COPY OF THE REGULATIONS OR CLASSIFICATIONS, PHONE (302) 451-3423.

NON-REGISTERED APPRENTICES MUST BE PAID THE MECHANIC'S RATE.

PROJECT: T201612101.01 Christina River Bridge , New Castle County

GENERAL DECISION: DE160020 06/17/2016 DE20

Superceded General Decision Number: DE20160020

State: DELAWARE

Construction Type: HIGHWAY

COUNTY: New Castle County in Delaware

HIGHWAY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.15 for calendar year 2016 applies to all contracts subject to the Davis-Bacon Act for which the solicitation was issued on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.15 (or the applicable wage rates listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2016. The EO minimum wage rate will be adjusted annually. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	06/17/2016

SUDE2016-002 04/23/2015

	Rates	Fringes
Bricklayer	50.49	
Carpenter	52.81	
Cement Mason/Concrete Finisher	31.10	
ELECTRICIAN		
Electrician	65.10	
Line Worker	23.23	
Ironworker	43.56	
Laborer	33.59	
Millwright	16.63	
Painter	63.14	
Power Equipment Operator:		
Piledriver	68.57	
Power Equipment Operator	41.90	
Sheet Metal Worker	23.49	
Truck Driver	34.02	

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under an "SU" identifier indicated that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

APPLICABILITY OF DAVIS-BACON LABOR STANDARD PROVISIONS TO FLAGGERS

The U.S. Department of Labor has established that the duties of flaggers working on contracts covered by the Davis-Bacon Act, are manual and physical in nature. Accordingly, all employees performing the work of flaggers on Davis-Bacon covered contracts shall be entitled to receive applicable prevailing wage rates.

* * * * *

ALL AGENCY MEMORANDUM NO. 130
U.S. DEPARTMENT OF LABOR
EMPLOYMENT STANDARDS ADMINISTRATION
WAGE AND HOUR DIVISION
WASHINGTON, DC 20210

GUIDELINES

HIGHWAY CONSTRUCTION

Highway projects include the construction, alteration, or repair of roads, streets, highways, runways, taxiways, alleys, trails, paths, parking areas, and other similar projects not incidental to building or heavy construction.

EXAMPLES: Alleys, Base Courses, Bituminous treatments, Bridle Paths, Concrete pavement, Curbs, Excavation and embankment (for road construction), Fencing (highway), Grade crossing elimination (overpasses and underpasses), Guard rails on highway, Highway signs, Highway bridges (overpasses, underpasses, grade separation), Medians, Parking lots, Parkways, Resurfacing streets and highways, Roadbeds, Roadways, Runways, Shoulders, Stabilizing courses, Storm sewers incidental to road construction, Street paving, Surface courses, Taxiways, and Trails.

ANY QUESTIONS REGARDING THE APPLICATION OF THE GUIDELINES ABOVE TO A PARTICULAR PROJECT OR ANY DISPUTES REGARDING THE APPLICATION OF THE WAGE SCHEDULES ARE TO BE REFERRED TO THE WAGE AND HOUR DIVISION, U.S. DEPARTMENT OF LABOR FOR RESOLUTION, AND THE INSTRUCTIONS OF THE WAGE AND HOUR DIVISION ARE TO BE OBSERVED IN ALL INSTANCES.

* ALL AGENCY MEMORANDUM NO. 130
U.S. DEPARTMENT OF LABOR
EMPLOYMENT STANDARDS ADMINISTRATION
WAGE AND HOUR DIVISION
WASHINGTON, DC 20210

SUPPLEMENTAL SPECIFICATIONS
TO THE
AUGUST 2001
STANDARD SPECIFICATIONS

EFFECTIVE AS OF THE ADVERTISEMENT DATE OF THIS PROPOSAL AND INCLUDED BY REFERENCE

The Supplemental Specifications can be viewed and printed from the Department's Website.

To access the Website;
- in your internet browser, enter; http://www.deldot.gov
- on the left side of the page under 'INFORMATION', Click; 'Publications'
- scroll down under 'MANUALS' and Click; "Standard Specifications 2001"

The full Website Link is;
http://www.deldot.gov/information/pubs_forms/manuals/standard_specifications/index.shtml

Printed copies of the Supplemental Specifications are available upon request. A printed copy of the above referenced Supplemental Specifications will be included in the final contract documents upon award.

The Contractor shall make himself aware of these revisions and corrections (Supplemental Specifications), and apply them to the applicable item(s) of this contract.

SPECIAL PROVISIONS

CONSTRUCTION ITEM NUMBERS

All construction pay items are assigned a six (6) digit number, shown as Item Number on the Plans and/or in the Special Provisions, and shall be interpreted in accordance with the following:

Standard Item Number:

The first three digits of the construction item numbers indicates the Section number as described in the Standard Specifications, and all applicable requirements of the Section shall remain effective unless otherwise modified by the Special Provisions. The last three digits of the construction item identifies the item by sequential number under that Section. Sequential numbers for all items covered under Standard Specifications range from 000 to 499. A comprehensive list of construction item numbers begins on page 421 of the Standard Specifications. Additions to this list will be made as required.

Special Provisions Item Number:

The first three digits of the construction items, covered under Special Provisions, indicates the applicable Section number of the Standard Specifications, and shall be governed fully by the requirements of the Special Provisions. The last three digit of the items covered under Special Provisions identifies the item by sequential number. Sequential numbers for Special Provision items, range from 500 to 999.

Examples

Standard Item Number - 202000 Excavation and Embankment

202 Indicates Section Number

000 Indicates Sequential Number

Special Provision Item Number - 202500 Grading and Reshaping Roadway

202 Indicates Section Number

500 Indicates Sequential Number

NOTE:

PLEASE NOTE revised Supplemental Specifications to the August 2001 Standard Specifications were issued November 24, 2014 and apply to this project. They can be viewed here and at www.deldot.gov.

SPECIFICATIONS: The Department is currently updating the August 2001 Specifications for Road and Bridge Construction. Through this update, some Divisions were renumbered and some new ones were created and added. The ***Specifications Note*** document is for the use by the bidders to reference the new numbers to the past numbers used for bidding purposes on previous Department contracts.

401502 - ASPHALT CEMENT COST ADJUSTMENT

For Sections 304, 401, 402, 403, 404, and 405, payments to the Contractor shall be adjusted to reflect increases or decreases in the Delaware Posted Asphalt Cement Price when compared to the Project Asphalt Cement Base Price, as defined in these Special Provisions.

The Delaware Posted Asphalt Cement Price will be issued monthly by the Department and will be the industry posted price for Asphalt Cement, F.O.B. Philadelphia, Pennsylvania. The link for the posting is http://www.deldot.gov/information/business/bids/asphalt_cement_english.shtml.

The Project Asphalt Cement Base Price will be the Delaware Posted Asphalt Cement Price in effect on the date of advertisement.

All deviations of the Delaware Posted Asphalt Cement Price from the Project Asphalt Cement Base Price are eligible for cost adjustment. No minimum increases or decreases or corresponding percentages are required to qualify for cost adjustment.

Actual quantity of asphalt cement qualifying for any Asphalt Cement Cost Adjustment will be computed using the weight of eligible asphalt that is shown on the QA/QC pay sheets as a percentage for the delivered material.

If the mix was not inspected and no QA/QC pay sheet was generated, then the asphalt percentage will be obtained from the job mix formula for that mix ID.

The asphalt percentage eligible for cost adjustment shall only be the virgin asphalt cement added to the mix.

There shall be no separate payment per ton cost of asphalt cement. That cost shall be included in the various unit prices bid per ton for those bid items that contain asphalt cement (mentioned above).

The Asphalt cement cost adjustment will be calculated on grade PG 64-22 asphalt regardless of the actual grade of asphalt used. The Project Asphalt Cement Base Price per ton for the project will be the Delaware Posted Asphalt Cement Price in effect on the date of project advertisement.

If the Contractor exceeds the authorized allotted completion time, the price of asphalt cement on the last authorized allotted work day, shall be the prices used for cost adjustment during the time liquidated damages are assessed. However, if the industry posted price for asphalt cement goes down, the asphalt-cement cost shall be adjusted downward accordingly.

NOTE:

Application of Asphalt Cement Cost Adjustment requirements as indicated above shall apply only to those contracts involving items related to bituminous base and pavements, and with bitumen, having a total of 1,000 tons or more of hot-mix bid quantity in case of Sections 401, 402 and 403; and 15,000 gallons or more in case of Sections 304, 404 and 405.

5/05/15

202505 - SETTLEMENT PLATFORM
202518 - SETTLEMENT MONUMENT

Description:

The work of this section includes furnishing, installing, protecting and maintaining settlement monuments (SM), settlement monitoring plates (SP), pipe extensions conforming to the design and at the locations shown on the Plans or as directed by the Department. All labor, materials, equipment and incidentals necessary to complete this work shall be considered part of this item required to provide devices to observe ground movement during and after construction. The Contractor shall perform the monitoring, recording and reporting of the settlement.

Submittals:

1. Qualifying Experience

   The Contractor shall submit proof of three or more projects of similar size and complexity on which the firm and personnel assigned to the project have successfully installed similar instrumentation within the last three years. The Contractor shall present the following information for each project listed as a reference prior to contract execution:

   1. Project Name, Location, Project Description, and Completion Date.

   2. Surface and Subsurface Conditions.

   3. Type and number of instruments installed.

   4. Installation equipment and techniques utilized when applicable.

   5. Provide names, current phone numbers, and current business addresses for the owner/designer, geotechnical consultant, and contract manager.

2. Settlement surveying and monitoring plan for review prior to preconstruction meetings. The Plan shall identify the detailed location of settlement monitoring points, reference benchmarks, survey schedules and procedures and reporting formats.

3. Description of the surveying equipment to be used.

4. Instrument Layout and Installation Details: Within two days after the installation of each settlement monument and settlement plate, the Contractor shall submit an installation record sheet including appropriate items from the following list.

   i. Project name.
   ii. Contract name and number.
   iii. Instrument type and number.
   iv. Material sizes and compositions.
   v. Planned location in horizontal position and elevation.
   vi. Planned orientation.
   vii. Personnel responsible for installation.
   viii. Date and time of start and completion.
   ix. Weather conditions at the time of installation.
   x. Notes of importance on the installation including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.

Schedule for Installations and Readings:

The Contractor shall provide settlement monuments, settlement monitoring plates, and pipe extensions to monitor settlement of new fill embankments. The Contractor shall make regular readings of the settlement as indicated on the plans.

Settlement monitoring plates shall be installed as shown on the plans. Settlement monitoring plates shall be located by repeatable survey (locations and elevations) and referenced to permanent benchmarks. Locations of benchmarks are to be determined by the Contractor and approved by the Engineer, and shall be located outside the zone of influence of the construction activity. Settlement monitoring plates shall be placed level and the risers shall be plumb.

The approximate locations of each instrument to be installed by the Contractor are shown on the project plans and include the following types: settlement plates and settlement monuments. Other locations may need to be added as directed by the Engineer.

Protection of Instrumentation and Repair of Damage

a. The Contractor shall protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations.

b. If an instrument is damaged or made inoperative due to the Contractor's operations or the operation of subcontractors under the direction of the Contractor, the Contractor shall notify the Engineer immediately. The Engineer will be the sole judge of whether repair or replacement is required. For each instrument that is abandoned for these reasons, the Contractor shall replace that instrument at no additional cost to the Department.

c. The Engineer will advise the Contractor immediately upon discovery of damage to instruments as to the necessary schedule for replacement and the times of required access. Damaged instruments shall be repaired or replaced within 24 hours of initial damage. The Contractor's construction operations in the area of a damaged instrument(s) may be halted during repair or replacement of each damaged instrument at the request of the Department.

Materials:

Settlement Plates

a. Settlement plates are sub-surface displacement reference platforms placed on the prepared ground surface prior to embankment fill placement. Risers are extended from the settlement plate as the fill is placed. A casing is placed around the riser for protection. Settlement plates are monitored by optical survey methods to determine vertical displacements occurring during and after embankment construction.

b. The base plate shall be made from steel conforming to the requirements of ASTM A36. The riser pipe and outer casing shall be steel pipe conforming to the requirements of ASTM A53, Grade B, standard weight. The casing and the risers shall be as shown on the plan. The casing pipe shall have a minimum wall thickness of 0.375 inches. The riser pipe shall be galvanized and have a minimum wall thickness of 0.25 inches. Couplings, pipe caps, etc. shall conform to the requirements of ASTM A865. Threaded pipes shall be used for riser and casing pipe extensions.

c. Sand shall conform to the requirements of ASTM C33.

Settlement Monuments

a. Settlement monuments to monitor embankment settlement may consist of a concrete block embedded 2-ft into the newly placed fill with a PK nail or a #4 bar driven a minimum 4-ft into the embankment fill with a maximum ½ inch stickup above the ground surface. Settlement monuments are monitored by optical survey methods to determine vertical displacements occurring after embankment construction.

b. Materials for the construction of the Settlement Monument shall conform to the applicable sections of Section 812 for the Concrete, Class C of the Standard Specifications.

c. The Reinforcement Bar shall conform to Section 824 of the Standard Specifications.

Construction Methods:

1. Readings on the settlement platforms and settlement monuments shall be performed by the Contractor. The Contractor is fully responsible for establishing benchmarks, submittals, and furnishing, installing and maintaining the settlement platforms.

2. The settlement monuments shall be installed at locations indicated on the plans or as directed by the Department.

3. The settlement plates shall be installed as indicated on the plans after all clearing and grubbing and topsoil removal has been completed. The sand base shall be tamped to provide a firm, level, and unyielding bearing surface for the base plate. The riser pipe shall be marked in 1-foot increments and labeled at 5-foot increments to indicate the distances above the plate extending up through the embankment fill. Settlement plates shall be fabricated as shown on the plans.

4. The initial casing and riser pipes shall have a maximum length of 4 feet for each section. Spacers shall be provided between the riser pipe and the casing at a minimum of 4-foot intervals to ensure concentricity. The spacers shall not be directly attached to the riser pipe or otherwise installed that would impede the independent movement of the riser pipe.

5. As the height of fill above the settlement plate changes, the casing and riser pipes shall be increased or decreased in a maximum of 4-foot intervals to maintain the top of the riser pipe and casing above the embankment. As each additional length of pipe is added or removed, the pipe cap on the casing shall be immediately transferred to the top section on the settlement plate so as to prevent fill material from entering the casing. At other times, the cap shall only be removed to check settlement.

6. The casing pipe shall be marked by flags or other approved method to clearly show its location and to warn equipment operators and others of its location. The Contractor shall maintain the flags during the entire length of the Contract and replace those flags that are missing. At no time shall the settlement plate risers and casings extend higher than 5 feet above the ground surface elevation. Sections shall be added or removed as necessary during embankment construction to maintain the tops of the risers and casings at least 1-foot above the surface of the embankment.

7. The Contractor is responsible for maintaining the settlement plates in working order during the length of the Contract. Settlement Plates which are to be abandoned at the completion of the project shall have their riser pipes cut off two feet below roadway subgrade level and capped. If an instrument is damaged, moved, or disturbed due to causes other than settlement, the Contractor shall repair, reset, or replace the damaged instrument at no additional cost to the Department within three days after being damaged. The Engineer will be the sole judge of whether repair, resetting, or replacement is required. No additional fills shall be placed within fifty (50) feet of a damaged settlement platform until the damage has been corrected to the satisfaction of the Engineer. The Engineer may impose a work stoppage in the vicinity of the damaged instrument until it is again operational at no additional cost to the Department. Any repairs or replacements required will be at the Contractor's expense.

8. By the end of the first work day in each week, the Contractor shall submit to the Engineer a description of the work performed during the previous week. This description shall include at a minimum: a plan view location of the placed embankment, the volume of embankment placed, and in-situ density test results in accordance with Standard Specification sections 202 and 209.

9. The use of the settlement platforms for collecting data related to embankment foundation response will extend beyond the time of completion of the Contractor's embankment placement operations. The Contractor shall be responsible for assuring that all platforms are in working order until the time of completion of the Contract.

10. Instrumentation shall be read as indicated on the plans.

11. For vertical deformation monitoring, runs shall be performed by a single run beginning and ending on two different benchmarks installed in accordance with NGS standards. Settlement monitoring points shall be used as turning points or as intermediate foresights from two different turning points, allowing elevations to be adjusted and eliminating significant observational errors. The maximum length of line of sight shall be 150 feet, and the imbalance between backsight and foresight shall not exceed 30 feet.

Allowable level loop misclosure shall not exceed ±0.033 times the square root of M feet (where M is the distance of the level run in miles) for a single run between two benchmarks. A formal initial reading on a settlement monitoring point will consist of the average of three elevations, from three independent level runs, which meet the closure specified herein. Elevations established subsequent to a formal initial reading shall be determined by a single run as specified herein. The least count (without estimation) of the rod and level combination shall read to 0.003 foot or less, such that the accuracy of an elevation measurement shall be ±0.01 foot (at 95 percent level of confidence).

12. Data shall be recorded in U.S. survey feet or inches.

13. Instruments used for vertical deformation monitoring shall have a minimum accuracy of plus or minus 0.005 of a foot (standard deviation for 3300 feet of double run leveling) and a minimum setting accuracy of plus or minus 1.0 arc seconds. Leveling rods shall be non-telescopic in design (i.e. "Chicago" style leveling rod). A bull's eye bubble shall be used to plumb the leveling rod. The use of fiberglass rods will need approval of Engineer prior to use.

14. All data recorded by the Contractor shall be of the following form:

    a. Raw and reduced data shall be on summary tables in printed tabular format on 8-1/2 inch x 11 inch sheets of paper.
    b. Reduced data for up to six like instruments that are located in the same geographical area shall be plotted on the same graphical plot. Each plot shall be submitted on an 8-1/2 inch x 11 inch sheet or 11 inch by 17 inch sheet.
    c. Plots of deformation data at Settlement Monitoring Plates shall show absolute vertical deformation versus time with height or elevation of fill placed at time of reading. Plots of settlement plate data shall show absolute vertical deformation versus time and shall show the height or elevation of fill placed at the time of reading. Deformation plots shall also be provided in electronic data file format.
    d. Survey data reports prepared by the Contractor shall be signed and sealed by either a Professional Engineer or Professional Land Surveyor licensed in the State of Delaware.

Method of Measurement:

The number of Settlement Platforms measured will be the actual number of platforms set in place and/or maintained as shown on the Plans or as directed by the Engineer. No measurement for payment will be made for pipe extensions. The number of Settlement Monuments measured will be the actual number of monuments set in place and/or maintained as shown on the Plans or as directed by the Engineer.

Basis of Payment:

Settlement Platforms and Settlement Monuments will be paid for at the Contract unit price per Each, complete in place, which price shall be full compensation for all materials, tools, labor, and work incidental thereto including pipe extensions, steel plate, sand, couplings, spacers, welding, protection of the plate and pipe extensions during construction, all labor tools, equipment, and necessary incidentals to complete the work.

8/30/16

202514 - PIEZOMETER

Description:

The Work covered by this Section includes furnishing all necessary plant, labor, equipment, and materials to install Vibrating Wire Piezometers, providing safe access for the Engineer and others for data collection, protecting instrumentation from damage, repairing certain types of instruments, and replacement costs for other instruments. The Contractor shall implement required remedial and precautionary measures based on the instrumentation data collected and evaluated by the Engineer.

Project Conditions

a. Prior to bidding, the Contractor shall visit and examine the work site and all conditions thereon and take into consideration all such conditions that may affect this work, in accordance with Section 102.05 of the Specifications. Subsurface data collected from the site is available in geotechnical reports upon request from the Department.

b. Protection of Existing Structures: Protect existing structures, underground utilities, and other construction from any possible or potential damage during drilling operations.

Submittals:

a. Qualifying Experience

The Contractor shall submit proof of three or more projects of similar size and complexity on which the firm and personnel assigned to the project have successfully installed similar instrumentation within the last three years. The Contractor shall present the following information for each project listed as a reference prior to contract execution:

1. Project Name, Location, Project Description, and Completion Date.

2. Surface and Subsurface Conditions.

3. Type and number of instruments installed.

4. Installation equipment and techniques utilized when applicable.

5. Provide names, current phone numbers, and current business addresses for the owner/designer, geotechnical consultant, and contract manager.

b. No instrumentation shall be delivered or installed on the site prior to the review and approval by the Department of the materials, products, and installation procedures. At least 45 calendar days prior to proceeding with the installation work, the Contractor shall submit to the Engineer for review the following:

1. Schedule and Procedures: Proposed schedule and procedures for instrumentation installation and performance of initial reading monitoring for the instruments. Detailed step-by-step procedure for installation, together with a sample installation record sheet. The procedures shall be bound and indexed. The installation procedures shall include:

- The method to be used for cleaning the inside of casing.

- The methods to be used for drilling of holes.

- Drill casing type and size.

- Depth increments for backfilling boreholes with sand and grout.

- Method for overcoming buoyancy of instrumentation components during grouting.

- Method for sealing of joints in pipes and inclinometer casing to prevent ingress of grout.

- Detailed step-by-step procedures developed in conjunction with the Department for conducting all survey measurements to obtain initial readings to the specified accuracy, including types of surveying equipment.

2. Product Data: Manufacturer's catalog cuts, shop drawings, material specifications, installation and maintenance instructions, and other data pertinent to the work of this Section.

3. Within 2 workdays of receipt of each instrument at the site, the Contractor shall submit to the Engineer a copy of factory calibration, manufacturer's test equipment certification, completed copy of quality assurance checklist, and warranty for each portable readout unit.

4. Grout Mix: Material specifications and mix design for grout required for piezometer installations along with verification from a certified testing laboratory that this mix is in accordance with the requirements specified. The information shall include specifications for proposed grout mixes, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size and quantity.

5. Certifications: Manufacturer's certifications that products, materials, and equipment furnished meet the specified requirements.

6. Instrumentation layout and installation details: Within 5 days of installing each instrument the Contractor shall submit the following:

   - Instrument type, identification numbers and locations, with initial elevations, stations and offsets, and coordinates, as applicable for each instrument.

   - As-built installation details of each instrument, including depths, lengths, elevations, materials used, and dimensions of key elements.

   - A separate statement describing the procedure used for the installation of each instrument.

   - A log of subsurface data indicating the elevations of strata changes encountered in the borehole. Soil strata nomenclature shall conform to ASTM D3282 and D2488.

   - Other data pertinent to instrument installation.

Schedule for Installations and Readings:

Prior to installation of the instruments, the Contractor shall submit an installation schedule as described in this specification. The installation of all instruments shall generally precede the placement of embankment material by at least 14 days so that neutral, or initial, readings can be obtained. The Contractor shall notify the Department within 24 hours of successful installation of each instrument.

The Contractor will make neutral readings on each of the instruments within 72 hours of successful installation of the instrument and again 24 to 72 hours afterwards to verify the initial data. During fill placement and the first 30 days thereafter, readings shall be taken at least weekly, and at least monthly for the next 6 months or as directed by the Department.

Protection of Instrumentation and Repair of Damage

The Contractor shall take the following measures to protect the installed instrumentation and repair any damages which occur.

a. The Contractor shall protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations.

b. If an instrument is damaged or made inoperative due to the Contractor's operations or the operation of subcontractors under the direction of the Contractor, the Contractor shall notify the Department immediately. The Department will be the sole judge of whether repair or replacement is required. For

each instrument that is abandoned for these reasons, the Contractor shall replace that instrument at no additional cost to the Department.

c. Should any instrument become damaged or inoperative through no fault of the Contractor, the damaged or inoperative instrument shall be repaired or replaced at the contract unit prices for that instrument.

d. The Department will advise the Contractor immediately upon discovery of damage to instruments as to the necessary schedule for replacement and the times of required access. Damaged instruments shall be repaired or replaced within 24 hours of initial damage. The Contractor's construction operations in the area of a damaged instrument(s) may be halted during repair or replacement of each damaged instrument at the request of the Department.

Interpretation of Data and Implementation of Plans of Action:

The Engineer may require a temporary delay from planned construction schedules before a stage of fill placement is commenced and/or completed in a given area if the fill instrumentation readings indicate the potential for unstable conditions or if settlement is substantially more than predicted. Resumption of fill placement shall be at the direction of the Engineer when instrumentation readings indicate sufficient stability has been achieved to allow such continuation of filling.

All data recorded by the Contractor shall be of the following form:

a. Raw and reduced data shall be on summary tables in printed tabular format on 8-1/2-inch x 11-inch sheets of paper.

b. Reduced data for up to six like instruments that are located in the same geographical area shall be plotted on the same graphical plot. Each plot shall be submitted on an 8-1/2-inch x 11-inch sheet or 11-inch by 17-inch sheet.

c. Plots for Vibrating Wire Piezometers shall present piezometer data versus time with height or elevation of fill placed at time of reading.

d. Data reports prepared by the Contractor shall be signed and sealed by either a Professional Engineer or Professional Land Surveyor licensed in the State of Delaware.

Quality Control:

The following measures shall be followed prior to and during the installation of the piezometers to ensure proper installation and operation:

a. Control of Materials

1. The materials to be used in fulfilling the requirements of instrumentation work are subject to the approval of the Engineer. Approval of the materials to be used for instrumentation shall not relieve the contractor of the responsibility to provide instrumentation in accordance with these Specifications.

2. The Engineer will inspect, test, and approve the workmanship of the instrumentation equipment, prior to, and/or after installation.

b. Field Monitoring

1. The Engineer will approve the method of installation and maintenance of monitoring devices. Approval of the method of installation and maintenance of monitoring devices shall not relieve the Contractor of the responsibility to install and maintain the instruments in conformance with the Specifications.

2. Measurements and readings of the monitoring devices shall be performed by the Contractor.

3. The Engineer shall be notified of monitoring devices which become damaged or inoperable immediately after the time the Contractor becomes aware of such conditions.

4. The Contractor shall engage qualified technicians with at least three years' previous experience in the installation of the instruments specified herein. The Contractor shall provide the Engineer, for his approval, a description of the applicable experience of such personnel. Approval of the personnel shall be received prior to commencing with the installation.

c. Factory Calibration

A factory calibration shall be conducted on all instruments at the manufacturer's facility prior to shipment. Each factory calibration shall include a calibration curve with data points clearly indicated, and a tabulation of the data. Each instrument shall be marked with a unique identification number.

Factory calibrations of piezometers shall be made against a pressure gage traceable to the National Institute of Standards and Technology. The accuracy of the pressure gage shall not be less than twice the specified accuracy of the piezometers. Calibrations shall be made to full scale in two complete cycles, recording the reading in 10 equal increments during two loading and two unloading cycles.

d. Field Calibration

Upon receipt of the instruments at the project site the Contractor shall check all instruments and perform field calibrations to ensure that they are functioning properly.

Materials:

Materials for the installation of the vibrating wire piezometers shall be in accordance with the following:

a. Vibrating wire piezometers shall be placed within the compressible soil layer(s) to monitor pore pressures during and after construction of the embankments. The piezometer's cable housing shall be extended as the fill is placed or the cable shall be extended outside the embankment area.

b. The piezometers shall be vibrating wire transducer type capable of measuring pore water pressures up to 100 psi. The piezometers shall be Model 4500 produced by Geokon, Inc., West Lebanon, New Hampshire; Model VW2100 produced by RST Instruments Ltd, Coquitlam, B.C., Canada; or an approved equal. Piezometers shall be supplied with thermistors built into the transducers to measure the temperature at the transducer location. A readout box shall be used to obtain pore pressure readings as required. This readout box shall be a Model GK-401 produced by Geokon, Inc., West Lebanon, New Hampshire; a Model VW2104; produced by RST Instruments Ltd, Coquitlam, B.C., Canada; or an approved equal.

c. Vibrating wire transducers shall have factory-attached cables of sufficient length to route to the terminal box without splicing. Cable shall be of same commercial source as the piezometers, and shall be 4-conductor, 22 gauge, with two (2) shielded twisted pairs, a common drain wire. Cable shall be attached to the piezometers through an integral bulkhead seal, consisting of an interior waterstop seal and cable entry seal. Seals shall be either O-rings or hermetic seals and must be tested and certified for water-tightness over the specified pressure range of the transducer.

d. The terminal box shall be a Model 4999-16VT as manufactured by Geokon Inc., Lebanon, New Hampshire; a Geomation 2300 produced by RST Instruments Ltd, Coquitlam, B.C., Canada; or an approved equal.

e. Surge protection circuit boards shall be installed on every lead wire connected into the terminal box to protect the vibrating wire piezometers. The surge protection circuit boards shall contain a combination of gas tube discharge rectifiers, solid state diode circuits, and coils to suppress electrical transients.

f. Grounding rods: 3/4-inch diameter by 10-feet long, copper clad steel as manufactured by copperweld; Blackburn; or approved substitute.

g. Ground cable: ASTM B8 copper, No. 4 AWG bare wire.

h. Cable identifications tags: Black Natvar 400 tubing with labels deeply embedded using Kingsley White Stamping Foil; Raychem thermofit marker; Alliance Industrial Products Co. white plastic marker with black code marking; Marked Flexrite Shrinkdown HT-105 tubing; Actioncraft heat-shrinkable polyolefin marker; or approved substitute.

i. The piezometers shall be installed with steel casing over the cable where traffic is likely to run over the casing. PVC casing may be used elsewhere.

Methods of Construction:

Equipment

The Contractor shall provide all necessary plant, labor, material, and equipment, and perform all operations required for the installation of the instrumentation. Upon completion of the project, all instruments will become property of the Department.

Installation

The vibrating wire piezometers shall be installed in boreholes at the locations and depths as specified on the project plans.

Piezometers can be installed in boreholes in single or multiple installations per hole, in cased or uncased holes. At locations requiring multiple installations per hole, one piezometer should be installed above the groundwater table and one below the groundwater table. Careful attention must be paid to borehole sealing techniques if pore pressures in a particular zone are to be monitored.

Boreholes should be drilled either without drilling mud or with a material that degrades rapidly with time, such as RevertJ. The hole should extend from 12 to 24 inches below the proposed piezometer location and should be washed clean of drill cuttings. The bottom of the boreholes should then be backfilled with clean fine sand to a point one foot below the piezometer tip. The piezometer can then be lowered into position. If applicable, any porous elements shall be saturated, and the piezometer filled with water prior to installation. The piezometer shall then be encapsulated in a canvas cloth bag containing clean, saturated silica sand, and having the diaphragm facing upwards prior to being lowered into position. While holding the instrument in position (a mark on the cable is helpful), clean sand should be placed around the piezometer and to a point one foot above it. The sand placed before and after the placement of the piezometer forms the collection zone.

Immediately above the sand layer (collection zone), the hole shall be grouted to a point no less than three feet above the collection zone using a special grout consisting of Portland cement, bentonite and water. The special grout shall be a non-shrink and non-metallic material and shall not contain calcium chloride or other salts, aluminum, or other harmful metals. When tested in accordance with ASTM C 827, the material shall show no shrinkage in the plastic state. When tested in accordance with ASTM C 109, the material shall show a seven-day strength of not less than 3.5 pounds per square inch (psi) and a 28-day strength of between 5.0 and 7.0 psi as measured on 2 inch cubes. The water used in the special grout shall be potable.

The cables for the vibrating wire piezometers shall be routed up through the boreholes and placed in trenches leading to the readout boxes. These trenches shall be a minimum of one foot deep and one foot wide. The cables shall be snaked in the trenches to include a minimum of 10 feet of additional cable length for every 100 feet of cable.

The Contractor is responsible for maintaining the vibrating wire piezometers in working order during the length of the Contract. Maintenance of vibrating wire piezometers which are to remain operational after completion of the project will be the responsibility of the Department.

Interpretation of Data

a. The Engineer shall interpret the data collected under this contract. The Contractor may independently interpret for its own purpose the data collected for the purpose of controlling the safety of the work.

b. The following table provides Threshold and Limiting Values for selected instruments. These values shall be defined collectively as Response Values. The actions associated with these Response Values are defined as well. Response Values may be adjusted by the Engineer as indicated by prevailing conditions or circumstance.

RESPONSE VALUES

INSTRUMENT	THRESHOLD VALUE	LIMITING VALUE
Vibrating Wire Piezometer	Increase in pore water pressure: 50% of the total overburden added to construct the roadway embankment	Increase in pore water pressure: 80% of the total overburden added to construct the roadway embankment

c. If a Threshold Value is reached the Contractor will:
   1. Immediately notify the Engineer.
   2. Meet with the Engineer to discuss response actions.
   3. Provide response actions to be taken.
d. If the Limiting Value is reached, the Contractor may also be required by the Engineer to initiate one or more of the following response actions in addition to those specified herein before:
   1. Install additional instruments.
   2. Modify construction procedures.
   3. Prepare and implement a plan of action as discussed above.
e. The Contractor shall take all necessary steps to avoid exceeding the Limiting Values. If limiting values are reached, the Contractor may be directed by the Engineer to suspend activities in the affected area and/or to undertake remedial actions to reduce readings to below Limiting Values.

Method of Measurement:

The Vibrating Wire Piezometers will be measured per Each satisfactorily installed. Drilling of holes, temporary casing, terminal boxes and covers, and incidental items necessary for installation of the instruments and abandonment of instruments no longer required, including filling of holes with grout, will not be measured separately for payment. These costs will be considered incidental to these items.

Basis of Payment:

Vibrating Wire Piezometers will be paid for at the Contract unit price per Each, complete in place, which price shall be full compensation for all materials, tools, labor, and work incidental thereto including all data collection, testing of materials, as-built reports, raw and reduced data reports, labor, tools, equipment, and necessary incidentals to complete the work.

8/30/16

202521 - INCLINOMETER

Description:

The work of this section includes furnishing, installing, initializing, protecting, and maintaining inclinometer casing and probes required to observe subsurface ground movements during construction.

No instrumentation installation shall take place before review by the Engineer of instrumentation submittals.

Purposes of the Geotechnical Instrumentation Program include but are not limited to:

a. Providing pre-construction baseline data for comparison with construction and post-construction data.
b. Providing a warning of conditions that may require remedial or precautionary measures in order to ensure the stability and safety of the work.
c. To monitor the stability of the proposed roadway embankment construction.

Description of Instruments

a. Inclinometers consist of an inclinometer casing installed and grouted within vertical boreholes in the in-situ soil materials. A probe lowered within the casing is used to monitor horizontal displacements of soil occurring during and after construction.

Responsibilities of Contractor:

Responsibilities of Contractor shall include, but not be limited to, the following:

a. Furnish all components of geotechnical instrumentation required by the Contract.
b. Furnish probes and portable readout units.
c. Install instruments specified as located on the Plans, listed in this specification or as directed by the Engineer.
d. Taking initial readings of all installed instrumentation.
e. Protect casings and instruments from damage and maintain instruments installed. Repair or replace damaged or inoperative instruments throughout the duration of the Contract, within 72 hours after the damage has been discovered and the Contractor informed.
f. Maintain and calibrate probes and portable readout units following the recommendations of the equipment manufacturer.
g. Perform and report the results of pre-installation and post installation acceptance tests.
h. Provide any additional instrument, collect and interpret data from that instrumentation that the Contractor or Engineer deems necessary.
i. Divert any machinery inducing disturbance during data collection.
j. The Contractor shall provide and facilitate safe access to the Work at all times for the Engineer to collect data from all instruments, including any additional instruments installed by the Contractor as specified herein. Safe access shall include, but not be limited to, cessation of work activities, temporary relocation of obstructing materials and equipment, provision of ladders, fall protection, working platforms and hoisting services, and any other needs that, in the opinion of the Engineer, are necessary to ensure the safety of data collection personnel. The Contractor shall furnish two sets of safety equipment for use by the Engineer when required to collect data.
k. Coordinate with the Engineer to verify consistency of collected data.

Qualification of Contractor's Instrumentation Personnel:

a. Geotechnical instrumentation work involves highly specialized tasks. The Contractor's Geotechnical Instrumentation Engineer who is responsible for overseeing the procurement shall have the qualifications specified herein. The Geotechnical Instrumentation Engineer may be on the staff of the Contractor or may be on the staff of a specialist instrumentation subcontractor.
b. The Contractor's instrumentation personnel shall include a superintendent who will be in responsible charge full-time on-site during the installation and initial readings of geotechnical instrumentation program. The superintendent shall have at least four years of direct field experience in installation and monitoring of the types of instrumentation specified herein and shall have supervised instrumentation

programs of similar magnitude in similar subsurface conditions. The superintendent shall be on-site and supervise all instrument installations, pre-installation acceptance tests, post-installation acceptance tests, field calibrations, initial readings and data collection, reduction, processing, plotting, and reporting after the geotechnical instrumentation engineer has performed the first two of these tasks as specified herein.

c. The Contractor's instrumentation personnel shall include a qualified Geotechnical Instrumentation Engineer who is a registered Professional Engineer in the State of Delaware, who has a minimum of Bachelor of Science degree in Civil Engineering, who has at least 4 years of experience in installation and monitoring of the types of instruments specified herein and in interpreting instrumentation data. The Geotechnical Instrumentation Engineer shall demonstrate previous successful experience on at least four instrumentation projects and experience with each types of geotechnical instrument specified herein. The Geotechnical Instrumentation Engineer shall:

    1. Supervise preparation, and review Contractor submittals related to geotechnical instrumentation.
    2. Be on site and supervise installations of each inclinometer.
    3. Conduct the pre-installation and post-installation acceptance tests for at least the first two inclinometers.
    4. Be on site until the completion and acceptance tests for at least the first two inclinometers.
    5. Be available on site to manage the repair and replacement of damaged instruments.

d. The driller responsible for drilling instrumentation boreholes shall be on-site full-time during the drilling program and shall have at least four years of direct field experience in drilling boreholes for the types of instruments specified herein.
e. The Contractor shall provide the Engineer, for his approval, a description of the applicable experience of such personnel. Approval of the personnel shall be received per submittal requirements below.
f. Contractor's instrumentation personnel and surveyors, including the geotechnical instrumentation engineer, the superintendent, the driller, the field survey party chief, and all other field and office personnel shall be subject to the approval of the Engineer.

Calibration:

a. A factory calibration shall be conducted on all instruments prior to shipment from the manufacturing location. Each factory calibration shall include a calibration curve with data points clearly indicated, and a tabulation of the data. Each instrument shall be marked with a unique identification number. Certification shall be provided to indicate that the test equipment used for this purpose is calibrated and maintained in accordance with the test equipment manufacturer's calibration requirements and that, where applicable, calibrations are traceable to the National Institute of Standards and Technology. A final quality assurance inspection shall be made by the Manufacturer prior to shipment with the results of the inspection recorded on a checklist. A copy of the completed checklist shall be included with each instrument in the shipment.
b. Factory calibrations of inclinometers shall include comprehensive calibrations of the force balance accelerometers before assembly in the probe. A final calibration shall include measurements made at 10 degree intervals from minus 30 degrees to plus 30 degrees with respect to vertical, and a comprehensive repeatability check over a smaller zone near vertical.
c. Contractor shall provide the manufacturer's warranty for each piece of equipment furnished for the monitoring program and such warranty shall be in place for the duration of the Contract.
d. Calibration shall be performed no longer than 6-months before the initial reading.

Submittal:

a. No instrumentation shall be delivered or installed on the site before review by the Engineer of the materials, products, and installation procedures.
b. Within 15 workdays after Notice of Proceed, submit to the Engineer for review the resumes of the Geotechnical Instrumentation Engineer sufficient to define details of relevant site experience on projects of this type and magnitude. Documentation that supervisory personnel and technicians performing the instrumentation work are qualified.
c. At least 20 workdays prior to commencing installation of the first inclinometer, submit to the Engineer for review the following items pertaining to that instrument type:

    1. Manufacturers' product installation data, including instruction manual and including any requests for consideration of substitutions, as specified herein, and warranty provisions. Manufacturer's catalog cuts,

shop drawings, material specifications, installation and maintenance instructions, and other data pertinent to the work of this Section.

2. Manufacturer's certifications that products, materials, and equipment furnished meet the specified requirements.
3. Detailed step-by-step procedure for installation, together with a sample installation record sheet. Proposed schedule and procedures for instrumentation installation and performance of initial reading monitoring for the instruments. The procedures shall be bound and indexed. The installation procedures shall follow guidelines provided in the manufacturers' instruction manuals, and include, but not limited to:

   i. The method to be used for cleaning the inside of casing or augers.
   ii. Method and equipment for mixing and placing the grout.
   iii. Grout Mix: Material specifications and mix design for grout required for deep benchmarks and inclinometer installations along with verification from a certified testing laboratory that this mix is in accordance with the requirements specified. The information shall include specifications for proposed grout mixes, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size and quantity.
   iv. Drill casing or auger type and size.
   v. Depth increments for backfilling boreholes with sand and granular bentonite.
   vi. Method for overcoming buoyancy of instrumentation components during placement and grouting.
   vii. Method of sealing joints in pipes and inclinometer casing to prevent ingress of grout.
   viii. Method for conducting post-installation acceptance test.
   ix. Method for protecting instruments from damage.
   x. Methods applicable to all instruments for compression of instruments due to consolidation of the foundation without damaging the instrument.

4. A flow chart indicating the proposed time sequence of instrument installation.
5. Sample of the quality assurance checklist, pre-installation acceptance test record, installation record for each instrument type to be used to check instruments on receipt from the manufacturer.

d. At least 20 workdays prior to installing each instrument, the Contractor shall submit to the Engineer for review, the location, installation schedule and monitoring schedule for that instrument.
e. Within 5 workdays of receipt of each instrument at the site, submit to the Engineer a copy of factory calibration, manufacturer's test equipment certification, completed copy of quality assurance checklist, and warranty for each instrument and portable readout unit.
f. Within 10 workdays of receipt of each instrument at the site, submit to the Engineer completed pre-installation acceptance test record form for that instrument.
g. Within 5 workdays of installing each instrument, submit to the Engineer the installation record sheet for that instrument, including as-built instrument location as specified, and any field calibrations performed.
h. Submit initialization data as specified herein.
i. The Contractor shall submit to the Engineer updated as-built instrument location plans and work drawings as specified herein within 5 workdays of the completion of installation of each instrument. The work drawings shall include, but not limited to:

   Instrumentation Layout and Installation Details: Within two days of installing each instrument, Contractor shall submit and installation record sheet including appropriate items from the following list.

   1. Project name.
   2. Contract name and number.
   3. Instrument type and number including readout unit.
   4. Planned location in horizontal position and elevation.
   5. Planned orientation.
   6. Planned lengths and volumes of backfill.
   7. Personnel responsible for installation.
   8. Plant and equipment used including diameter and depth of any drill casing or augers used.
   9. Date and time of start and completion.
   10. Spaces on record sheet for necessary measurements or readings required at hold-points during installation to ensure that all previous steps have been followed correctly including instrument readings made during installation.
   11. A log of subsurface data indicating the elevations of strata changes encountered in the borehole. Soil strata nomenclature shall conform to ASTM D 2487.

12. Type of backfill used to fill instrumentation boreholes.
13. As-built location in horizontal position, top elevation, and bottom elevation.
14. As-built orientation.
15. As-built lengths and volumes of various backfill materials placed in the instrumentation borehole.
16. Result of post-installation acceptance test.
17. Weather conditions at the time of installation.
18. Notes of importance on the installation including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.

Control of Materials:

a. The Engineer reserves the right to approve each of the materials to be used in fulfilling the requirements of instrumentation work. Approval of the materials to be used for instrumentation shall not relieve Contractor of the responsibility to provide instrumentation in accordance with these Special Provisions.
b. The Engineer reserves the right to inspect, test, and approve the workmanship of the instrumentation equipment and materials.

Field Monitoring:

a. The Engineer reserves the right to approve the method of installation and maintenance of monitoring devices. Approval of the method of installation and maintenance of monitoring devices shall not relieve Contractor of the responsibility to install and maintain the instruments in conformance with the Specifications.
b. The Engineer shall be notified of monitoring devices that become damaged or inoperable within 12 hours of the time Contractor becomes aware of such conditions.

Scheduling of Work:

a. The Geotechnical Instrumentation Engineer and the Engineer shall meet and jointly gather initial readings in accordance with the following schedule:

    1. Inclinometers for ground instrumentation shall be installed and formal initial readings agreed on at least 20 workdays prior to the start of any construction. Data from the ground instrumentation shall be obtained at least three times a week during the construction of the embankment and at least weekly thereafter.

b. Variations in this schedule proposed by the Geotechnical Instrumentation Engineer require the prior review and acceptance by the Engineer.

Storage of Instruments:

All instrumentation materials, after receipt at the site and prior to installation, shall be stored in a secure facility in accordance with the manufacturers' recommendations. The requirements may include indoor, clean, dry, and temperature controlled storage space.

Materials:

a. All materials shall be new.
b. Whenever any product is specified by brand name and model number, such specifications shall be deemed to be used for the purpose of establishing a standard of quality and facilitating the description of the product desired. The term "or approved equal" shall be understood to indicate that the "approved equivalent" product is the same or better than the product named in the specifications in function, performance, reliability, quality, and general configuration. This procedure is not to be construed as eliminating from competition other suitable products of equal quality by other manufacturers. In such cases Contractor may submit complete comparative data to the Engineer for consideration of another product. Substitute products shall not be ordered, delivered to the site, or used in the work unless accepted in writing by the Engineer. The Engineer will be the sole judge of the suitability and equivalency of the substituted product.

c. Any request from the Contractor for consideration of a substitution shall clearly state the proposed alternative, the nature of the deviation from the product specified and the reason for the deviation requested. The Contractor shall also provide documentation supporting the claim of "acceptable equivalent".
d. The Contractor shall furnish specified readout units, together with associated calibration devices and software for making pre-installation and post-installation acceptance tests, for taking any required readings during installation, and for taking additional readings required by the Contractor during the course of the Work. Such readout units shall be identical to the specified readout units and shall be of sufficient quantity to meet the schedule needs of the project.
e. The Contractor shall furnish all installation tools, materials, and miscellaneous instrumentation components necessary to install the required instrumentation in a fully functional state. The Contractor shall provide protection to each instrument to prevent damage by the elements, vandals and the Work activities. The Contractor shall submit proposed protection methods and measures to be used for review and acceptance by the Engineer at least 30 workdays prior to the start of the installation. The Contractor shall maintain and repair all protection measures for the duration of the Contract.
f. For each instrument type, provide an instruction manual which shall include the following:

    1. A description of the purpose of the instrument.
    2. Theory of operation.
    3. Step-by-step procedures for:
        i. Pre-installation acceptance test when instruments are received on site, to ensure the instruments are functioning correctly before installation.
        ii. Calibration of readout units.
    4. A list of calibration equipment required, and recommended frequency of calibration.
    5. Step-by-step instrument installation procedure including materials, tools, spare parts and any borehole requirements, and post-installation acceptance tests.
    6. Maintenance procedure.
    7. Step-by-step data collection procedure.
    8. Data reduction, processing, and plotting procedures.

g. Contractor shall provide products, materials, and equipment in conformance with the Plans and Special Provisions so as to fulfill the requirements of the instrumentation work.
h. All measurements, dimensions and units shall be in U.S. Customary Units, for example, feet, inches, and pounds.
i. Provide inclinometer casing, probe, cable, readout unit, and accessories as manufactured by Slope Indicator Company, or approved equivalent.
j. Inclinometer casing shall be ABS plastic or acceptable equivalent with a minimum outside diameter of 2.75-inch and with adequate wall thickness to withstand external ground pressures but with flexibility enough to reflect horizontal ground movement. The casings shall have broached internal keyways equally spaced 90 degrees apart, with twist-tolerance better than one degree per 10-foot of length, and shall be compatible with other components of the inclinometer. Couplings shall be of the telescoping type to permit the casing to adjust to compression of the foundation.
k. Probe shall be Slope Indicator Company Model No. 50302510, or approved equivalent. Probe shall be supplied in a carrying case. Probe shall be biaxial consisting of two force balance accelerometers mounted at 90 degrees, with a 2-foot wheelbase.
l. The control cable shall Slope Indicator Company Model No. 50601010 or approved equivalent and shall be compatible with sensor and readout unit, 100 feet long, sheathed with neoprene or polyurethane, with vulcanized rubber markers, and an internal wire rope. Minimum cable outside diameter shall be 0.4 inch.
m. Readout unit shall be Slope Indicator Company "Digitilt DataMate" Model No. 50310900, or approved equivalent. The time interval between recordings 2-foot apart in the casing shall be such that the reading stabilizes to within plus or minus one unit of display within eight seconds. The readout unit shall be compatible with inclinometer probe. Readout unit shall include a battery charger.
n. Provide accessories, consisting of end caps, tools, and materials for attaching couplings and taking readings.
o. Provide inclinometer software, DigiPro, as supplied by Slope Indicator Company, or GTILT Plus Version 1.46 or later, as supplied by Mitre Software Corporation, or approved equivalent.
p. Cement grout shall be Type III Portland cement and water. Special grout Type B shall include cement, bentonite, and water, and shall have a 7-day unconfined compressive strength of not less than 300 psf and not more than 500 psf.
q. Provide additional casing to extend the inclinometer up through any added fill.

r. Surface protection shall have a diameter adequate to allow attachment of cable support assembly, or shall allow for an inclinometer casing extension while readings are being taken. The length of the inclinometer casing extension as installed shall not vary by more than 0.05 inches between sets of readings.

Construction:

Pre-Installation Acceptance Tests

a. When instruments are received at the site, Contractor's instrumentation personnel shall perform pre-installation acceptance tests to ensure that the instruments and readout units are functioning correctly before installation. Pre-installation acceptance tests shall include relevant items from the following list:

   1. Examine factory calibration curve and tabulated data to verify completeness.
   2. Examine manufacturer's final quality assurance inspection checklist to verify completeness.
   3. Check cable length.
   4. Check tag numbers on instrument and cable.
   5. By comparing with procurement document, check that the model, dimensions, materials, etc. are correct.
   6. At point of connection to instrument bend cable back and forth while reading the instrument to verify connection integrity.
   7. Perform resistance and insulation testing in accordance with criteria provided by the instrument manufacturer using a gauge insulation or circuit tester that applies 2 volts or less for resistance testing and 15 volts or less for insulation testing.
   8. Verify that all components fit together in the correct configuration.
   9. Check all components for signs of damage in transit.
   10. Check that quantities received correspond to quantities ordered.

b. During pre-installation acceptance testing of each instrument, the Contractor's instrumentation personnel shall complete a pre-installation acceptance test record form. The test record sheet shall include appropriate items from the following list:

   1. Project Name.
   2. Instrument type and number.
   3. Identification of any testing or readout equipment used during testing.
   4. Personnel responsible for testing.
   5. Date and time of test.
   6. Measurements and observations made during testing as specified herein.
   7. Test results, pass or fail.
   8. Notes on any environmental condition or test condition or observed anomaly that might affect subsequent use of instrument or data obtained from it.

c. An instrument that fails the specified pre-installation acceptance test shall be repaired such that it passes a subsequent pre-installation acceptance test or shall be replaced by an identical instrument at no additional cost to the Department.

Installation

a. The Geotechnical Instrumentation Engineer shall install instruments in accordance with the Contractor' detailed step-by-step procedures that were submitted as specified herein, and reviewed by the Engineer.
b. All instrumentation shall be installed and furnished in accordance with the details shown on the Plans and requirements of the Specifications at the locations indicated or as directed by the Engineer.
c. Installation procedures for inclinometer and deep bench marks shall be such that all steps in the procedure can be verified in a quality assurance program. Granular bentonite shall be placed in depth increments not exceeding 1 foot. Volumes of each increment of backfilling with sand and bentonite shall be small enough such that no bridging occurs, and the depth to the top of each increment shall be checked after placement with sounding hammer.
d. Grout shall be placed using a tremie method with side discharge ports on the tremie pipe.
e. Prior to installing any instrument through drill casing or augers, all material adhering to the inside of the casing or augers, and all cuttings, shall be removed thoroughly.

f. Whenever withdrawing drill casing or augers during instrument installation in a borehole, care shall be taken to minimize the length of unsupported borehole and the rate of casing or auger withdrawal. Collapse of the borehole shall not be allowed to build up inside the casing or auger such that the instrument is lifted as the casing or auger is withdrawn. The casing or auger shall be withdrawn without rotation. The casing or auger may be omitted, if allowed by the Engineer, only where is can be shown that instrument installation without the casing or auger will not cause collapse of the borehole or in any way adversely affect instrument installation. If casing or augers are omitted, or the Engineer allows withdrawal of casing or augers prior to instrument installation, the following requirements shall apply. The instrument shall be installed in the borehole in a continuous operation, starting when instrumentation materials are first placed in the borehole, and shall not be interrupted prior to complete backfilling of the borehole to the ground surface. Partially completed instrument installations shall not be left in unsupported boreholes overnight without the prior written concurrence of the Engineer.
g. The Contractor shall notify the Engineer at least 2 workdays prior to installing each instrument.
h. Contractor's data will be accepted by the Engineer only if the data are obtained from instrumentation furnished, calibrated, tested, installed, and maintained as specified herein.
i. As each instrument is installed, an installation record sheet shall be prepared, including appropriate items from the following list:

    1. Project Name.
    2. Contractor name and number.
    3. Instrument type and number, including readout unit.
    4. Planned location in horizontal position and elevation.
    5. Planned orientation.
    6. Planned lengths and volumes of backfills.
    7. Personnel responsible for installation.
    8. Plant and equipment used, including diameter and depth of any drill casing or auger used.
    9. Date and time of start and completion.
    10. Spaces on record sheet for necessary measurements or readings required at hold points during installation to ensure that all previous steps have been followed correctly, including instrument readings made during installation.
    11. Type of backfill used.
    12. As-built location in horizontal position and elevation including the elevation referenced to the Project Elevation Datum, together with the location of the point used for the elevation measurement.
    13. As-built orientation.
    14. As-built lengths and volumes of backfill.
    15. Results of post-installation acceptance test.
    16. Weather conditions at the time of installation.
    17. A space on record sheet for notes, including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.

j. Any instrument that fails the specified post-installation acceptance test shall be replaced by an identical instrument at no additional cost to the Department.
k. Instrumentation shall include maintaining instrumentation throughout the Contract.
l. Damaged instrumentation shall be repaired or replaced at the expense of Contractor. The repair or replacement shall occur within one week of notification of damage by the Engineer, unless otherwise specified.
m. The Contractor shall submit updated as-built instrument location plans to the Engineer. The location plans shall be reproducible composite plans of all installed instruments plotted on 11-inch by 17-inch or 24-inch by 36-inch sheets at a scale of 1 inch = 30 feet. The first plans shall be submitted within 20 workdays after completion of the first instrument installation, regardless of instrument type. Update plans shall be submitted every 4 calendar weeks. Updated plans need not be submitted for periods during which no instruments have been installed.
n. The Contractor shall label each instrument with the instrument number. Numbers shall be unique for the project. The label shall be permanent and visible without having to remove protective measures. The reference mark and orientation required for instruments shall be clearly marked on the instrument in a permanent manner.
o. Inclinometer casings shall be installed at the locations and depths indicated or as directed by the Engineer, and according to the manufacturer's recommendations. The Engineer reserves the right to modify the locations, number, and depth of the instrument based on the materials encountered in the boreholes during installation. After installation, the casing groove spiral shall not exceed one degree per 10 feet of length,

the orientation of the grooves at the top of the casing shall be within 10 degrees of the planned orientation, and no part of the casing shall deviate from vertical by more than 4 percent of the depth to that part.

p. Correct casing groove orientation shall be maintained throughout installation. Once installed the casing cannot be rotated to align the grooves.
q. Telescoping couplings should be installed in the fully extended position.
r. After completion of installation, the as-built location in horizontal position shall be determined to an accuracy of ±0.03 foot, and the elevation of the top of the inclinometer casing to an accuracy of ±0.01 foot. The point selected to determine horizontal position shall be marked on the casing and indicated on the installation record sheet.
s. Place protective cap on the bottom of the inclinometer casing and seal with ABS solvent cement to provide a waterproof seal.
t. Assemble additional sections of inclinometer casing using appropriate couplings and lower them into the hole. Fully extend telescoping casing sections and ensure that seals are watertight.
u. After completion of installation but before the grout has set, a post-installation acceptance test shall be performed to verify that there is no grout in the inclinometer casing, that groove orientation is correct, and that the inclinometer probe tracks correctly in all four orientations. After the grout has set, a check shall again be made to verify that the inclinometer probe tracks correctly in all four orientations.
v. Install protective terminal box with locking cover over the top end of the inclinometer casing. Lock cover.
w. Each inclinometer installation shall be marked with a survey stake 3 feet long and tied with flags to clearly show its location and to warn equipment operators and others of its location. Contractor shall maintain the stakes and flags during the entire period of this Contract, and replace those that are missing.
x. Contractor is responsible for maintaining the inclinometers in working order during the period of this Contract. This includes raising and lowering inclinometer casing with preload fill. Sections shall be added and removed as necessary to maintain the top of the inclinometer casing at least 1 foot but no more than 5 feet above the surface of the fill. As each additional inclinometer casing is added, Contractor shall immediately lower the "dummy" probe into the inclinometer casing up to the bottom in two directions to ensure that the four grooves are free of obstructions over their entire length. Instruments damaged by Contractor's construction operation shall be repaired or replaced by Contractor at Contractor's expense, to the satisfaction of the Engineer.

Field Calibration and Maintenance

a. The Geotechnical Instrumentation Engineer shall conduct regular field calibrations and maintenance of readout units used for the Contractor's monitoring program and regular maintenance of field terminals and accessible instrument components. Regular field calibrations shall be made at least every three months.
b. On each day during which initial inclinometer readings are to be made by the Contractor, the Geotechnical Instrumentation Engineer shall verify inclinometer repeatability by lowering the inclinometer probe to a stable depth in one selected inclinometer casing, at a depth below the water table where verticality of the casing is within ± 0.5% of vertical, wait for temperature stabilization, take readings on both box, rotate probe 180 degrees and repeat readings, and determine the algebraic differences for both the A-A and B-B axes. The standard deviation of this A-axis difference all the previous such A-axis differences shall not be greater than 0.0002 ft over a 2 ft interval. The standard deviation of the B-axis difference and all the previous such a-axis differences shall not be greater than 0.0006 ft over a 2 ft interval. If no installed inclinometer casing satisfied the specified criteria for verticality and stability, the Geotechnical Instrumentation Engineer shall construct a test length of inclinometer casing that satisfies these criteria and shall use the test length for field calibration.

Data Collection

a. The Contractor's Geotechnical Instrumentation Engineer shall check the validity of formal initial readings, and shall sign agreement to such readings. No instrument will be accepted or paid for until formal initial readings are agreed upon as specified herein.
b. Contractor's data and formal initial readings shall be recorded on field data records, which shall include at least the following:
    1. project name
    2. contract name and number
    3. instrument type
    4. date and time
    5. observer
    6. readout unit number
    7. instrument number

8. readings
9. remarks
10. visual observations
11. other casual data including weather, temperature, and construction activities.

Contractor's data shall be recorded in U.S. Customary Units, such as feet, inches, pounds.

c. This definition of readings shall apply to all data obtained by the Contractor:

   1. An inclinometer reading is defined as a set of readings at 2-foot intervals throughout the casing, and a second set at 180 degrees to the first set. A formal initial inclinometer reading will be selected from three readings as defined above, involving six complete traverses along the casing. Each reading (one set plus one set at 180 degrees) other than the formal initial reading shall be a single reading. Check sums (sum of two readings at the same depth but 180 degrees apart) shall be examined in the field. Except where obvious imperfections in the casing have affected the check-sums, the standard deviation of A- and B-axis check-sums over a 2-foot interval shall not exceed 0.0005 foot and 0.0010 foot, respectively.

d. The Contractor's geotechnical instrumentation personnel and the Engineer shall meet at least once per week following the start of instrument installation to examine data, resolve any incompatibilities, and discuss any issues associated with the monitoring programs. Procedures for resolving incompatibilities of data may include comparing measurement procedures, taking simultaneous readings and comparing results, and checking and comparing calibration procedures. These meetings may be onsite, offsite, or via the teleconference as directed by the Engineer.
e. Readings of each instrument shall be performed at least once per week starting after the initial reads described above and at least two weeks prior to starting of embankment construction, continuing at least twice weekly during the embankment construction and shall be at least once per week for 5 months after completion of the embankment.

Data Reductions, Processing, Plotting and Reporting

a. All data submitted by the Contractor shall be of the following form:
   1. Raw and reduced data shall be on summary tables in printed tabular format on 8-1/2 inch x 11 inch sheets of paper.
   2. Inclinometer data shall be provided in DigiPro format.
   3. Plots of inclinometer data shall be "cumulative change" data, showing absolute horizontal deformation versus depth, and "change" data showing incremental deflection versus depth, and shall be prepared on 8-1/2 inch x 11 inch sheets using DigiPro software. The top of the inclinometer casing (excluding any extension length added during data collection) shall be used as a datum for depth measurement. Multiple plots shall be on the same sheet to provide a time history, each labeled with the date. Each plot shall include the instrument numbers, station, and offset.
b. By the end of the first work day in each week, the Contractor shall submit to the Engineer a description of the work performed during the previous week including:
   1. A summary of filling activities. This summary shall include a location plan and a description of where filling has occurred during the week, together with plots of the elevation of the top of the fill versus station, showing a plot for the current date and one each for the three previous weeks.
   2. A description and location of any construction activities other than excavation and filling, including any surcharge caused by temporary construction loads.
c. If the Contractor collects data from an instrument that has been installed to replace a damaged instrument, the formal initial reading for the damaged instrument shall be used as an initial reading for the replacement instrument so that data are plotted continuously, without an offset at the time of damage. The time of damage and replacement shall be noted on the plot.

Damage to Instrumentation

a. The Contractor shall protect all instruments and appurtenant fixtures, leads, connections, and other components of instrumentation systems from damage due to construction operations, weather, traffic, use, and vandalism.
b. If an instrument is damaged or inoperative, the Contractor shall repair or replace the damaged or inoperative instrument within 3 workdays at no additional cost to the Department. The Contractor shall notify the Engineer at least 1 full workday prior to repairing or replacing a damaged or inoperative

instrument. The Engineer will be the sole judge of whether repair or replacement is required. The Department holds the right to withhold progress payments in the event that the Contractor fails to repair or restore damaged or inoperative instrumentation within 3 workdays. The Engineer may impose a work stoppage in the vicinity of the damaged instrument until it is again operational, at no additional cost to the Department.

Interpretation of Data

a. The Engineer shall interpret the data collected under this contract. The Contractor may independently interpret for its own purpose the data collected for the purpose of controlling the safety of the work.
b. The following table provides Threshold and Limiting Values for selected instruments. These values shall be defined collectively as Response Values. The actions associated with these Response Values are defined as well. Response Values may be adjusted by the Engineer as indicated by prevailing conditions or circumstance.

RESPONSE VALUES

INSTRUMENT	THRESHOLD VALUE	LIMITING VALUE
Inclinometer	Accumulated Lateral Deflection of 1.0 inches or Shear of 3%	Accumulated Lateral 80% of the Deflection of 2.0 inches or Shear of 6%

c. If a Threshold Value is reached the Contractor will:
   a. Immediately notify the Engineer.
   b. Meet with the Engineer to discuss response actions.
   c. Provide response actions to be taken.
d. If the Limiting Value is reached, the Contractor may also be required by the Engineer to initiate one or more of the following response actions in addition to those specified herein before:
   a. Install additional instruments.
   b. Modify construction procedures.
   c. Prepare and implement a plan of action as discussed above.
e. The Contractor shall take all necessary steps to avoid exceeding the Limiting Values. If limiting values are reached, the Contractor may be directed by the Engineer to suspend activities in the affected area and/or to undertake remedial actions to reduce readings to below Limiting Values.

Disposition of Instruments.

1. All instruments shall remain in place except those that may be removed or abandoned, as directed by the Engineer because of interference with the construction. When directed by the Engineer, remove and dispose of those portions of all instruments, including terminal boxes and covers, which are readily accessible. Grout all remaining open portions of the boreholes and inclinometer casings, backfill the area, patch pavement of surface, and restore to the Engineer's satisfaction. Grout shall be cement grout consisting of Type III Portland cement and water. No instrumentation shall be demolished, abandoned, removed, or disposed of without prior approval of the Engineer.
2. All surfaces affected by installation of instruments shall be restored to the original condition prior to completion of the work.

Method of Measurement:

The Inclinometer will be measured per Each satisfactorily installed and maintained as described in this specification or as directed by the Engineer. Drilling of holes, temporary casing, covers, and incidental items necessary for installation of the instruments and abandonment of instruments no longer required, including filling of holes with grout, and all readings and data reduction will not be measured separately for payment. These costs will be considered incidental to these items.

Method of Payment:

Inclinometers shall be paid for Each, complete in place, which price shall be full compensation for all equipment, materials, tools, labor, all readings and data reduction, and necessary incidentals to complete the work.

8/30/16

202560 - CONTAMINATED MATERIAL

Description:

Contaminated Material is defined as solids or liquids (including soil) potentially contaminated with a hazardous substance, requiring special handling and/or disposal per state or federal regulation.

This work describes the excavation, removal and treatment/disposal of contaminated materials resulting from project construction including utility and other types of excavation activities in accordance with the locations and notes on the Plans, and as directed by the Engineer or the Department's environmental representative. The Contractor will be notified of the Department's environmental representative at the pre-construction meeting.

Overview of Costs:

Potential contaminated solids may affect contractor's costs as follows;
Additional cost to normal excavation requirements:
-Cost of 8 mil plastic for placement under and over solid contaminated material,
-Maintaining the segregated contaminated solids staging area.
Reduced cost to normal excavation requirements:
-Not required to, or charged for, loading of contaminated material from stockpile.
-Not required to, or charged for, transport of contaminated material from site.
-Not required to, or charged for, disposal of contaminated soil.

Potential contaminated liquids will affect contractor's cost as follows;
Additional cost to normal excavation requirements:
-None
Reduced cost to normal excavation requirements:
-Not required to, or charged for, transport of contaminated material from site.
-Not required to, or charged for, disposal of contaminated water and sediment.

Construction Methods and Responsibilities:

Contractor's Responsibilities for potential contaminated solids:

The Contractor shall be responsible for providing the appropriate equipment and personnel necessary to excavate, and stockpile or direct load contaminated material for off-site disposal, as identified from previous site environmental investigations or identified during construction activities. The work will be performed in accordance with the procedures described in the site specific "Contaminated Material and Water Removal Work Plan" prepared by the Department's environmental representative. The Department will provide a copy of this plan after the project is awarded and before any work begins. The Contractor shall adhere to applicable Occupational Safety and Health standards, Guidelines and/or Laws. This will include compliance with 29 CFR Part 1910. The loading of stockpiled contaminated material and the off-site disposal of contaminated solids will be the responsibility of DelDOT's environmental representative.

After award of the Contract, the Contractor shall immediately be responsible for notifying the Department's HAZMAT Program Mananger's office (760-2108) for scheduling coordination with the environmental representative. The contractor shall submit a proposed schedule of work to the Department for review and approval prior to any commencement of work on this site. The Contractor is required to perform to a high standard of workmanship to assure protection of workers, local water supplies, and the environment. The Contractor shall coordinate with the utility companies prior to excavation. The Department's environmental representative shall be present during all phases of work associated with the excavation and removal of potentially contaminated material. Payment will not be made for any work done when a Department approved Inspector or environmental representative is not present to provide environmental oversight.

Specific tasks to be performed by the Contractor will include excavating soil per the project specifications. The Contractor will segregate "contaminated" soil as designated by the Department or their environmental representative, from "clean" soil and place the "contaminated" soil in a designated on-site staging area

constructed by the Contractor. At a minimum the staging area needs to be lined with 8-mil plastic and a berm constructed to minimize storm water run-off. The "contaminated" soil will need to be covered by the Contractor at the end of each work day. When possible, instead of stockpiling, the Contractor will be responsible for direct loading contaminated soil onto trucks arranged by the Department's environmental representative to be shipped off-site to a licensed disposal/treatment facility. The Contractor will backfill and compact the excavated area(s) according to the project specifications and payment will be made under that item of the Contract.

Department's Responsibilities:

The Department is responsible for providing and paying; the environmental representative; the loading of stockpiled contaminated material; the transportation of contaminated material for disposal; and the disposal of contaminated material.

The "Contaminated Material and Water Removal Work Plan" will identify; the procedures to be used to excavate and stage the contaminated material; the licensed treatment/disposal facility where the Department will ship the contaminated material; the method the material will be transported to the treatment/disposal facility; and any additional health and safety requirements for site personnel.

The Department's environmental representative will conduct a health and safety briefing prior to commencement of activities on the sites to insure an understanding of all applicable standards, guidelines, laws, procedures, etc. consistent with the successful completion of this type of activity. The Department's environmental representative will conduct air monitoring during any excavation activities at the site to identify and mitigate fire, explosion and vapor hazards.

The Department's environmental representative shall coordinate the excavation activities with all applicable local, state, and federal environmental regulatory agencies. The Department's environmental representative will also oversee the excavation, removal and treatment/disposal of the material in the designated area(s) and perform such tests as field screening for soil contamination utilizing vapor monitoring techniques and collect soil samples for laboratory analysis to meet the requirements of the treatment/disposal facility, DNREC and/or the USEPA. The Department's environmental representative's personnel will subcontract with the disposal/treatment facility to provide transportation and disposal/treatment of all contaminated materials to be removed as part of the project. The Department's environmental representative is responsible for measuring the quantity of contaminated material removed, via certified scale weights, for the Department's records.

Method of Measurement:

The quantity of contaminated material will not be measured. It will be included in the excavation quantity.

Basis of Payment:

No additional payment will be made for the handling of contaminated material included in the excavation quantities. Contractor's costs for handling contaminated material as described herein are to be included in the standard excavation pay items included in this contract, and will constitute full compensation for excavation, constructing and maintaining the segregated soil staging area, placement of the contaminated soil in the staging area or direct loading into trucks arranged by the Department’s environmental representative, and providing plastic and daily covering of the segregated soil staging area.

8/30/16

209505 - EXPANDED POLYSTYRENE

Description:

1.01 General

This work shall consist of furnishing and installation of block-molded expanded polystyrene lightweight fill for use in highway approaches referred to herein after as "EPS Wall" structures on soft ground, as indicated on the Contract Drawings or as directed by the Department. This work shall also consist of preparing shop drawings indicating the proposed layout of all the EPS blocks, inter-block connector, and all accessory items. All labor, material, equipment and incidental necessary to complete this work shall be considered part of this item required to complete the work of this Section.

1.02 Definitions

For the purpose of this specification, the following definitions are used for the parties indicated below, involved with EPS Wall applications on this contract.

EPS-Block Fill Structure:
An assemblage of EPS blocks forming an embankment structure that constitutes part of this contract.

Molder:
Is the company actually manufacturing the EPS blocks used for the proposed EPS Wall structures. In the event several EPS molders are supplying EPS blocks to this contract, one Molder shall be designated as the Primary Molder and assume the responsibility for all EPS block material supplied to this contract and its compliance with the requirements of this specification. All references herein after to the "Molder" shall be taken to mean the Primary Molder if there are multiple molders.

Supplier:
Is the company having the contractual relationship with the Contractor for the supply of the EPS blocks. This may be the Molder (or Primary Molder in case of multiple molders) directly or an intermediary company (typically a distributor of construction and / or geosynthetic products manufactured by others). Were appropriated, the Supplier may delegate certain tasks of this Specification to the Molder or Primary Molder.

EPS-block grade:
Refers to one of the AASHTO material designation types indicated in Table 1 of this specification.

1.03 References

a. General
   Comply with the provisions of the following codes, specification and standards except as otherwise indicated

   1. ASTM D6817 – Standard Specification for Rigid Cellular Polystyrene Geofoam
   2. ASTM C203 – Breaking Load and Flexural Properties of Block-type Thermal Insulation
   3. ASTM C578 – Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
   4. ASTM C303 – Standard Test Method for Dimensions and Density of Preformed Block and Board-Type Thermal Insulation
   5. NCHRP Web Document 65
   6. NCHRP Report 529 Guideline and Recommended Standard for Geofoam Applications in Highway Embankments

1.04 Submittals

A. Product Data:

Molder's product data, installation instructions, use limitations and recommendations for each material specified herein shall all be submitted for review and approval by the Engineer. Certifications shall be provided stating that materials comply with requirements.

B. Shipping Plan:

As part of Phase I Manufacturing Quality Assurance (MQA) Supplier Pre-certification requirements the Contractor shall submit its proposed shipping procedure for the EPS block to the Engineer for review. Such procedure shall include protective measures during shipping to avoid any damage to the blocks including crushing to the edges, sides and corners of blocks. Timber cribbing with straps, tarp attached to the truck or other effective means may be proposed to secure the blocks to the transporting vehicle. Alternatively, closed container trucks may be used to transport the blocks to the Project construction site.

C. Shop Drawings:

a. As described in Section 1.05.B, Contractor shall submit full-size shop drawings to scale for each EPS-Block Fill structure on this contract, indicating the proposed location and layout of all EPS blocks, inter-block connectors, and all accessory items to be used. The submitted drawings shall include, but not limited to, plans, elevations, cross-sections showing profiles and cross-slopes, location of connectors between EPS blocks, connections and accessory items as necessary.

b. Contractor shall include on the submitted shop drawings a step-by-step description of the installation and construction procedure proposed for the EPS-Block Fill structure on this contract. Installation and construction sequence, supplemented by drawings as necessary, of the EPS blocks, pavement system and utilities shall all be included. EPS block sizes and laying pattern as well methods of temporarily ballasting and stabilizing EPS blocks to prevent movement during construction, prior to placement of the Load Distribution Slab, as applicable, shall all be identified.

c. Shop drawings, working drawings, installation and construction procedures and supporting calculations shall all be stamped by a professional engineer registered in the State of Delaware.

d. All details different than those depicted on the Contract drawings, required in support of the construction procedures shall be engineered by the Contractor. All Contractor engineered items shall be stamped by a professional engineer registered in the State of Delaware. All such details shall be reviewed and approved by the Engineer prior to construction.

e. The layout of all EPS blocks and attachments shall be in conformance with the design details shown on the contract documents.

D. Manufacturing Quality Control (MQC) Submittals:

Submit the following manufacturing quality control submittals:

a. Test Compliance:

1. The Contractor shall supply a summary of test compliance with specified performance characteristics and physical properties for the EPS blocks and galvanized steel connector plates for review and approval by the Engineer.

b. Certificates:

1. The Contractor shall supply for review and approval by the Engineer, hard copy product certificates showing compliance to the Material properties stated in this specification. Product certificates shall be signed by the Supplier to certify material compliance with the specified performance characteristics, criteria and physical requirements outline in this specification.

2. The Contractor shall indicate in writing to the Engineer whether or not the Supplier has a Third Party Certification. If Third Party Certification is offered, this notification shall be accompanied by documentation that indicates the business entity providing the Third Party Certification and describes in detail the steps to be taken by this agency to verify the Molder's compliance with the specific requirements of this specification. Acceptance of the Molder's Third Party Certification by the Engineer will not waive the need for pre-construction product submittal and testing as specified in Sections 1.05.B.2 and 1.05.B.3.

3. The Contractor shall submit, for the Department's acceptance, Supplier's standard warranty document or certificate executed by an authorized company official. Supplier's warranty is in addition to, and not a limitation of other rights the Department may have under contract documents.

1.05 Manufacturing Quality Assurance (MQA)

A. General Requirements:

a. Manufacturing Quality Assurance (MQA) of the EPS-Block product will be conducted to verify the Molder's Quality Control (MQC) procedures. The Contractor shall employ the services of an Independent Testing Agency or laboratory (ITA) to perform all MQA duties unless the Department notifies the Contractor otherwise.

b. MQA of the EPS-Block will consist of two phases:

   1. Phase I MQA – Supplier Pre-certification, which consists of pre-certification of the Supplier and shall be conducted prior to shipment of any EPS blocks to the Project construction site. Phase I MQA is covered in Section 1.05.B of this specification.

   2. Phase II MQA – Block Verification, which is conducted as the EPS blocks are delivered to the Project construction site. Phase II MQA is covered in 1.05.D of this specification.

c. Regulatory Requirements: Installation must comply with the requirements of all applicable local, state and national jurisdictions.

d. Pre-installation Meeting: A pre-installation meeting shall be held to verify Project requirements, substrate conditions, and details relative to the manufacturing, shipping and placement of the EPS-Block. The meeting shall involve the Contractor, the ITA, Engineer and EPS Supplier.

e. Construction Quality Control: Contractor shall be directly responsible for all Construction Quality Control (CQC). Items covered by CQC include all earthwork and related activities other than manufacturing and shipment of the EPS blocks.

f. Previously used EPS blocks are not allowed in part or in full on any and all EPS Wall structures on this contract.

B. Phase I MQA – Supplier Precertification

No EPS blocks shall be shipped to the Project construction site until such time as all parts of Phase I MQA - Supplier Pre-certification, as specified in this section, have been completed in the order listed below:

a. The Contractor shall supply a scale with sufficient capacity and precision for weighing of the EPS blocks. This scale shall be delivered to the Project construction site or to an alternate location specified by the Engineer. This scale shall be calibrated within six months of delivery to the site, and certification of such calibration made submitted to the Engineer.

b. The Contractor shall deliver a minimum of three full-size EPS blocks for each AASHTO EPS-Block grade to be used on this contract to a location specified by the Engineer. These blocks shall in all respects be the same as the blocks to be supplied to this contract, including required seasoning as described in Section 1.06.C.

c. The ITA will weigh and measure each of the three blocks of each grade of EPS supplied. The ITA will sample and test at least one of the three blocks of each grade, selected randomly, to evaluate the ability of the supplier to deliver EPS blocks for Phase II MQA as discussed in Section 1.05.D. Any EPS blocks not used for testing may be utilized for construction provided they satisfy all the requirements outlined in this specification.

d. The Contractor has submitted shop drawings as required by Section 1.04.C of this specification, and such drawings have been reviewed and approved for construction in conformance with Project standards.

e. Prior to delivery of any EPS blocks to the Project construction site, a meeting shall be held, as a minimum, between the Engineer, ITA and Contractor. The Supplier and/or Molder of the EPS blocks may also attend at the Contractor's discretion to facilitate answering any questions first hand. The purpose of this meeting shall be to review the Phase I MQA results and discuss Phase II MQA as well as other aspects of construction to ensure that all parties are familiar with the requirements of this specification. At the satisfactory conclusion of this meeting, the Contractor shall be allowed to begin on-site receipt, storage (if desired) of the EPS blocks in accordance with Section 1.05.C of this specification.

C. Product Delivery, Storage and Handling:

Prior to delivery of the EPS blocks to the Project construction site, Contractor shall review, plan and implement, with the assistance of the Supplier, a material handling procedure that shall include the following as a minimum:

a. Care should be exercised during shipping to prevent any damage to the EPS blocks. Particular attention should be paid to avoid crushing to the edges, sides and corners of the blocks during shipping from the Molder to the Project construction site. All shipment shall conform to shipping plan as indicated in Section 1.04.B.

b. The Contractor shall prevent any damage to the EPS blocks during delivery, handling, storage, and construction. EPS blocks with cracks of any size are considered not acceptable and shall be rejected and replaced by the Contractor with undamaged equal EPS blocks and no additional cost to the Department. Holes shall not be created in the blocks at any stage of manufacturing or construction to facilitate shipping or handling of the blocks during placement.

c. Each EPS block shall be labeled to indicate the name of the Molder (if there is more than one for a given EPS-Block Fill structure), the date the block was molded, the mass of the entire block in pounds as measured after a satisfactory period of seasoning as specified in Section 1.06.C, the dimensions of the block in inches and the actual dry unit weight in pounds per cubic foot.

   Additional identification markings using alphanumeric characters and/or symbols, applied as necessary by the Supplier, to indicate the location of placement of each block relative to the shop drawing shall also be provided. Stripes of different paint, color can be utilized to identify blocks of higher grade of EPS if multiple grades of EPS are to be supplied for a given EPS-Block Fill structure. If two grades of EPS blocks are to be supplied, the use of no marking shall be considered an acceptable marking for one of the material grades as long as it is used for the lower (lowest) grade EPS blocks supplied for that structure. Any paint, etc. used to mark EPS blocks shall be chemically compatible with EPS and not cause any dissolution of the EPS during application of the paint, etc.

d. If the EPS blocks are to be stockpiled at the construction site until placement, a secure storage area shall be identified and designated by the Contractor for this purpose. The storage area shall be away from any heat source or construction activity that produces heat or flame or would expose the blocks to hydrocarbon fuels (diesel, kerosene, gasoline). In addition, personal tobacco smoking shall not be allowed in the storage area. EPS blocks in temporary on-site storage shall be secured with sandbags and similar "soft" weights to prevent their being dislodged by wind. The blocks shall not be covered in any manner that might allow the build up of heat beneath the cover. The blocks shall not be trafficked by any vehicle or equipment. In addition, foot traffic by persons shall be kept to a minimum.

e. EPS is not an inherently dangerous or toxic material so there are no particular safety issues to be observed other than normal construction safety and protection against heat and flame and hydrocarbon fuels (diesel, kerosene, gasoline) which can cause EPS to melt. However, extra caution is required during wet or cold weather since surfaces of the EPS blocks tend to be more slippery wet than dry. In addition, when air temperature will approach or go below freezing, a thin layer of hoarfrost (ice) can readily develop on the exposed surfaces of EPS blocks if the dew-point is sufficiently high. Thus the surfaces of the EPS blocks can pose particular slip hazards in this condition. The maximum amount of time during which EPS blocks can be stored at the Project construction site shall be limited to a maximum of 30 calendar days.

D. Phase II MQA – Block Verification:

The ITA shall assume the primary responsibility for conducting this phase of the work. Contractor shall cooperate with and assist the ITA in implementing Phase II MQA – Block Verification.

No EPS blocks shall be placed on any structure of this contract until such time as all activities of Phase II MQA – Block Verification, as specified in this section, have been completed successfully in the order listed below:

a. Each block of every grade of EPS delivered on any truck to the construction site shall be inspected on-site visually to check for damage as well as for verification of the labeled information included on each block. Any blocks with damage or not meeting the requirements of the specification shall be rejected on the spot.

b. At least one block of every grade EPS delivered on every truck to the construction site shall be checked to verify its compliance with the requirement of the specifications for the minimum block dry unit weight specified in 2.01.A, as well as the physical tolerances, specified in Sections 2.01.D through 2.01.F, inclusive. Weighing of blocks shall be conducted onsite using a scale with sufficient capacity and precision for weighing of EPS blocks to be supplied by the Contractor in conformance with Section 1.06.B.

c. Should verification of the parameters of Item b above indicates lack of compliance, at least three additional blocks of every grade EPS delivered from the same truck-load will be individually checked. The entire shipment of the grade of EPS in questions shall be rejected should any one of the three additional blocks fails to meet the requirements of the specification for minimum block dry unit weight and physical tolerances outlined above.

d. At least one block of every grade of EPS delivered on the first truck to the construction site for use of any one EPS-Block Fill structure, shall be selected for sampling and testing. Sampling will be at three locations on the block surface. The samples should be approximately square in cross-section and of sufficient width to enable preparing the test specimen required by this specification. The Contractor shall cooperate with and assist the ITA with obtaining the necessary samples and perform the tests under the direction of the Engineer.

e. Laboratory tests will check for compliance with the material properties shown in Table 2 of this specification. Additional block of each grade of EPS shall be selected by the ITA for sampling during the course of construction at a rate of sampling not to exceed one block for every 500 cubic yards of EPS delivered.

f. Portions of sampled blocks that are used for testing are not acceptable for construction. Portions of sampled blocks that are otherwise acceptable can be used as desired by the Contractor provided that they comply with all other requirements of this specification.

g. The Contractor shall allow for early delivery of the EPS blocks to the construction site to allow for conducting laboratory testing of the blocks. For those truckloads where EPS blocks will be selected for sampling and testing per Section 1.05.D, a minimum of 3 business days are required prior to their scheduled installation, to allow for samples to be taken and laboratory testing conducted. Any shipment of EPS blocks, for which the representative samples fail to meet the parameters outlined in this specification, are considered defective and shall be replaced by the Contractor with non-defective EPS block at no additional cost or time to the Department.

1.06 Manufacturing Quality Control (MQC)

A. Manufacturing Quality Control (MQC) of EPS blocks product is the primary responsibility of the Molder. The purpose of this section is to define the parameters for use by a Molder in developing an MQC plan. These parameters will also be those measured as part of the Manufacturing Quality Assurance (MQA) to be conducted by the ITA. MQA requirements are detailed in Section 1.05 of this specification.

B. All EPS blocks shall consist entirely of expanded polystyrene. All EPS blocks shall consist of virgin raw material (expandable polystyrene bead of resin). Previously used EPS blocks are not allowed in part or in full of any and all EPS-Block Fill structures on this contract.

C. All EPS blocks shall be adequately seasoned prior to shipment to the Project construction site. For purposes of this specification, seasoning is defined as storage in an area suitable for the intended purpose as subsequently defined herein for a minimum of 72 hours after an EPS block is released from the mold. Seasoning shall be done within a building or other structure that protects the EPS blocks from moisture as well as UV radiation. The area in which EPS blocks are stored for seasoning shall also be such that adequate space is allowed between blocks and positive air circulation and venting of the structure provided so as to foster the out-gassing of blowing agent and trapped condensate from within the blocks. The Engineer shall be allowed to inspect the structure to be used for seasoning upon request and during normal business days and hours. The supplier may request a shortened seasoning period if the EPS blocks are seasoned within an appropriate heated storage space and the molder demonstrates to the satisfaction of the Engineer that the alternative seasoning treatment produces blocks that equal or exceed the quality of blocks subjected to the normal 72-hour seasoning period.

D. All EPS blocks shall satisfy the product flammability requirements specified in ASTM C578.

E. All EPS blocks shall satisfy the product the material property requirements outlined in Section 2.01 of this specification.

F. All galvanized steel inter-block connectors shall satisfy the requirements outlined in Section 2.02 of this specification.

1.07 Project Conditions

Provide inserts and anchorages which must be built into other work at the time they are needed.

Materials:

2.01 Expanded Polystyrene Block

A. Only AASHTO material type designations shall be used on all correspondence and communication related to this contract. Table 1 indicates the AASHTO material type designations used for the different unit weights of EPS blocks that are covered by this specification. For a given material type, the dry unit weight of each EPS block (as measured for the overall block as a whole) after the period of seasoning as defined in Section 1.06.C of this specification shall equal or exceed that shown in Table 1. The dry unit weight shall be determined by measuring the mass of the entire block by weighing on a scale and dividing the mass by the volume of the block.

AASHTO Material Designation	Minimum Allowable Dry Unit Weight of entire EPS block (pcf)
EPS70	1.35

Table 1. AASHTO Material Type Designations for EPS-Block

B. Table 2 gives the minimum allowable values for the Material Properties corresponding to each AASHTO material type shown in Table 1. These material properties shall be obtained by testing specimens prepared from samples taken from actual blocks produced for the Project covered by this specification for either MQC by the Molder or MQA by the ITA as described in Section 1.06.D and 1.05.D, respectively, of this specification. Testing for material properties shall comply with the following:

a. All test specimens shall be seasoned as specified in ASTM C578.

b. Dry density, compressive strength and flexural strength shall all be measured as specified in ASTM C578.

c. The specimens used for compressive testing shall be cubic in shape with a two (2) inch side length.

d. A strain rate of 10% per minutes shall be used for the compressive strength tests.

e. Both the elastic-limit stress and initial tangent Young's modulus shall be determined in the same test used to measure compressive strength. The elastic-limit stress is defined as the measured compressive normal stress at a compressive normal strain of 1%. The initial tangent Young's modulus is defined as the average slope of the compressive stress versus compressive strain curve between 0% and 1% strain.

AASHTO Material Designation	Dry Density (pcf)	Compressive Strength (psi)	Flexural Strength (psi)	Elastic Limit Stress (psi)	Initial Tangent Young's Modulus (psi)
EPS70	1.35	15	40	10.2	1015

Table 2. Minimum Allowable Values of MQC/MQA Material Properties for Individual Test Specimens

C. Each EPS block shall meet dimensional tolerances as determined in three distinct areas:

a. Variations in linear dimensions as defined in Section 2.01.D

b. Deviation from perpendicularity of block faces as defined in Section 2.01.E.

c. Overall warp of block faces as defined in Section 2.01.F

D. The thickness, width and length dimensions of an EPS block are defined herein as the minimum, intermediate and maximum overall dimensions of the block, respectively, as measured along a block face. These dimensions of each block shall not deviate from the theoretical dimensions by more than ±0.5%.

E. The corner or edge formed by any two faces of an EPS block shall be perpendicular, i.e. form an angle of 90-deg. The deviation of any face of the block from a theoretical perpendicular plane shall not exceed one eight (1/8) inch over a distance of twenty (20) inches.

F. Any one face of a block shall not deviate from planarity by more than one quarter (1/4) inch when measured using a straightedge with a length of ten (10) feet.

G. The EPS shall contain a flame retardant additive and shall have UL Certification of Classification as to External Fire Exposure and Surface Burning Characteristics so as to comply with the Oxygen Index requirements of ASTM C578.

2.02 Inter-block Connectors

A. Inter-block Connectors shall be used to restrain EPS blocks from moving laterally in layer over layer applications. Contractor shall supply samples and test data for the proposed inter-block connectors to comply with Section 2.02.B of this specification for review and approval by the Engineer prior to construction.

B. Inter-block Connections shall be made of 20 gauge (minimum) galvanized steel with two sided multi-barbed design, or approved equal, capable of piercing the EPS up to three quarters (3/4) inch. Each plate shall be capable of a lateral holding strength of at least 60 lbs.

C. The Contractor shall propose a layout for the inter-block connectors for review and approval by the Engineer prior to the start of construction. The layout shall be incorporated on the shop drawings in conformance with Section 1.04.C of this specification.

2.03 Geomembrane

A. Geomembrane (gasoline-resistant) shall consist of a separate, puncture-free geomembrane. The geomembrane shall be flexible and, by its own weight, shall cover and conform closely to 90 degree edges and corners of EPS blocks at ambient temperatures above 45 degrees Fahrenheit, without additional heating of the geomembrane.

B. The geomembrane shall be reinforced or unreinforced geomembranes. It shall be manufactured from a tripolymer consisting of polyvinyl chloride, ethylene interpolymer alloy, and polyurethane or a comparable

polymer combination. It shall meet the following physical and chemical requirements (specified as minimum or maximum, not average roll properties)

a. ASTM D751: Thickness, mils: Minimum 28

b. ASTM D814: Unleaded Gasoline Vapor: Maximum = 0.40 transmission rate, ounces per square foot per 24 hours

c. ASTM D751: Grab tensile strength, pounds: Minimum = 600 both machine and cross direction (1-inch grip, 4-inch by 8-inch sample)

d. ASTM D751: Elongation at break, percent: Minimum = 20; Toughness: Minimum = 14,000 grab tensile times percent elongation (for example: 620 pounds x 23% = 14,260); puncture resistance, pounds: Minimum = 800

e. ASTM D751 (ball tip)

f. ASTM D2136: Cold crack, pass degrees Fahrenheit -30 (1-inch mandrel, 4 hours) factory seams bonded width, inches each seam: Minimum = 2

g. ASTM D751: Shear, pounds (modified per minimum = 320 National Sanitation Foundation Std. No. 54) Fail in base geomembrane material

C. Furnish a Certificate of Compliance stating that the selected geomembrane has been tested, meets the above mentioned requirements, and is:

a. Free from pinholes, tears, and other defects that would cause leakage of liquids through the geomembrane.

b. Acceptable for spill containment of hydrocarbons, including automobile gasoline, aviation gas, diesel fuel, kerosene, hydraulic fluid, methanol, ethanol, mineral spirits, and naphtha.

Construction Methods:

3.01 Construction Quality Control (CQC)

A. The Contractor shall be directly responsible for all Construction Quality Control (CQC). Items covered by CQC include all earthwork and related activities other than manufacturing and shipment of the EPS blocks. Items of particular relevance to the placement of EPS-Block Fill structure are given in Section 3.02 through 3.05, inclusive, of this specification.

3.02 Site Preparation

A. The natural soil subgrade shall be cleared of vegetation, any large or sharp-edged soil particles, any kind of debris and be reasonably planar prior to placing the separation geotextile and sand bedding layer. Reasonably planar is defined as a vertical deviation of no more than 0.5-inch over any 10-ft distance.

B. The separation geotextile shall consist of geotextile conforming to the Specifications Section 827-Geotextile. The sand bedding layer shall consist of sand conforming to the Specifications Section 804-Fine Aggregate. The required smoothness of the sand bedding layer prior to placement of the first layer of EPS blocks shall be no more than ±three-eighth (3/8) of one inch over any ten (10) ft. distance.

C. There shall be no debris of any kind on the sand bedding surface at the time EPS blocks are placed.

D. Unless directed otherwise by the Engineer, there shall be no standing water or accumulated snow or ice on the sand bedding layer within the area where EPS blocks are placed at the time of block placement.

E. EPS blocks shall not be placed on a frozen subgrade nor de-icing salts be used except as directed by the Engineer.

3.03 EPS Block Placement

A. EPS blocks shall be placed at the locations shown on approved shop drawings submitted by the Contractor. Particular care is required if EPS blocks of different density are to be used on EPS-Block Fill structures of this contract.

B. Three shall be no debris of any kind between adjacent surfaces of EPS blocks at the time adjacent EPS blocks are placed.

C. There shall be no standing water or accumulated snow or ice on the previously placed EPS block layer within the area where subsequent EPS blocks are to be placed at the time of block placement.

D. EPS blocks shall be placed so that all vertical and horizontal joints between blocks are tight.

E. While placing successive layers of EPS blocks, Contractor should exercise care to guarantee that all placed blocks are supported over their entire bearing area. In the event the top constructed surface of an assembly of blocks become uneven or where rocking of the blocks is observed, Contractor shall notify the Engineer and propose a remedial procedure for corrective action. Such procedure shall be submitted for review and approval by the Engineer prior to resuming construction.

F. Blocks shall be placed such that the resulting exterior surface on the sides of the EPS-Block Fill structures are vertical and planar within a tolerance of ± one-eighth (1/8) inch between blocks. Block faces not satisfying this criterion shall be field trimmed using a hot wire cutting apparatus supplied by the manufacturer to achieve the desired evenness within the above tolerance.

G. The inter-block connectors shall be placed at the locations shown on the shop drawings and shall be set into the EPS block such that the inter-block connectors do not cause a gap to exist between adjacent layers of EPS blocks.

H. The final surface of the EOS blocks shall be covered as shown on the Contract Drawings. Care shall be exercised during placement of the cover material so as not to cause any damage to the EPS blocks.

I. The surfaces of the EPS blocks shall not be directly traversed by any vehicle or construction equipment during or after placement of the block.

J. With the exception of sand bags or similar “soft” weights used to temporarily restrain EPS blocks against wind, no construction material other than that shown on the contract drawings shall be placed or stockpiled on the EPS blocks.

3.04 Field Quality Requirements

A. Field cutting of EPS blocks shall be permitted, but limited to the use of the following devices:

   a. Hot wire cutters supplied by the manufacturer
   b. Wire saws
   c. Chain saws

B. With the exception of sand bags or similar “soft” weights used to temporarily restrain EPS blocks against wind, no construction material other than that shown on the contract drawings shall be placed or stockpiled on the EPS blocks.

C. At no time shall heat, open flame or motor vehicle fuels be used in proximity to the EPS blocks so as to cause combustion or melting of the EPS.

D. The final surface of the EPS blocks, beneath paved areas shall be covered with a cast-in-place concrete Load Distribution Slab as shown on the Contract Drawings. Care shall be exercised during placement of the cover material so as not to cause any damage to the EPS blocks.

E. The surface of the EPS blocks shall not be directly traversed by any vehicle or construction equipment during or after placement of the blocks.

3.05 Pavement Construction

A. The pavement system is defined for the purposes of this specification as all material placed above the EPS blocks within the limits of the roadway, including any shoulders.

B. The pavement system shall be constructed above the EPS blocks as shown on the contract drawings. Specifications covering construction of the pavement system are given elsewhere in the contract documents.

C. Concrete and reinforcement steel for the Load Distribution Slab shall be installed over the EPS blocks or separation layer using appropriate labor and equipment that will not damage the EPS blocks.

D. No vehicles or construction equipment shall traverse directly on the EPS blocks or on any separation material placed between the EPS blocks and the pavement system. Soil or aggregate for the pavement system layers shall be pushed onto the EPS blocks or separation layer using appropriate equipment such as a bulldozer or a front-end loader. A minimum of 300 mm (12 in.) of soil or aggregate shall cover the top of the EPS blocks or separation layer before compaction commences

3.06 Load Distribution Slab (LDS) Construction

A. The LDS system is defined for the purposes of this specification as the reinforced concrete slab placed above the EPS blocks within the limits indicated in the plans.

B. The LDS system shall be constructed above the EPS blocks as shown on the contract drawings. Specifications covering construction of the LDS system are given elsewhere in the contract documents.

3.07 Precast Wall System

A. The precast wall system is defined for the purposes of this specification are the precast wall facing and footing adjacent to portions of the EPS.

B. The precast wall system shall be constructed as shown on the contract drawings.

3.08 Protection

Protect partial installation and installed product and finish surface from damage during construction in accordance with Section 1.05.C

3.09 EPS Disposal

Contractor shall assume total responsibility for disposal of EPS block material or portions of unused blocks resulting from testing or construction by returning it to the Supplier/Molder for recycling. Such process shall be conducted on a regular basis or as instructed by the Engineer.

3.10 Geomembrane

Where shown in the drawings, shall be as specified in Section 2.03.

3.11 Soil Cover

Soil cover over geomembrane on embankment slopes shall meet requirements of Section 202 of the Specifications.

Method of Measurement:

Expanded Polystyrene will not be measured for payment.

Basis of Payment:

The cost associated with the construction of expanded polystyrene, included but not limited to the design, fabrication, furnishing, installation, and testing of EPS blocks; geotextile, geomembrane, bedding layer sand, the Load Distribution Slab, foundation for the facing panels, and for all materials, labor, tools, equipment, and incidentals necessary to complete the installation in accordance with the Plans and Details shall be incidental to the construction of the pertinent Precast Concrete EPS Wall being placed.

The pavement system above the LDS, concrete and reinforcement for the moment slab, barrier and coping will be measured separately and will be paid for as separate items.

8/30/16

401699 - QUALITY CONTROL/QUALITY ASSURANCE OF BITUMINOUS CONCRETE

.01 Description

This item shall govern the Quality Assurance Testing for supplying bituminous asphalt plant materials and constructing bituminous asphalt pavements and the calculation for incentives and disincentives for materials and construction. The Engineer will evaluate all materials and construction for acceptance. The procedures for acceptance are described in this Section. Include the costs for all materials, labor, equipment, tools, and incidentals necessary to meet the requirements of this specification in the bid price per ton for the bituminous asphalt. Payment to the Contractor for the bituminous asphalt item(s) will be based on the Contract price per ton and the pay adjustments described in this specification.

.02 Bituminous Concrete Production – Quality Acceptance

(a) Material Production - Tests and Evaluations.

All acceptance tests shall be performed by qualified technicians at qualified laboratories following AASHTO or DelDOT procedures, and shall be evaluated using Quality Level Analysis. The Engineer will conduct acceptance tests. The Engineer will directly base acceptance on the acceptance test results, the asphalt cement quality, the Contractor's QC Plan work, and the comparisons of the acceptance test results to the QC test results. The Engineer may elect to utilize test results of the Contractor in some situations toward judging acceptance.

Supply and capture samples, as directed by the Engineer under the purview of the Engineer from delivery trucks before the trucks leave the production plant. Hand samples to the Engineer to be marked accordingly. The sample shall represent the material produced by the Contractor, and shall be of sufficient size to allow the Engineer to complete all required acceptance tests. The Engineer will direct the Contractor when to capture these samples, on a statistically random, unbiased basis, established before production begins each day based upon the anticipated production tonnage. The captured sample shall be from the Engineer specified delivery truck. The Contractor may visually inspect the specified delivery load during sampling and elect to reject the load. If the contractor elects to reject the specified delivery truck, each subsequent load will be inspected until a visually acceptable load is produced for acceptance testing. All visually rejected loads shall not be sent to a Department project.

The first sample of the production day will be randomly generated by the Engineer between loads 0 and 12 (0-250 tons). Subsequent samples will be randomly generated by the Engineer on 500-ton sub-lots for the production day. Samples not retrieved in accordance with the Contractor's QC plan will be deemed unacceptable and may be a basis for rejection of material produced. Parallel tests or dispute resolution tests will only be performed on material captured at the same time and location as the acceptance test sample. Parallel test samples or Dispute Resolution samples will be created by splitting a large sample or obtaining multiple samples that equally represent the material. The Engineer will perform all splitting and handling of material after it is obtained by the Contractor.

The Contractor may retain dispute resolution samples or perform parallel tests with the Engineer on any acceptance sample.

The Engineer will evaluate and accept the material on a lot basis. All the material within a lot shall have the same JMF (mixture ID). The lot size shall be targeted for 2000 tons or a maximum period of three days, whichever is reached first. If the 2000th ton target lot size is achieved during a production day, the lot size shall extend to the end of that production day. The Contractor may interrupt the production of one JMF in order to produce different material; this type of interruption will not alter the determination of the size or limits of material represented by a lot. The Engineer will evaluate each lot on a sublot basis. The size for each sublot shall be 100 to 500 tons and testing for the sub lots will be completed on a daily basis. For each sublot, the Engineer will evaluate one sample.

The target size of sub-lots within each lot, except for the first sample of the production day, is equal-sized 500 ton sub lots and will be based upon anticipated production, however, more or fewer sublots, with differing sizes, may result due to the production schedule and conditions. If the actual production is less than anticipated, and it's determined a sample will not be obtained (based upon the anticipated tonnage), a new sample location will be determined on a statistically random, unbiased basis based upon the new actual

production. If the actual production is going to be 50 tons or greater over the anticipated sub lot production, a new sample location will be determined on a statistically random, unbiased basis based upon the new actual production. The Engineer will combine the evaluation and test results for all of the applicable sublots in order to evaluate each individual lot.

If the Engineer is present, and the quantity exceeds 25 tons, a statistically random sample will be used for analysis. When the anticipated production is less than 100 tons and greater than 25 tons, and the Engineer is not present, the contractor shall randomly select a sample using the Engineer's random location program. The captured sample shall be placed in a suitable box, marked to the attention of the Engineer, and submitted to the Engineer for testing. A box sample shall also be obtained by the contractor at the same time and will be used as the Dispute Resolution sample if requested by the Engineer. The Contractor shall also obtain one liquid asphalt sample (1 pint) per grade of asphalt used per day and properly label it with all pertinent information.

The Engineer will conduct the following tests in order to characterize the material for the pavement compaction quality and to judge acceptance and the pay adjustment for the material:

- AASHTO T312 - Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
- AASHTO T166, Method C (Rapid Method) - Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface Dry Specimens
- AASHTO T308 - Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
- AASHTO T30 - Mechanical Analysis of Extracted Aggregate
- AASHTO T209 - Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
- ASTM D7227 - Standard Practice for Rapid Drying of Compacted Asphalt Specimens using Vacuum Drying Apparatus

(b) Pavement Construction - Tests and Evaluations.

The Engineer will directly base acceptance on the compaction acceptance test results, and on the inspection of the construction, the Contractor's QC Plan work, ride smoothness as referenced in the contract documents, lift thickness as referenced in the contract documents, joint quality as referenced in the contract documents, surface texture as referenced in the contract documents, and possibly the comparisons of the acceptance test results to the independent test results. For the compaction acceptance testing, the Engineer will sample the work on a statistically random basis, and will test and evaluate the work based on daily production.

Notify the Engineer of any locations within that road segment that may not be suitable to achieve minimum (93%) compaction due to existing conditions prior to paving the road segment. Schedule and hold a meeting in the field with the Engineer in order to discuss all areas that may potentially be applicable to Table 5a before paving starts. Areas that will be considered for Table 5a will be investigated in accordance to the method described in Appendix B. If this meeting is not held prior to paving, no areas will be considered for Table 5a. Areas of allowable exemptions that will not be cored include the following: partial-depth patch areas, driveway entrances, paving locations of less than 100 tons, areas around manholes and driveway entrances, and areas of paving that are under 400 feet in continuous total length and/or 5 feet in width.

The exempt areas around manholes will be a maximum of 4 feet transversely on either side from the center of the manhole, and 20 feet longitudinally on either side from the center of the manhole. The exempt areas around driveway entrances shall be the entire width of the driveway, and 3 feet from the edge of the longitudinal joint next to the driveway. Areas of exemption that will be cored for informational purposes only include: areas where the mat thickness is less than three times the nominal maximum aggregate size as directed by the Engineer, violations of Section 401.08 in the Standard Specifications as directed by the Engineer, and areas shown to contain questionable subgrade properties as proven by substantial yielding under a fully legally loaded truck. Failure to obtain core samples in these areas will result in zero payment for compaction regardless of the exempt status. The Engineer will evaluate and accept the compaction work on a daily basis. Payment for the compaction will be calculated by using the material production lots as referenced in **.02 Acceptance Plan (a) Material Production - B Tests and Evaluation** and analyzing the compaction results over the individual days covered in the material production lot. The compaction results will be combined with the material results to obtain a payment for this item.

The minimum size of a compaction lot shall be 100 tons. If the compaction lot is between 101 and 1000 tons, the Engineer shall randomly determine four compaction acceptance test locations. If the compaction lot is between 1001 and 1500 tons, the Engineer shall randomly determine six compaction acceptance test locations. If the compaction lot is between 1501 and 2000 tons, the Engineer shall randomly determine eight compaction acceptance test locations. If the compaction lot is greater than 2000 tons, the Engineer shall randomly determine two compaction acceptance test locations per 500 tons.

If a randomly selected area falls within an Engineer approved exemption area, the Engineer will select one more randomly generated location to be tested per the requirements of this Specification. If that cannot be accomplished, or if an entire location has been declared exempt, the compaction testing shall be performed as per these Specifications but a note will be added to the results that the location was an Engineer approved exempt location.

Testing locations will be a minimum of 1.0 feet from the newly placed longitudinal joint and 50 feet from a new transverse joint.

Cut one six (6) inch diameter core through the full lift depth at the exact location marked by the Engineer. Cores submitted that are not from the location designated by the Engineer will not be tested and will be paid at zero pay.

Notify the Engineer prior to starting paving operations with approximate tonnage to be placed. The Contractor is then responsible for notifying the appropriate Engineer test personnel within 12 hours of material placement. The Engineer will mark core locations within 24 hours of notification. After determination of locations, the Contractor shall complete testing within two operational days of the locations being marked. If the cores are not cut within two operational days, the area in question will be paid at zero pay for compaction testing.

Provide any traffic control required for the structural number investigation, sampling, and testing work at no additional cost to the Department.

Commence coring of the pavement after the pavement has cooled to a temperature of 140°F or less. Cut each core with care in order to prevent damaging the core. Damaged cores will not be tested. Label each core with contract number, date of construction, and number XX of XX upon removal from the roadway Place cores in a 6-inch diameter plastic concrete cylinder mold or approved substitute for protection. Separate cores in the same cylinder mold with paper. Attach a completed QC test record for the represented area with the corresponding cores. The Engineer will also complete a test record for areas tested for the QA report and provide to Materials & Research. Deliver the cores to the Engineer for testing, processing, and report distribution at the end of each production day.

Repair core holes per Appendix A, Repairing Core Holes in Bituminous Asphalt Pavements. Core holes shall be filled immediately. Failure to repair core holes at the time of coring will result in zero pay for compaction testing for the area in question.

The Engineer will conduct the following tests on the applicable portion of the cores in order to evaluate their quality:

- AASHTO T166, Method C (Rapid Method) – Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface Dry Specimens
- AASHTO T209 - Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt
- ASTM D7227 - Standard Practice for Rapid Drying of Compacted Asphalt Specimens using Vacuum Drying Apparatus

The Engineer will use the average of the last five test values of the same JMF (mixture ID) material at the production plant in order to calculate the average theoretical maximum specific gravity of the cores. The average will be based on the production days test results and as many test results needed from previous days production to have an average of five samples. If there are less than five values available, the Engineer will use the JMF design value in addition to the available values to calculate the average theoretical maximum specific gravity.

.03 Payment and Pay Adjustment Factors.

The Engineer will determine pay adjustments for the bituminous asphalt item(s) in accordance with this specification. The Engineer will determine a pay adjustment factor for the material produced and a pay adjustment factor for the pavement construction. Pay adjustments for material and construction will be calculated independently. When the pay adjustment calculation for either material or construction falls to zero payment per tables 4, 5, or 5a, the maximum pay adjustment for the other factor will not exceed 100.

Pay Adjustment factors will only be calculated on in place material. Removed material will not be used in payment adjustment calculations.

Material Production Pay Adjustments will be calculated based upon 70% of the contract unit price and calculated according to section .03(a) of this specification. Pavement construction Pay Adjustments will be calculated based upon 30% of the contract unit price and calculated according to section .03(b) of this specification.

(a) Material Production - Pay Adjustment.

Calculate the material pay adjustment by evaluating the production material based on the following parameters:

Table 2 - Material Parameter Weight Factors

Material Parameter	Single Test Tolerance (+/-)	Weight Factor
Asphalt Content	0.4	0.30
#8 Sieve (>=19.0 mm)	7.0	0.30
#8 Sieve (<=12.5 mm)	5.0	0.30
#200 Sieve (0.075mm Sieve)	2.0	0.30
Air Voids (4.0% Target)	2.0	0.10

Using the JMF target value, the single test tolerance (from Table 2), and the test values, the Engineer will use the following steps to determine the material pay adjustment factor for each lot of material:

1. For each parameter, calculate the mean value and the standard deviation of the test values for the lot to the nearest 0.1 unit.
2. For each parameter, calculate the Upper Quality Index (QU):
   QU = ((JMF target) + (single test tolerance) - (mean value)) / (standard deviation).
3. For each parameter, calculate the Lower Quality Index (QL):
   QL = ((mean value) - (JMF target) + (single test tolerance)) / (standard deviation).
4. For each parameter, locate the values for the Upper Payment Limit (PU) and the Lower Payment Limit (PL) from Table 3 - Quality Level Analysis by the Standard Deviation Method. (Use the column for "n" representing the number of sublots in the lot. Use the closest value on the table when the exact value is not listed).
5. Calculate the PWL for each parameter from the values located in the previous step:
   PWL = PU + PL - 100.
6. Calculate each parameter's contribution to the payment adjustment by multiplying its PWL by the weight factor shown in Table 2 for that parameter.
7. Add the calculated adjustments of all the parameters together to determine the Composite PWL for the lot.
8. From Table 4, locate the value of the Pay Adjustment Factor corresponding to the calculated PWL. When all properties of a single test are within the single test tolerance of Table 2, Pay Adjustment factors shall be determined by Column B. When any property of a single test is outside of the Single Test Tolerance parameters defined in Table 2, the Material Pay Adjustment factor shall be determined by Column C.
9. For each lot, determine the final material price adjustment:

Final Material Pay Adjustment =
(Lot Quantity) x (Item Bid Price) x (Pay Adjustment Factor) x 70%. This final pay calculation will be paid to the cent.

In lieu of being assessed a pay adjustment penalty, the Contractor may choose to remove and replace the material at no additional cost to the Department. When the PWL of any material parameter in Table 2 is below 60, the Engineer may require the removal and replacement of the material at no additional cost to the Department. Test results on removed material shall not be used in calculation of future PWL calculations for Mixture ID.

The test results from the Engineer on production that is less than 100 tons will be combined with the two most recently completed Engineer tests with the same Mixture ID to calculate payment for the lot encompassing the single test. If that cannot be accomplished, the approved JMF will be used to calculate payment for the lot encompassing the single test. Payment for previously closed lots will not be affected by the analysis.

When a sample is outside of the allowable single test tolerance for any Materials criteria in Table 2, that sample will be isolated. For payment purposes, the test result of the out of acceptable tolerance sample will be combined with the two previous acceptable samples of the same JMF and analyzed per this specification. The material that is considered out of the acceptable tolerance will only include the material within the represented sub-lot (i.e., a maximum of 500 tons). If the previous acceptable test result is from the previous production day, only the material produced on the second production day will be considered out of tolerance. All future sub lots will not include the isolated test. The pay factors for the out of tolerance sample lot will be calculated using column C of table 4.

If, during production, a QA sample test result does not meet the acceptable tolerances and the Contractors QC sample duplicates the QA sample test result, the Contractor can make an appropriate change to the mixture (within the JMF boundaries), and request to have that sample further isolated. After the Contractor has made appropriate changes, the Contractor will visually inspect each produced load. The first visually acceptable load will be sampled and tested. If that sample test result shows compliance with the specifications, the material that is considered out of the acceptable tolerance will include the material from the previous acceptable test result to the third load after the initially sampled and tested sample. If the sample does not meet the specification requirements, the Engineer will no longer accept material. Production may resume when changes have been made and an acceptable sample and test result is obtained.

Table 3 – Quality Level Analysis by the Standard Deviation Method

PU or PL	QU and QL for "n" Samples						
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8	n = 9
100	1.16	1.50	1.79	2.03	2.23	2.39	2.53
99	-	1.47	1.67	1.80	1.89	1.95	2.00
98	1.15	1.44	1.60	1.70	1.76	1.81	1.84
97	-	1.41	1.54	1.62	1.67	1.70	1.72
96	1.14	1.38	1.49	1.55	1.59	1.61	1.63
95	-	1.35	1.44	1.49	1.52	1.54	1.55
94	1.13	1.32	1.39	1.43	1.46	1.47	1.48
93	-	1.29	1.35	1.38	1.40	1.41	1.42
92	1.12	1.26	1.31	1.33	1.35	1.36	1.36
91	1.11	1.23	1.27	1.29	1.30	1.30	1.31
90	1.10	1.20	1.23	1.24	1.25	1.25	1.26
89	1.09	1.17	1.19	1.20	1.20	1.21	1.21
88	1.07	1.14	1.15	1.16	1.16	1.16	1.17
87	1.06	1.11	1.12	1.12	1.12	1.12	1.12
86	1.04	1.08	1.08	1.08	1.08	1.08	1.08
85	1.03	1.05	1.05	1.04	1.04	1.04	1.04

84	1.01	1.02	1.01	1.01	1.00	1.00	1.00
83	1.00	0.99	0.98	0.97	0.97	0.96	0.96
82	0.97	0.96	0.95	0.94	0.93	0.93	0.93
81	0.96	0.93	0.91	0.90	0.90	0.89	0.89
80	0.93	0.90	0.88	0.87	0.86	0.86	0.86
79	0.91	0.87	0.85	0.84	0.83	0.82	0.82
78	0.89	0.84	0.82	0.80	0.80	0.79	0.79
77	0.87	0.81	0.78	0.77	0.76	0.76	0.76
76	0.84	0.78	0.75	0.74	0.73	0.73	0.72
75	0.82	0.75	0.72	0.71	0.70	0.70	0.69
74	0.79	0.72	0.69	0.68	0.67	0.66	0.66
73	0.75	0.69	0.66	0.65	0.64	0.63	0.63
72	0.74	0.66	0.63	0.62	0.61	0.60	0.60
71	0.71	0.63	0.60	0.59	0.58	0.57	0.57
70	0.68	0.60	0.57	0.56	0.55	0.55	0.54
69	0.65	0.57	0.54	0.53	0.52	0.52	0.51
68	0.62	0.54	0.51	0.50	0.49	0.49	0.48
67	0.59	0.51	0.47	0.47	0.46	0.46	0.46
66	0.56	0.48	0.45	0.44	0.44	0.43	0.43
65	0.52	0.45	0.43	0.41	0.41	0.40	0.40
64	0.49	0.42	0.40	0.39	0.38	0.38	0.37
63	0.46	0.39	0.37	0.36	0.35	0.35	0.35
62	0.43	0.36	0.34	0.33	0.32	0.32	0.32

Table 3 – Quality Level Analysis by the Standard Deviation Method

PU or PL	QU and QL for "n" Samples						
	n = 3	n = 4	n = 5	n = 6	n = 7	n = 8	n = 9
61	0.39	0.33	0.31	0.30	0.30	0.29	0.29
60	0.36	0.30	0.28	0.27	0.27	0.27	0.26
59	0.32	0.27	0.25	0.25	0.24	0.24	0.24

Table 4 - PWL Pay Adjustment Factors

PWL	Pay Adjustment Factor (%) Column B	Pay Adjustment Factor (%) Column C
100	+5	0
99	+4	-1
98	+3	-2
97	+2	-3
96	+1	-4
95	0	-5
94	-1	-6
93	-2	-7

92	-3	-8
91	-4	-9
PWL<91	PWL - 100	PWL - 100

(b) Pavement Construction - Pay Adjustments.

The Engineer will determine the pavement construction pay adjustment by evaluating the construction of the pavement, based on the following parameter:

- Degree of compaction of the in-place material

Using the test values for the cores, the Engineer will use the following steps to determine the pavement construction pay adjustment for each lot of work. .

1. Calculate the core bulk specific gravity values from the sublot tests values, to the nearest 0.001 unit. Obtain the Theoretical maximum Specific Gravity values from the corresponding laboratory sublot tests.
2. Calculate the Degree of Compaction:
   Degree of Compaction =
   ((Core Bulk Specific Gravity) / (Theoretical Maximum Specific Gravity)) x 100% recorded to the nearest 0.1%.
3. The average compaction for the sublots shall be averaged together for the compaction level of the lot. The lots compaction test level shall be averaged and recorded to the nearest whole percent.
4. Locate the value of the Payment Adjustment Factor corresponding to the calculated degree of compaction from Table 5 or Table 5a.
5. Determine the pavement construction price adjustment by using the following formula:
   Construction Pay adjustment = (Lot Quantity) x (Bid Price) x (Pay Adjustment Factor) x 30%.

Table 5: Compaction Price Adjustment Highway Locations

Degree of Compaction (%)	Range	Pay Adjustment Factor (%)
>= 97.0	>= 96.75	-100*
96.5	96.26 – 96.74	-5
96.0	95.75 – 96.25	-3
95.5	95.26 – 95.74	-2
95.0	94.75 – 95.25	0
94.5	94.26 – 94.74	0
94.0	93.75 – 94.25	1
93.5	93.26 – 93.74	3
93.0	92.75 – 93.25	5
92.5	92.26 – 92.74	3
92.0	91.75 – 92.25	0

91.5	91.26 – 91.74	0
91.0	90.75 – 91.25	-5
90.5	90.26 – 90.74	-15
90.0	89.75 – 90.25	-20
89.5	89.26 – 89.74	-25
89.0	88.75 – 89.25	-30
88.5	88.26 – 88.74	-50
=<88.0	=<88.25	-100*

* or remove and replace it at Engineer's discretion

Table 5A: Compaction Price Adjustment Other[1] Locations		
Degree of Compaction	Range	Pay Adjustment Factor (%)
>= 97.0	>= 96.75	-100*
96.5	96.26 – 96.74	-5
96.0	95.75 – 96.25	-3
95.5	95.26 – 95.74	-2
95.0	94.75 – 95.25	0
94.5	94.26 – 94.74	0
94.0	93.75 – 94.25	0
93.5	93.26 – 93.74	1
93.0	92.75 – 93.25	3
92.5	92.26 – 92.74	1
92.0	91.75 – 92.25	0
91.5	91.26 – 91.74	0
91.0	90.75 – 91.25	0
90.5	90.26 – 90.74	0
90.0	89.75 – 90.25	0
89.5	89.26 – 89.74	0
89.0	88.75 – 89.25	-1
88.5	88.26 – 88.74	-3
88.0	87.75 – 88.25	-5
87.5	87.26 – 87.74	-10
87.0	86.75 – 87.25	-15
86.5	86.26 – 86.74	-20

86.0	85.75 – 86.25	-25
85.5	85.26 – 85.74	-30
85.0	84.75 – 85.25	-40
84.5	84.26 – 84.74	-50
=< 84.0	=<84.25	-100*

* or remove and replace at Engineer's discretion

[1] This chart is to be used for areas where the structural value of the area to be paved is less than 1.75 as determined by the Engineer. See Appendix B - Method for Obtaining Cores for Determination of Roadway Structure. This chart is applicable to rehabilitation work only; full depth construction will not be considered for Table 5a.

.04 Dispute Resolution.

Disputes or questions about any test result shall be brought to the attention of the Contractor and the Engineer within two operational days of reported test results. The following dispute resolution procedures will be used.

The Engineer and the Contractor will review the sample quality, the test method, the laboratory equipment, and the laboratory technician. If these factors are not the cause of the dispute, a third party dispute resolution will be used.

Third party resolution testing can be performed at either another Contractor's laboratory, the Engineer's laboratory, or an independent accredited laboratory. Unless otherwise mutually agreed upon by DAPA and the Engineer, the Engineer's qualified laboratory in Dover and qualified personnel shall conduct the necessary testing for third party Dispute Resolution after the Engineer has provided reasonable notice to allow the Contractor to witness this testing.

When disputes over production testing occur, the samples used for Dispute Resolution testing will be those samples the properly captured, labeled, and stored, as described in the second paragraph of the section of these specifications titled **.02 Acceptance Plan, (a) Material Production - Tests and Evaluations**. If no samples are available, the original testing results will be used for payment calculations.

Dispute Resolution samples for air void content will be heated by a microwave oven.

If there is a discrepancy between the Engineer's acceptance test result and the Contractor's test result, the Contractor may ask for the Dispute Resolution sample to be tested. The Contractor may request up to two dispute resolution samples be tested per calendar year without charge. Any additional Dispute Resolution samples run at the Contractors request where the results substantiate the acceptance test result will be assessed a fee of $125. Any additional Dispute Resolution samples that substantiate the Contractors test result will not be assessed the fee.

When disputes over compaction core test results occur, the Engineer's acceptance core will be used for the dispute resolution sample. The Contractor will be advised on when the testing will occur as referenced above to witness the testing. The results of the dispute resolution testing shall replace all of the applicable disputed test results for payment purposes.

Appendix A - Repairing Core Holes in Bituminous Asphalt Pavement

Description.

This appendix describes the procedure required to repair core holes in a bituminous concrete pavement.

Materials and Equipment.

The following material shall be available to complete this work:

- Patch Material - DelDOT approved High Performance Cold Patch material shall be used.

The following equipment shall be available to complete this work:

- Sponge or other absorbent material - Used to extract water from the hole.
- Compaction Hammer - mechanical (electrical, pneumatic, or gasoline driven) tamping device with a flat, circular tamping face smaller than 6 inches in diameter.

Construction Method.

After core removal from the hole, remove all excess water from within the hole, and prevent water from re-entering the hole.

Place the patch material in lifts no greater than 3 inches and compact with mechanical tamping device. If the hole is deeper than 3 inches, use two lifts of approximately equal depths so that optimum compaction is achieved. Make sure that the patch surface matches the grade of the existing roadway. Make every effort to achieve the greatest possible compaction

Performance Requirements.

The Engineer will judge the patch on the following basis:

- The patch shall be well compacted
- The patch surface shall match the grade of the surrounding roadway surface.

Basis of Payment.

No measurement or payment will be made for the patching work. The Contractor must gain the Engineer's acceptance of the patching work before the Engineer will accept the material represented by the core.

Appendix B - Method for Obtaining Cores for Determination of Roadway Structure

The Contractor is responsible for obtaining cores in areas that they propose are eligible for compaction price adjustments according to Table 5a in this specification. Table 5a is not applicable for new full-depth pavement box construction. Cores submitted for this process shall be obtained according to the following process.

1. Contact Materials & Research (M&R) personnel to determine if information about the area is already available. If M&R has already obtained cores in the location that is being investigated, the contractor may opt to use the laboratory information for the investigation and not core the area on their own.

2. If M&R does not have information concerning the section of the roadway, the contractor needs to contact M&R to arrange for verification of coring operations. Arrangements shall be made to allow for an individual from M&R to be on the site when the cores are obtained. Cores will be turned over to M&R for evaluation.

3. The Contractor is responsible for providing all traffic control and repairing core holes in accordance to 401699 Appendix A - Repairing Core Holes in Bituminous Asphalt Pavements.

4. Cores are to be taken throughout the entire project for the area in question. Cores will be spaced, from the start of the project in increments determined based on field and project specifics. Cores will be evenly distributed throughout the project location. The cores will be taken in the center of the lane in question.

5. Additional cores may be taken at other locations, if surface conditions indicate that there may be a substantial difference in the underlying section. The location of these cores should be documented and submitted to M&R.

6. Cores shall be full depth and include underlying materials. If there is a stone base included in the pavement section, at a minimum 1 core must have information concerning the thickness of the base. This is determined by augering to the subgrade surface.

7. The calculations used to determine the structural capacity of the roadway is as follows. If the contractor finds, upon starting the coring process, that the areas are of greater thickness than applicable to Table 5a, they may terminate the coring process on their own and retract the request.

Structural Number Calculations

Each pavement box material is assigned a structural coefficient based upon AASHTO design guides. The structural coefficient is used to determine the total strength of the pavement section.

Materials used in older pavement sections are assigned lower structural coefficients to compensate for aging of the materials. The coefficients used to determine the structural number of an existing pavement are:

Existing Material	Structural Coefficient
HMA	0.32
Asphalt Treated Base	0.26
Soil Cement	0.16
Surface Treatment (Tar & Chip)	0.10
GABC	0.14
Concrete	0 - 0.7*

* The Structural Coefficient of Concrete is dependent upon the condition of the concrete. Compressive strengths & ASR analysis are used to determine condition - contact the Engineer if this situation arises.

Newly placed materials use a different set of structural coefficients. They are as follows:

New Material	Structural Coefficient
HMA	0.40
Asphalt Treated Base (BCBC)	0.32
Soil Cement	0.20
GABC	0.14

Example:

Location includes placement of a 1.25" Type C overlay on 2.25" Type B. Existing roadway is cored and is shown to consist of 2" HMA on 7" GABC.

Calculation:

For the Type B lift the calculation would be:

Existing HMA	2 * 0.32 =	0.64
GABC	7 * 0.14 =	0.98
		1.62

For the Type C lift the calculation would be:

Newly Placed B	2.25 * 0.4 =	0.90
Existing HMA	2 * 0.32 =	0.64
GABC	7* 0.14 =	0.98
		2.52

11/3/14

401752 – SAFETY EDGE FOR ROADWAY PAVEMENT

Description:

This work consists of the construction of safety edge(s) along bituminous concrete pavement or P.C.C. pavement in accordance with the details and notes on the Plans and as directed by the Engineer.

Construction Methods:

The safety edge shall not be constructed adjacent to curb or in front of guardrail sections.

In bituminous concrete pavement sections, prior to the construction of the safety edge, the fill or in situ material at the edge of pavement shall be compacted so that it is level with the top of the pavement, prior to the final surface overlay.

In bituminous concrete pavement sections, the contractor shall attach a device to the screed of the paver unit that confines the material at the end of the gate and extrudes the asphalt material in such a way that results in a compacted wedge shape pavement edge of 32 degrees (+/- 2 degrees). Contact shall be maintained between the device and the road shoulder surface. The device shall be manufactured so that it can be easily adjusted to transition at cross roads, driveways and obstructions without stopping the paver unit. The device's shape shall constrain the asphalt and cause compaction, as well as increase the density of the extruded profile.

In bituminous concrete pavement sections, the Transtech Shoulder Wedge Maker, Carlson Safety Edge End Gate or an approved equal shall be used to produce the safety edge. Contact information for these wedge shape compaction devices is listed below:

Transtech Systems, Inc.
1594 State Street
Schenectady, NY 12304
1-800-724-6306
www.transtechsys.com

or

Carlson Paving Products
18425 50th Ave. E
Tacoma, WA 98446
1-253-278-9426
www.carlsonpavingproducts.com

or an approved equal.

In P.C.C. pavement sections, the paver screed shall be modified to provide a chamfer at the end of the P.C.C. pavement in accordance with the details and notes on the Plans, or as directed by the Engineer.

Method of Measurement:

Safety Edge will not be measured for payment.

Basis of Payment:

The cost associated with the construction of safety edge(s), including but not limited to the wedge device, preparation and compaction of the fill or in situ material, and placement of the safety edge in accordance with the Plans and Details shall be incidental to the bituminous concrete pavement or P.C.C. pavement item being placed.

10/15/2013

401800 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 115 GYRATIONS, PG 64-22 (CARBONATE STONE)
401801 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 64-22 (CARBONATE STONE)
401804 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 70-22 (CARBONATE STONE)
401807 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 76-22 (CARBONATE STONE)

401809 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 115 GYRATIONS, PG 64-22
401810 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 160 GYRATIONS, PG 64-22
401813 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 160 GYRATIONS, PG 70-22
401816 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 160 GYRATIONS, PG 76-22

401818 - BITUMINOUS CONCRETE, SUPERPAVE, BITUMINOUS CONCRETE BASE COURSE, 115 GYRATIONS, PG 64-22
401819 - BITUMINOUS CONCRETE, SUPERPAVE, BITUMINOUS CONCRETE BASE COURSE, 160 GYRATIONS, PG 64-22
401821 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 64-22, PATCHING
401822 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 160 GYRATIONS, PG 64-22, PATCHING
401823 - BITUMINOUS CONCRETE, SUPERPAVE, BITUMINOUS CONCRETE BASE COURSE, 160 GYRATIONS, PG 64-22, PATCHING
401824 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG-64-22, WEDGE
401825 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 160 GYRATIONS, PG-64-22, WEDGE

401827 -BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 64-22, (NON-CARBONATE STONE)
401830 - BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 70-22, (NON-CARBONATE STONE)
401833 -BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 76-22, (NON-CARBONATE STONE)

401835 - THIN BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 115 GYRATIONS, PG 64-22
401836 - THIN BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 64-22
401838 - THIN BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 70-22
401840 - THIN BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS, PG 76-22

.01 Description:

This specification shall govern the production and construction of bituminous concrete pavement. The following Subsections of the Standard Specifications shall be applicable: 401.01, 401.03 - 401.10, 401.12, and 401.13. All other subsections have been modified herein.

Payment for bituminous concrete shall be in accordance with item 401699. The Contractor shall read and thoroughly understand the requirements of the QA/QC specification as defined in item 401699. It is the responsibility of the Contractor to determine all costs associated with meeting these requirements and to include them in the per ton bids for the various Superpave bituminous concrete items. Payment adjustment factors will be calculated in accordance with the latest version of item 401699.

Bituminous concrete may be produced by one or a combination of several technologies involving asphalt foaming processes and equipment or additives that facilitate the reduction of the temperature at which the mix can be placed and satisfactorily compacted thereby permitting the mix to be produced at reduced temperatures.

.02 Materials:

Use materials conforming to standard specifications 823.

Materials for bituminous concrete shall conform to the requirements of Subsections 823.01, 823.05-823.17, and 823.25 - 823.28 of the Standard Specifications and the following. If the Contractor proposes to use a combination of materials that are not covered by this Specification, the mix design shall be submitted and reviewed by the Engineer 30 calendar days prior to use.

a) **Asphalt Binder:**

Meet the requirements of Superpave performance-grade asphalt binder, as referenced in the Plans, according to M 320 [1], Table 1 and tested according to AASHTO R29 with the following test ranges:

TEST Procedure	AASHTO REFERENCE	SPECIFICATION LIMITS
Temperature, °C	M 320	Per Grade
Original DSR, G*/sin (δ)	T 315	1.00 - 2.20 kPa[1]
RTFO DSR, G*/sin (δ)	T 315	>/= 2.20 kPa
PAV DSR, G*/ sin (δ)	T 315	</=5000 kPa
BBR Creep Stiffness, S	T 313	</= 300.0 kPa
BBR m-value	T 313	>/=0.300

Note 1: The exception to M 320 is that the original DSR shall be 1.00 to 2.20 kPa

Substitution of a higher temperature grade will require prior approval by the Engineer.

The highest low temperature grade virgin binder to be used is -22.

Depending on the level of Recycled materials used, the low temperature properties, per T 313, may be different than stated in M 320 or the previous table.

b) **Recycled Materials:**

RAP (Recycled Asphalt Pavement): Bituminous concrete pavement mechanically processed to a homogenous consistency to be recycled through the production plant for use in a new bituminous concrete mixture.

The percentage allowance of recycled materials (recycled asphalt pavement and/or shingles) shall be controlled through the use of the Materials & Research recycled mixture program available through the Materials & Research Section. The program can be used by the Contractor to determine which materials and combinations of materials can be used to meet the specified material on the contract.

If the Contractor proposes to use a combination of materials that are not covered by this program, the mix design shall be submitted and reviewed by the Engineer.

c) **Shingles:**

RAS (Recycled Asphalt Shingles): Materials reclaimed from the shingle manufacturing process such as tabs, punch-outs, and damaged new shingles mechanically broken down with 100% passing the ½ in (12.5 mm) sieve. Shipping, handling, and shredding costs are incidental to the price of Superpave item.

Post-consumer shingles or used shingles are not acceptable. Fiberglass-backed and organic felt-backed shingles shall be kept separate. Both materials shall not be used in the same mixture at the same time. All shingles shall be free of all foreign material and moisture.

The use of Recycled Asphalt Shingles will be considered for 115 gyration mix designs upon demonstration by the producer of adequate blending of the binder verified by laboratory testing on plant produced material.

d) Mineral Aggregate:

Conform to Section 805 and the following criteria. These criteria apply to the combined aggregate blend.

DESIGN ESAL'S (MILLIONS)	COARSE AGGREGATE ANGULARITY[1] (% MIN)		FINE AGGREGATE ANGULARITY[2] (% MIN)		CLAY CONTENT[3] (% - MIN)	FLAT AND ELONGATED[4] (% - MAX)
	≤ 100 MM	> 100 MM	≤ 100 MM	> 100 MM		
< 0.3	55/-	-/-	-	-	40	-
0.3 to < 3	75/-	50/-	40	40	40	-
3 to <10	85/80[5]	60/-	45	40	45	-
10 < 30	95/90	80/75	45	40	45	-
30	100/100	100/100	45	45	50	10

[1]Coarse Aggregate Angularity is tested according to ASTM D5821.
[2]Fine Aggregate Angularity is tested according to AASHTO TP-33.
[3]Clay Content is tested according to AASHTO T176.
[4]Flat and Elongated is tested according to ASTM 4791 with a 5:1 aspect ratio.
[5] 85/80 denotes that 85% of the coarse aggregate has one fractured face and 80% has two or more fractured faces.

The following source properties apply to the individual aggregates in the aggregate blend for the proposed JMF.

TEST METHOD	SPECIFICATION LIMITS
Toughness, AASHTO T96 Percent Loss, Maximum	40
Soundness, AASHTO T104 Percent Loss, Maximum for five cycles	20
Deleterious Materials, AASHTO T112 Percent, Maximum	10
Moisture Sensitivity, AASHTO T283 Percent, Minimum	80

For any roadway with a minimum average daily traffic volume (ADT) of 8000 vehicles and a posted speed of 35 mph (60 kph) or greater, the polish value of the composite aggregate blend shall be greater than 8.0 when tested according to Maryland State Highway Administration MSMT 411 B ALaboratory Method of Predicting Frictional Resistance of Polished Aggregates and Pavement Surfaces.@ RAP shall be assigned a value of 5.0. The Contractor shall supply all polish values to the Engineer upon request.

e) **Mineral Filler:**

Conform to AASHTO M17.

f) **Warm Mix Additives:**

For any WMA technology requiring addition of any material by the producer during production, the following information will be submitted with the proposed JMF for review and approval at least 30 calendar days prior to production:

1. WMA technology and/or additive information.
2. WMA technology manufacturer's recommendation for usage.
3. WMA technology target dosage rate and tolerance envelope. Support tolerance envelope with test data demonstrating acceptable mix production properties conforming to all sections of this specification.
4. WMA technology manufacturer's material safety data sheets (MSDS).
5. Documentation of past WMA technology field application including points of contact.
6. Temperature ranges for mixing and compacting.
7. Laboratory test data, samples, and sources of all mix components, and asphalt binder viscosity-temperature relationships.

Follow the manufacturer's recommendation for incorporating additives and WMA technologies into the mix. Comply with the manufacturer's recommendation regarding receiving, storage, and delivery of additives.

If the producer performs blending of the WMA technology in their tank, a separate Quality Control plan shall be submitted by the producer to the Department for review and approval at least 30 calendar days prior to production.

g) **Anti-stripping additives**

Conform to standard specifications Section 829 and blend with the asphalt cement in accordance with this specification. Incorporate anti-stripping additives when the Tensile Strength Ratio (TSR) as determined in accordance with AASHTO T283 is less than 80 or when specified for use by the Engineer.

.03 Bituminous Concrete Production – Quality Control

(a) Process Control - Material Production Quality Control.

Submit through electronic mail a QC Plan from each proposed production plant to the Engineer; no hot-mix asphalt material will be accepted until the Engineer approves the QC Plan. This plan must be submitted to the Engineer on an annual basis for review and approval prior to material production. The Engineer will send a signed copy back to the Contractor stating that it is approved. The approved QC Plan shall govern contractor operations.

The QC Plan shall include actions that will assure all materials and products will conform to the specifications, whether manufactured or processed by the Contractor, or procured from suppliers, subcontractors, or vendors. The Contractor shall perform the inspection and tests required to substantiate product conformance to contract requirements. The Contractor shall document QC inspections and tests, and provide copies to the Engineer when requested. The Contractor shall maintain records of all inspections and tests for at least one year. The records shall include the date, time, and nature of deficiency or deficiencies found; the quantities of material involved until the deficiency was corrected; and the date, time, and nature of corrective actions taken.

In the QC Plan shall detail the type and frequency of inspection, sampling, and testing deemed necessary to measure and control the various properties of material and construction governed by the Specifications. The QC Plan shall include the following elements as a minimum:

- Production Plant - make, type, capacity, and location.
- Production Plant Calibration - components and schedule; address documentation.
- Personnel - include name and telephone number for the following individuals:
- Person responsible for quality control.
- Qualified technician(s) responsible for performing the inspection, sampling, and testing.

- Person who has the authority to make corrective actions on behalf of the Contractor.
- Testing Laboratory - state the frequency of accuracy checks and calibrations of the equipment used for testing; address documentation.
- Load number of QC samples (1-10 if QA sample is not within trucks 1-10)
- Locations where samples will be obtained and the sampling techniques for each test
- Tests to be performed and their normal frequency; the following, at a minimum, shall be conducted:
  - Mixture Temperature: each of the first five trucks, and each load that is sampled for QC or acceptance testing.
  - Gradation analysis of aggregate (and RAP) stockpiles - one washed gradations per week for each aggregate stockpile; RAP: five gradations and asphalt cement contents for dedicated stockpiles where new material is not being added; one gradation and asphalt cement content test per week for stockpiles where material is continually being added to the stockpile.
  - Gradation analysis of non-payment sieves
  - Dust to effective asphalt calculation
  - Moisture content analysis of aggregates - daily.
  - Gradation analysis of the combined aggregate cold feed - one per year per mixture.
  - Bulk specific gravity and absorption of blended material - one per year per mixture.
  - Ignition Oven calibration - one per year per mixture.
  - Hot-Bins: one per year per mixture.
  - Others, as appropriate.
- Procedures for reporting the results of inspection and tests (include schedule).
- Procedures for dealing with non-compliant material or work.
- Presentation of control charts. The contractor shall plot the results of testing on individual control charts for each characteristic. The control charts shall be updated within on working day as test results for each sublot become available. The control charts shall be easily and readily accessible at the plant laboratory. The following parameters shall be plotted from the testing:
  - Asphalt cement content.
  - Volumetrics (air voids, voids in mineral aggregates [VMA])
  - Gradation values for the following sieves:
    - 4.75 mm (#4).
    - 2.36 mm (#8).
    - 0.075 mm (#200).
    - Operational guidelines (trigger points) to address times when the following actions would be considered:
      - Increased frequency of sampling and testing.
      - Plant control/settings/operations change.
      - JMF adjustment.
      - JMF change (See 401644 Section .04(a)(1)).
      - Change in the source of the component materials.
      - Calibration of material production equipment (asphalt pump, belt feeders, etc.).
      - Rejection of material.

When any point of non-compliance with the QC plan, or material not meeting the Specifications, comes to the attention of either the Contractor or the Engineer, the other party shall be notified immediately, and the Contractor shall take appropriate corrective actions. Failure to take corrective actions immediately shall be cause for rejection of material or work by the Engineer.

The following are considered significant violations to the Contractor's QC Plan:

- Using testing equipment that is knowingly out of calibration or is not working properly.
- Reporting false information such as test data, JMF information, or any info requested by DelDOT
- Failure to perform materials testing per their approved QC Plan
- Deviating from AASHTO or DelDOT testing procedures.
- Use of any material or the use of a JMF component in a proportion that exceeds the allowable tolerance as specified in section 04(a)(1) of this specification not listed in the JMF.
- Use of the wrong PG graded asphalt.
- Failure to take corrective action per action points in the Contractors approved QC plan.

The following steps will be taken for violations listed above:

1. First offence: Written notice of violation to the Contractor

2. Second offence: Written notice of violation and forfeiture of any bonus (material production or pavement construction) payment eligibility under 401699 section .03 for that production shift.
3. Third offence: Written notice of violation, forfeiture of bonus payment eligibility, and a 5% deduction of payment based upon contract unit price in addition to any calculated pay adjustment factors per 401699 Section 03.
4. Fourth offence: Written notice of violation, forfeiture of bonus payment eligibility, 50% deduction of payment based upon contract unit price in addition to any calculated payment adjustment factor per 401699 Section 03, and immediate suspension of the Contractor until corrective actions are taken. Corrective actions shall be submitted in writing to the Engineer for approval. The Engineer may request a meeting with the Contractor to discuss proposed changes prior to lifting suspension.

Violations of Contractor QC plans shall be kept on record for a period of 1 year from the date of violation at the Central Lab.

(b) Material Production Test Equipment.

Establish, maintain, and operate a qualified testing laboratory at the production plant site of sufficient size and layout that will accommodate the testing operations of both the Contractor and the Engineer.

Facilities for the use of the Engineer and inspectors shall be a minimum of 600 square feet of floor space conditioned to maintain constant temperature of 77F with two windows and a door equipped with functional locks and latches, located such that plant activities are plainly visible from one window of the building. Work space shall be furnished with illumination, tables, chairs, desks, telephone, and water including drinking water, sanitary facilities, fuel, and power necessary to conduct all necessary tests.

Maintain all the equipment used for handling, preparing, and testing materials in proper operating condition. For any laboratory equipment malfunction, the Contractor shall remedy the situation within one working day or the Engineer may suspend production. In the case of an equipment malfunction, the Engineer may elect to test the material at another qualified testing laboratory while waiting for repairs to equipment.

Maintain minimum calibration records for the referenced equipment:
- SUPERPAVE^{R} Gyratory Compactor: once every year; verified once every month by the Engineer.
- Ovens: once every three months, verified once every month.
- Vacuum Container and Gauge (Rice Bowls): once every three months, verified once every month.
- Balances and Scales: once every year, verified once every month.
- Thermometers: once a year; verified once every month.
- Gyratory Compactor molds and base plates: once every year
- Mechanical Shakers: once every year
- Sieve Verifications: once every year

All calibrations shall be documented and on file for review by the Engineer at any time.

(c) Material Production Test Methods

- AASHTO T312 - Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
- AASHTO T166, Method C (Rapid Method) - Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface Dry Specimens
- AASHTO T308 - Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method
- AASHTO T30 - Mechanical Analysis of Extracted Aggregate
- AASHTO T209 - Theoretical Maximum Specific Gravity and Density of Hot Mix Asphalt (HMA)
- ASTM D7227 - Standard Practice for Rapid Drying of Compacted Asphalt Specimens using Vacuum Drying Apparatus

.04 Job Mix Formula (JMF)

Mix Design. Develop and submit a job mix formula for each mixture according to AASHTO R35. Each mix design shall be capable of being produced, placed, and compacted as specified. Assign a unique identification number to each JMF.

a) Development of JMF

Gradation: Use the FHWA Superpave 0.45 Power Chart to define permissible gradations for the specified mixture. Type C shall be either a No.4 (4.75 mm), 3/8" (9.5 mm), or 1/2" (12.5 mm) Nominal Maximum Aggregate Size bituminous concrete. Unless otherwise noted in the Plans, the Type C shall meet the 3/8" (9.5 mm) Nominal Maximum Aggregate Size. Type B bituminous concrete shall be the 3/4" (19.0 mm) Nominal Maximum Aggregate Size and the Bituminous Concrete Base Course (BCBC) shall be the 1" (25.0 mm) Nominal Maximum Aggregate Size. Target values for percent passing each standard sieve for the design aggregate structure shall comply with the Superpave control points and should avoid the restricted zone. Percentages shall be based on the washed gradation of the aggregate according to AASHTO T11.

In addition to the results of the material requirements specified above, the following material properties shall be provided by the contractor: bulk specific gravity Gsb, apparent specific gravity Gsa, and the absorption of the individual aggregate stockpiles to be used, tested according to AASHTO T84 and AASHTO T85 and reported to three decimal places along with the specific gravity of the mineral filler to be used, tested according to AASHTO T100 and reported to three decimal places.

Superpave Gyratory Compactive (SGC) Effort:

The Superpave Gyratory Compaction effort employed throughout mixture design, field quality control, or field quality assurance shall be as indicated below. All mixture specimens tested in the SGC shall be compacted to N_M Height data provided by the SGC shall be employed to calculate volumetric properties at N_I, N_D, and N_M

Superpave Gyratory Compactive (SGC) Effort:

DESIGN TRAFFIC LEVEL (MILLION ESAL'S)	$N_{INITIAL}$	N_{DESIGN}	$N_{MAXIMUM}$
0.3 to < 3	7	75	115
3 to < 30	8	100	160
≥30	9	125	205

Volumetric Design Parameters. The design aggregate structure at the target asphalt cement content shall satisfy the volumetric criteria below:

DESIGN ESAL'S (MILLION)	REQUIRED DENSITY (% OF THEORETICAL MAXIMUM SPECIFIC GRAVITY)			VOIDS-IN-MINERAL AGGREGATE (% - MINIMUM) NOMINAL MAX. AGGREGATE (MM)					VOIDS FILLED WITH ASPHALT (%)
	$N_{INITIAL}$	N_{DESIGN}	N_{MAX}	25.0	19.0	9.5	12.5	4.75	
0.3 to < 3	≤ 90.5	-	-	-	-	-	-	-	65.0 - 78.0
3 to < 10	-	-	-	-	-	-	-	-	-
10 < 30	-	-	-	-	-	-	-	-	-
≤ 30	≤ 89.0	96.0	≤ 98.0	12.5	13.5	15.5	14.5	16.5	65.0 - 75.0[1]

Air voids (V_a) at N_{design} shall be 4.0% for all ESAL designs. Air voids (V_a) at N_{max} shall be a minimum of 2.0% for all ESAL designs. The dust to binder ratio for the mix having aggregate gradations above the Primary Control Sieve (PCS) Control Points shall be 0.6-1.2. For aggregate gradations below the PCS Control Points, the dust to binder ratio shall be 0.8-1.6. For the No. 4 (4.75 mm) mix, the dust to binder ratio shall be 0.9-2.0 whether above or below the PCS Control Points.

For 3/8@ (9.5 mm) Nominal Maximum Aggregate Size mixtures, the specified VFA range shall be 73.0% to 76.0% and for 4.75 mm Nominal Maximum Size mixtures, the range shall be 75 % to 78% for design traffic levels $3 million ESALs.

Gradation Control Points:

The combined aggregates shall conform to the gradation requirement specified in the following table when tested according to T-11 and T-27.

TABLE 1

Nominal Maximum Aggregates Size Control Points, Percent Passing										
	25.0 MM		19.0 MM		12.5 MM		9.5 MM		4.75 MM	
SIEVE SIZE	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
37.5 MM	100	-	-	-	-	-	-	-	-	-
25.0 MM	90	100	100	-	-	-	-	-	-	-
19.0 MM	-	90	90	100	100	-	-	-	-	-
12.5 MM	-	-	-	90	90	100	100	-	100	-
9.5 MM	-	-	-	-	-	90	90	100	95	100
4.75 MM	-	-	-	-	-	-	-	90	90	100
2.36 MM	19	45	23	49	28	58	32	67	-	-
1.18 MM	-	-	-	-	-	-	-	-	30	60
0.075 MM	1	7	2	8	2	10	2	10	6	12

Note: The aggregate's gradation for each sieve must fall within the minimum and maximum limits.

Gradation Classification

The Primary Control Sieve (PCS) defines the break point of fine and coarse mixtures. The combined aggregates shall be classified as coarse graded when it passes below the Primary Control Sieve (PCS) control point as defined below. All other gradations shall be classified as fine graded.

PCS CONTROL POINT FOR MIXTURE NOMINAL MAXIMUM AGGREGATES SIZE (% PASSING)					
Nominal Maximum Aggregates Size	25.0 mm	19.0 mm	12.5 mm	9.5 mm	4.5 mm
Primary Control Sieve	4.75 mm	4.75 mm	2.36 mm	2.36 mm	1.18 mm
PCS Control Point	40	47	39	47	30-60

Plant Production Tolerances:

Volumeric Property	Superpave Criteria
Air Voids (V_a) at (%) N_m	2.0 (min)
Air Voids (V_a) at N_{design} (%)	6.0 (max)
Voids in Mineral Aggregate (VMA) at N_{design}	
25.0 mm Bituminous Concrete Base Course	-1.5
19.0 mm Type B Hot-Mix	+2.0

Volumeric Property	Superpave Criteria
12.5 mm Type C Hot-Mix	
9.5 mm Type C Hot-Mix	
4.5 mm Type C Hot-Mix	

The proposed JMF shall include the following:

Submit for approval to the Engineer the following documentation on Pinepave mixture design software prior to starting production of a new mixture:

1. Job mix formula (JMF) design of the component materials and target characteristic values for each mixture proposed for use. The component materials design shall include designating the source and the expected proportion (within 1 percent for the aggregate components and within 0.1 percent for the other components) of each component to be used in order to produce workable bituminous concrete meeting the specified properties. Recycled Asphalt Pavement (RAP) is one individual aggregate component regardless of fractionation size. Recycled Asphalt Shingles (RAS) is a separate component from RAP.

2. The JMF target characteristic values include the mixing temperature range, core temperature range for gyration, the percentage of the asphalt cement component (both total and virgin), and the percentages of the aggregate amounts retained on the sieves to be addressed by the JMF as shown in Table 1.

3. Plot of the design aggregate structure on the FHWA Superpave 0.45 power chart showing the maximum density line and Superpave control points.

4. Plot of the three trial asphalt binder contents at +/- 0.5% gyratory compaction curves where the percent of maximum specific gravity (% of G_{mm}) is plotted against the log base ten of the number of gyrations (log (N)) showing the applicable criteria for N_i, N_d, and N_m.

5. Plot of the percent asphalt binder by total weight of the mix (P_b) versus the following:

   % of G_{mm} at N_d, VMA at N_d, VFA at N_d, Fines to effective asphalt binder (P_{be}) ratio, and unit weight (kg/m²) at both N_d and N_m.

6. Summary of the consensus property standards test results for the design aggregate structure, summary of the source property standards test results for the individual aggregates in the design aggregate structure, target value of the asphalt binder content, and a table of G_{mm} of the asphalt mixture for the four trial asphalt binder contents determined according to AASHTO T209.

7. Test data with each JMF and tests performed by a Qualified Laboratory on representative materials, verifying the adequacy of the design. Refer to the specifications for each mix type in order to determine the design requirements. The JMF sieve percentage values shall conform to the ranges shown in Table 1.

   For any mixture that has a 20% or greater failure rate on any combined volumetric criteria, the JMF will not be approved for use on Department contracts.

8. Provide raw material of each JMF so NCAT Ignition Oven calibration correction numbers can be established for the Engineers and Contractors ovens. The Engineer shall provide an ignition oven correction number for each JMF.

.05 Approval of JMF

The Engineer will have up to three weeks once the JMF is submitted to review the submitted information. All submitted JMF's shall correspond to the Pinepave mixture design software. The Engineer, for evaluation of the submitted JMF, will use the first three test samples. These test results acquired during production shall be within the following range compared to the submitted JMF on the Pinepave mixture design software: Gmm: + / -0.030 and Gmb: + / - 0.040

a) **Design Evaluation:**

The Engineer may elect to evaluate the proposed JMF and suitability of all materials through laboratory trial batches. All materials requested by the Engineer shall be provided at the contractor's expense to the Central Laboratory in Dover in a timely manner upon request. To verify the complete mixture design and evaluate the suitability of all materials, the following approximate quantities are required:

5.25 gal (20 liters) of the asphalt binder;
0.13 gal (0.5 liters) sample of liquid heat-stable anti-strip additive;
254 lb. (115 kg) of each coarse aggregate;
154 lb. (70 kg) of each intermediate and fine aggregate;
22 lb. (10 kg) of mineral filler; and
254 lb. (115 kg) of RAP, when applicable.

For more expeditious approval, the Contractor may undertake the following steps:

1. Submit the proper documentation on Pinepave mixture design software.
2. Produce the new mixture for a non-Department project. The Engineer will test the material, by taking three series per section 401800 03(c). The mixture will be approved by the Engineer for Department projects if the test results are within the specifications.

A new JMF is required when any of the following conditions occur:

- A change in the source of any of the aggregate component materials
- A change in the proportion of any aggregate component by more than 5.0%
- A change in the aggregate components resulting in a change in percent passing any sieve as identified in Table 1 by more than 5% of the JMF target.
- A change in the target AC content by more than 0.20% from the JMF target to maintain other Volumetric properties of the approved JMF.
- For any mixture that has a 20% or greater failure rate on any combined volumetric criteria.

Although a new JMF is not required, the Contractor shall inform the Engineer of any proposed changes to an existing JMF. The Contractor shall notify the Engineer by electronic mail of the proposed changes. This notification shall include the total change made from the approved JMF proportions, and the effective time of the change. The Engineer will reply to the proposed changes within one operational day and notify the Contractor of the effective date of the changes.

.06 Construction.

(a) Pavement Construction Test Equipment.

The Contractor shall furnish and use in-place density gauges, and/or coring equipment to meet the requirements of these Specifications.

Weather Limitations.

Place mix only on dry, unfrozen surfaces and only when weather conditions allow for proper production, placement, handling, and compacting.

The following table of ambient temperatures for various binder grades and lift thicknesses for placement with the following parameters:

Lift Thickness (in)	PG Binder		
	76-22	70-22	64-22
1.50	50°F	45°F	40°F
2.00	40°F	38°F	35°F
3.00	32°F	32°F	32°F

- Minimum surface temperature of 32°F and
- Minimum production temperature of 275°F and
- Maximum wind speed of 8 miles per hour

Construction outside of these conditions with WMA technology will be at the discretion of the Engineer.

Compaction:

(b) Pavement Construction - Process Control.

Perform Quality Control of pavement compaction by testing in-place pavement density by the following methods.

- ASTM D2950 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods; the use of other density gauges shall be as per the manufacturer's recommendations.
- AASHTO T166, Method C (Rapid Method) Bulk Specific Gravity of Compacted Hot Mix Asphalt (HMA) Using Saturated Surface Dry Specimens
- ASTM D7227 - Standard Practice for Rapid Drying of Compacted Asphalt Specimens using Vacuum Drying Apparatus

Cores may be cut on the first day of paving or once after the change of a JMF for gauge calibration. The number of cores obtained for calibration purposes shall not exceed the number of QA samples obtained by the Department for payment. The Contractor may use any method to select locations for the Quality Control calibration cores.

Repair all core holes in accordance with 401699 Appendix A.

Method of Measurement:

Method of Measurement will be in accordance with Subsections 401.14 and 401.15 of the Standard Specifications.

Basis of Payment:

All work completed under this item shall be considered for full payment and subsequently modified in accordance with the procedures enumerated under 401699.

Material production quality shall be evaluated per item 401699 - Quality Control/Quality Assurance of Bituminous Concrete .03 (a) Material Production - Tests and Evaluations.

Compaction quality shall be evaluated per Item 401699 - Quality Assurance of Bituminous Concrete .03 (b) Pavement Construction - Tests and Evaluations.

12/7/2015

601520 - TEMPORARY TIMBER MAT

Description:

The item shall consist of furnishing all materials and constructing a temporary timber mat for access across the wetland area as shown on the Plans and as directed by the Engineer. All equipment shall utilize this temporary timber mat when trying to access the stockpile/staging area and the underside of the bridge.

Materials:

In accordance with Section 601 of the Standard Specifications and the following:

Timber shall have a strength and grade adequate to support the Contractor's anticipated vehicular or equipment loads. Any preservative treatment applied to the matting shall be environmentally safe for wet conditions and be preapproved by the Department.

Hardware shall be in accordance with Section 601.07 of the Standard Specifications.

Construction Methods:

The Contractor shall submit to the Department for approval shop drawings and design calculations indicating the layout, size of members, arrangement of members and the construction methods at least two weeks prior to initiating construction. This information shall be signed and sealed by a Professional Engineer registered in the State of Delaware. A timber mat system is shown on the plans and shall be used for conceptual purposes only. The actual timber mat system utilized for the construction shall be designed for the anticipated construction loads and shall be compatible with the environment. Placement of stone within the wetland area is not permitted.

The temporary timber matting should be periodically inspected by the Contractor and any damaged or deteriorated components should be replaced. The Contractor assumes full responsibility for the load carrying capability of the system and for its anchorage, as required, to resist high water flows. No additional compensation will be granted for repairing any portion of the system damaged during naturally occurring weather events or contractor usage. The Contractor is responsible for retrieving lost mats and repairing any damage caused by naturally occurring weather events.

Basis of Payment:

The payment for the item shall be made for at the contract unit price bid per Lump Sum for "601520 - Temporary Timber Mat", which price and payment shall constitute full compensation for furnishing and placing all materials, for design, submission of signed and sealed drawings and computations, installation and removal of timber mat materials, and for all labor, equipment, tools and incidentals required to complete the work.

7/16/08

602512 - REINFORCED CONCRETE LANDSCAPE WALL

Description:

This item shall consist of constructing reinforced concrete landscape walls with form liner finish with precast concrete wall caps conforming to the configurations, sizes and dimensions as shown on the plans and these specifications. Reinforced concrete landscape wall shall be constructed at the locations, lines and grades as indicated on the Plans.

Materials:

The reinforced concrete landscape wall with form liner finish shall conform to the applicable requirements of the following sections of the Standard Specifications:

207 Excavation and Backfill for Structures
210 Furnishing Borrow Type "C" for Pipe, Utility, Trench, and Structure Backfill
602 Concrete Structures
603 Bar Reinforcement

Portland Cement Concrete shall be 4500 psi minimum and shall conform to the material requirements of Class A, section 812, Portland Cement Concrete of the Standard Specifications.

Construction Methods:

Construction methods shall conform with the applicable subsections of Sections 602 and 603 of the Standard Specifications, and details shown on the plans.
Additional specifications that are also applicable to the wall shall include:

602549 Form Liners
602627 Precast Wall Cap

Construction details/finishes:

Form Liner Pattern – All form liner patterning shall be horizontally level. Pattern should NOT follow any finished grade lines. Pattern shall be cast so the 6” of pattern is below finished grades.

Weep holes – All weeps shall be 2” PVC pipe set in wall at a 2” pitch out to the face of the wall with a filter fabric screen at each end. Weeps shall be located horizontally 10’ O.C.

Method of Measurement:

The quantity of reinforced concrete landscape wall will be measured as the number of linear feet of reinforced concrete landscape wall and piers constructed in place, completed and accepted, measured horizontally from end to end of top wall including piers.

Basis of Payment:

The quantity of reinforced concrete landscape wall will be paid for at the Contract unit price per linear foot. Price and payment shall constitute full compensation for furnishing and installing all cribbing, shoring, sheeting, excavation, backfill, compaction, formwork, concrete reinforcement, concrete, concrete surface finishing, open-graded stone, PVC pipe, filter fabric and the materials, labor, equipment, tools and all other incidentals required to complete the work. Payment for Form Liner and Precast Wall Cap shall be paid under separate items.

8/30/16

602520 - EPOXY PROTECTIVE COATING FOR CONCRETE

Description:

This work consists of preparing concrete surfaces and furnishing and applying an epoxy protective coating, in accordance with notes and details on the Plans, these specifications and directions from the Engineer.

Materials:

Scope. This Special Provision covers the material requirements of a two component, pigmented epoxy resin protective coating system used for the environmental protection of Portland cement concrete and other materials. This material should not be applied at temperatures above 95°F (35°C) or below 40°F (4°C).

General. The epoxy resin protective coating system shall be a two component, flexible, solvent-free, thermosetting system consisting of a modified epoxy resin, Component A, and a curing agent, Component B.

Material Requirements:

Characteristics of Component A. Component A shall be based on a high grade epoxy resin such as obtained from the condensation of Bisephenol A and Epichlorohydrin having the following characteristics:

Property	Specific Value Min.	Max.	Test Method
Viscosity, CPS @24±1 Degrees C.	9,000	12,000	Brookfield Model RV No. 5/20 RPM ASTM D445
Weight per liter @24±1 Degrees C., kg.	1.45	----	----
Percent filler and pigment	----	40.0	By Ignition

Pigment filler shall be light-fast, durable and resistant to alkali.

Characteristics of Component B. Component B shall have the following characteristics:

Property	Specific Value Min.	Max.	Test Method
Viscosity, CPS @ 24±1 Degrees C.	50	----	Brookfield Model RV No. 1/20 RPM ASTM D 445
Weight per liter @ 24±1 Degrees C, kg	0.8	----	----

Characteristics of the Mixture. The mixture of Components A & B shall have the following characteristics:

Property	Specific Value Min.	Max.	Test Method
Viscosity, CPS @24±1 Degrees C.	----	10,000	Brookfield Model RV No. 5/20 RPM ASTM D 445
Pot Life, minutes @ 24±1 Degrees C.	30	----	----
Initial Cure, hrs. @24±1 Degrees C.	----	6	Tack-free to Touch
Shore D Hardness, @24±1 Degrees C. after 7 days	70/1	----	ASTM D 2240
Color-Off White	37722	37722	Federal Std. No. 595 A

Color Fastness	no appreciable change	High Intensity Ultra Violet Altas Weatherometer Model DMC-HRC
Package stability of each in original unopened container, in months, between 27 degrees Celsius and 0 degrees Celsius	12	---- ----

Packaging. All materials furnished must be shipped in strong, substantial containers. The containers shall be identified as "Part A -- contains epoxy resin," and "Part B -- contains curing agent," and shall be plainly marked with the following:

1. Delaware D.O.T. Specifications number.
2. Name of product.
3. Mixing proportions and instructions.
4. Name and address of the manufacturer.
5. Lot number and batch number.
6. Date of manufacture.
7. Quantity.
8. Date of expiration of acceptance.

Sampling. Material will be sampled and inspected at the place of manufacture or in warehouse lots as determined by the Department. Samples submitted to the Materials and Research Section will be taken as directed by the Department.

Tests.

Viscosity. - The viscosity of the mixture of components A & B shall be taken 20 minutes after the components are mixed within 15-20 seconds of the time the viscometer is started. This material shall then be used to fill the lid of a .09 gal (0.35 liter) ointment can approximately two-thirds full. This specimen shall be used to determine the tack-free time for initial cure requirement.

Initial Cure. The initial cure shall be considered that time at which a mixture of components A & B as prepared under viscosity above shall be tack-free to touch.

Pot Life. The pot life is determined as follows.

Samples of each resinous cement component are conditioned at 75°F (24±1°C). When the samples have reached 75°F (24±1°C), 2.1 oz. (60±0.4 g.) total of components A and B in the proportions recommended by the manufacturer are weighed into an unwaxed paper cup. The time is recorded and they are immediately mixed, stirring for three minutes with a wooden tongue depressor, taking care to periodically scrape the walls and bottom of the cup and the mixer. The sample is then poured into an .06 gal (0.24 liter) unwaxed paper cup, set on a bench top, and probed every two minutes with a small stick, starting twenty minutes from the time of mixing. The time at which a soft ball forms in the center of the container is recorded as the pot life. This specimen shall be retained and used for the determination of the Shore D hardness.

Shore D Hardness. The hardness test shall be performed on the specimen retained from Pot Life above.

Color Fastness. The test for color fastness of the cured epoxy shall be conducted as follows.

Cast two, 3 1/2″ (89 mm) diameter buttons following the manufacturer's instructions for mixing the epoxy components. Allow each button to cure for 72±2 hours at laboratory temperature in a dark chamber away from sources of ultraviolet light. Designate one button as the color control button and retain it in the dark chamber. Subject the other button to 16 hours total exposure time (20 minute cycle) in the High Intensity Ultra Violet Weatherometer, Model DMC-HRC. Each cycle, continuously repeating, starts with 17 minutes of light followed by 3 minutes of light and water spray. Remove the test button and compare the color of the exposed area to Federal Standard 595A, color, and to the color of the control button. The color of the test button shall not differ appreciably from the color of the control button and the color, defined by Federal Standard 595A.

Basis of Acceptance. This material will be considered for acceptance in stock lot quantities at manufacturer of supply locations in accordance with procedural directives of the Materials and Research Section. The expiration date of acceptance of this material shall be twelve months after the date of manufacture. Any unauthorized tampering or breaking of the seals on the containers between the time of sampling and delivery to the jobsite will be cause for rejection of the material.

Construction Methods:

Preparation of Surfaces. New concrete surfaces shall be thoroughly cleaned before epoxy application. All laitance, curing membranes, paint, oil, grease, silicone, dust, asphalt and other substance which might prevent bond between the epoxy and the concrete shall be removed. The surface preparation shall be accomplished by waterblasting with sand added, sand blasting, or shot blasting, followed by high pressure, oil-free, air blasting.

The epoxy protective coating shall be applied as soon as practicable after cleaning is completed. If, in the opinion of the Engineer, the concrete surface has become soiled, or otherwise contaminated, prior to epoxy application, the surface shall be recleaned in accordance with the requirements of this subsection at no additional cost to the Owner.

Mixing. The two parts of the epoxy protective coating are furnished in separate containers. Each part of the coating shall be thoroughly stirred in its own container prior to mixing in order to disperse any settlement which may have occurred. The two parts of the epoxy protective coating shall be proportioned in strict accordance with the instructions on their containers and then thoroughly blended together. A paddle attached to a 1/2″ (12 mm) electric drill with a rated speed not to exceed 550 rpm is recommended for mixing. For batches for less than 1 gal (4 liters), thorough hand stirring may be satisfactory. No diluent, solvent, thinner or other foreign material shall be added to either the individual components or the mixed epoxy protective coating.

Application. Materials shall be applied only when the air temperature is at least 40°F (4°C) and rising, but less than 95°F (35°C) and the surface temperature of the area to be coated is at least 40°F (4°C). Surfaces must be dry before application.

Epoxy placement may be allowed in suitably prepared, artificially heated enclosures. Artificial heat shall be applied at rates sufficient to ensure that the substance and air temperatures within the enclosure are, at all times, maintained between 40°F (4°C) and 95°F (35°C) inclusive. Artificial heat shall be supplied within the enclosure until the epoxy is cured to a tack-free condition, firm to hand pressure, and satisfactory to the Engineer.

The surface shall be coated in accordance with the manufacturer's recommendations. The finished coating shall be uniform in color and coverage.

Note: Under certain combinations of circumstances, the cured epoxy protective coating may develop an "oily" condition on the surface due to amine blush. This condition is not detrimental to the applied system.

Care shall be taken so that the entire surface of the concrete is covered and all pores filled. The Contractor shall use only one manufacturer's material on all surfaces visible from one location, in order to provide a uniform appearance.

Method of Measurement:

The quantity of epoxy protective coating will be measured as the actual number of square yards (square meters) of surface area covered with the epoxy protective coating, completed and accepted.

Basis of Payment:

The quantity of epoxy protective coating will be paid for at the Contract unit price per square yard (square meter). Price and payment will constitute full compensation for furnishing and placing all materials, preparation of surfaces, artificial heat and enclosure, and for all labor, equipment, tools, and incidentals, necessary to complete the work.

602528 - PRECAST PIER FOOTING FORMWORK
602529 - PRECAST CONCRETE EPS WALL

Description:

A. This Section includes the performance criteria, materials, design, production, and erection of structural precast and precast, prestressed concrete with a commercial architectural (CA) finish for the entire project. The work performed under this Section includes all labor, material, equipment, related services, and supervision required for the manufacture and erection of the structural precast and precast, prestressed concrete work shown on the Contract Drawings.

B. This Section includes the following with a commercial architectural (CA) finish:

1. Precast EPS wall units. Refer to the specification section 209505 for details on the Expanded Polystyrene (EPS).
2. Pier Footing Shell Form with Granite Stone Veneer

Materials:

Form Materials

A. Forms: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required surface finishes.

1. Form-Release Agent: Commercially produced form-release agent that will not bond with, stain or affect hardening of precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated in the Construction Document. Provide solid backing and form supports to ensure that form liners remain in place during concrete placement. Use manufacturer's recommended form-release agent that will not bond with, stain, or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder capable of temporarily delaying setting of newly placed concrete to depth of reveal specified.

Reinforcing Materials

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M epoxy coated.
C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.
D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, or ASTM A 1064/A 1064M, fabricated from as-drawn steel wire into flat sheets.
E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, or ASTM A 1064/A 1064M, flat sheet.
F. Epoxy-Coated-Steel Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, deformed, flat sheet, Type 1 bendable coating.
G. Supports: Use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

Concrete Materials

A. Portland Cement: ASTM C 150, Type I or III.
1. For surfaces exposed to view in finished structure, use white, same type, brand, and mill source throughout the precast concrete production.
2. Standard gray portland cement may be used for non-exposed backup concrete.

B. Supplementary Cementitious Materials

1. Metakaolin: ASTM C 618, Class N.
2. Silica Fume: ASTM C 1240 with optional chemical and physical requirements. Only white silica fume will be permitted.
3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse, non-reactive aggregates complying with Class 4S or 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
   a. Gradation: To match design reference sample.

2. Face-Mixture Fine Aggregates: Selected, natural or manufactured sand of a material compatible with coarse aggregate to match selected Sample finish.

D. Backup Concrete Aggregates: ASTM C 33 or C 330.

E. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or liquid coloring admixtures, temperature stable and nonfading.

F. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

G. Air Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

H. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. Water-Reducing and Accelerating Admixture ASTM C494/C 494M, Type E.
   5. High Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   7. Plasticizing Admixture for Flowable Concrete: ASTM C 1017/C 1017M.
   8. Corrosion Inhibiting Admixture: ASTM C 1582/C 1582M

Steel Connection Materials

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M

B. Carbon-Steel Headed Studs: ASTM A 108, Grades 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with the minimum mechanical properties of PCI MNL 116, Table 3.2.3.

C. Carbon-Steel Plate: ASTM A 283/A 283M, Grade C.

D. Malleable Iron Castings: ASTM A 47/A 47M. Grade 32510 or 35028.

E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).

F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M

G. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or C.

H. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65 (Grade 450).

I. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.

J. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A or C (ASTM F 568M, Property Class 4.6) carbon-steel, hex-head bolts and studs; carbon-steel nuts (ASTM A 563/A 563M, Grade A); and flat, unhardened steel washers (ASTM F 844).

K. Shop-Primed Finish: Prepare surfaces of non-galvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust -inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

L. Zinc-Coated Finish: For exterior steel items and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M, after fabrication, ASTM A 153/A 153M, or ASTM F 2329 as applicable.
   1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon content and 2.5 times phosphorous content to 0.09 percent.

2. Galvanizing Repair Paint: Zinc paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

Stainless-Steel Connection Materials

A. Stainless-Steel Plate: ASTM A 666, Type 304, Type 316, or Type 201, of grade suitable for application.

B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 304 or 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.
   1. Lubricate threaded parts of stainless steel bolts with an anti-seize thread lubricant during assembly.

C. Stainless-Steel Headed Studs: ASTM A 276, with minimum mechanical properties for studs as indicated under MNL 116, Table 3.2.3.

Other Accessories

A. Erection Accessories: Provide clips, hangers, high density plastic or steel shims, and other accessories required to install structural precast concrete members.

B. Welding Electrodes: Comply with AWS standards for steel type and/or alloy being welded.

Grout Materials

A. Non-shrink Grout: Premixed, prepackaged ferrous and non-ferrous aggregate shrink-resistant grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application with a 30-minute working time. Water-soluble chloride ion content of grout less than 0.06 percent chloride ion by weight of cement when tested in accordance with ATM C1218/C1218M.

Stone Materials and Accessories

A. Granite: Granite shall be fine to medium grained, of sound, compact structure, resistant to weathering action, uniform in color, free from seams, cracks, laminations and minerals which by wreathing would cause discoloration or deterioration and conforming to the following:

ASTM Designation C422.

Modulus of Rupture - 2,000 psi in accordance with ASTM Designation C99.

Veneer samples to be submitted for approval
Color to be dark grey/ black
Basis of Design:
Chester Grey
Williams Stone Company, Inc.
1158 Lee Westfield Road
P.O. Box 278
East Otis, MA 01209-0278
413.269.4544
www.williamsstone.com

Tolerance of length and width of +0, -1/8 inch (+0, -3mm)

B. Mortar: Type S: parts by volumne, Portland Cement - 1, Hydrated Lime -1/2, Sand -2 ½. Additives for the purpose of lowering the mortar freezing point shall not be permitted.

C. Anchoring Devices:

Stainless steel, ASTM A 666, Type 304 or Type 316, of temper and diameter required to support loads without exceeding allowable design stresses.

Fit each anchor leg with 60 durometer, ASTM D 2240, neoprene grommet collar of width at least twice the diameter of the anchor and a length at least five times the diameter of the anchor.

SS dovetail slots shall be provided by this section for use in anchoring veneer to concrete walls where shown. Spacing as shown on drawings.

SS dovetail anchors shall be spaced as shown on drawings.

SS dowel anchors and bent dowel anchors shall be sized and spaced as indicated on drawings.

Non-shrink grout: to be nonmetallic mixed to plastic consistency and shall be non-corrosive and non-staining to conform with ASTM C-827.

D. Fabrication: Stone shall be cut fabricated and finished to the dimensions and configurations indicated on the drawings.

Dimensions: as shown on drawings

Edges - sawn and straight (to the angle indicated on the drawings)

Finish:

a. Concealed surfaces - split or saw cut.
b. Exposed surface - split face

Provide drill holes for dowels, slots for dovetail anchors.

Each stone to be numbered on top edge in accordance with shop drawings.

E. Sealant Filler: ASTM C 920, low-modulus, multicomponent, non-sag polyurethane or silicone sealant complying with requirements in Section 07920 "Joint Sealants" and that is non-staining to stone substrate.

F. Bond Breaker: Preformed, compressible, resilient, non-staining, non-waxing, closed-cell polyethylene foam pad, nonabsorbent to liquid and gas, 1/8 inch (3.2 mm) thick. Polyethylene sheet, ASTM D4397, 6 to 10 mil (0.15 to 0.25 mm) thick may be used as alternate.

Concrete Mixtures

A. Prepare design mixtures for each type of precast concrete required as per Contract Document.
   1. Limit use of fly ash to 15 to 20 percent replacement of portland cement by weight; granulated blast-furnace slag to 15 to 20 percent of portland cement by weight; and metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at structural precast concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 116 when tested in accordance with ASTM C 1218/C 1218M.

D. Normal weight Concrete Face and Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal weight concrete with the following properties:
   1. Compressive Strength (28 Days): 5000 psi (34.5 Mpa) minimum.
   2. Release Strength: 3000 psi minimum.
   3. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

F. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

G. Concrete Mixture Adjustments: Concrete mixture design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

Related Documents

A. Drawings and general provisions of the Contract, including the Standard Specifications dated August 2001 and all revisions up to the date of advertisement, apply to this Section.

Action Submittals

A. Product Data: For each type of product indicated. Retain quality control records and certificates of compliance for 5 years after completion of structure.

B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests, if required.

C. Shop (Erection) Drawings:

1. Detail fabrication and installation of structural precast concrete units including connections at member ends and to each adjoining member.
2. Indicate locations, plan views, elevations, dimensions, shapes, and cross sections of each unit, openings, support conditions and types of reinforcement, including special reinforcement.
3. Indicate aesthetic intent including joints, rustications or reveals, and extent and location of each surface finish.
4. Indicate stone veneer coursing and termination and attachment details.
5. Indicate details at building corners.
6. Indicate separate face and backup mixture locations.
7. Indicate welded connections by AWS standard symbols. Show size, length, and type of each weld.
8. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
9. Indicate locations, tolerances and details of anchorage devices to be embedded in or attached to structure or other construction.
10. Include and locate openings larger than 10 in (250 mm). Where additional structural support is required for openings include header design.
11. Coordinate and indicate openings and inserts required by other trades.
12. Indicate location of each structural precast concrete member by same identification mark placed on unit.
13. Indicate relationship of structural precast concrete members to adjacent materials.
14. Indicate locations and details of thin, half and full brick units and joint treatment.
15. Indicate locations and details of stone veneer-facings, stone anchors, and joint widths.
16. Indicate areas receiving toppings and magnitude of topping thickness.
17. Indicate estimated cambers for floor slabs receiving cast-in-place topping.
18. Indicate multiple wythe connection devices.
19. Indicate shim sizes and grouting sequence.
20. Design Modifications: If design modifications are proposed to meet performance requirements and field conditions, notify the Engineer and submit design calculations and Shop Drawings. Do not affect the appearance, durability or strength of members when modifying details or materials. Maintain the general design concept when altering size of members and alignment.

D. Provide handling procedures, erection sequences, and for special conditions provide temporary bracing and shoring plan.

E. Samples: Design reference samples for initial verification of design intent, approximately 12 by 12 by 2 inches (300 by 300 by 50 mm), representative of finishes, colors, and textures of exposed surfaces of structural precast concrete members.

1. When back face of precast concrete member is to be exposed, include Samples illustrating workmanship, color, and texture of the concrete.

Informational Submittals

A. Qualification Data: For installer, fabricator, testing agency and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include list of completed projects with project names and addresses, names and addresses of engineers and owners, and other information specified.

B. Material Test Reports for aggregates: From an accredited testing agency, indicating and interpreting test results for compliance with requirements indicated.

C. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements.

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.
6. Insulation.
7. Clay product units and accessories.
8. Stone anchors.

9. Other components specified in Contract Documents with applicable standards.

D. Field quality-control test and special inspections reports.

Quality Assurance

A. Erector Qualifications: A precast concrete erector Qualified by the Precast/Prestressed Concrete Institute (PCI) prior to beginning work at the jobsite. Submit a current Certificate of Compliance furnished by PCI designating qualification in Category S1 (Simple Structural Systems) for single-lift wall panels and Category S2 (Complex Structural Systems) for load-bearing members. Erector should have a minimum of 2 years of experience in structural precast concrete work comparable to that shown in the Contract Document and specified in not less than three projects of similar scope with the Owner or Architect determining the suitability of the experience.

B. Erector Certification: A precast concrete erector with erecting organization and all erecting crews Certified and designated, prior to beginning work at project site, by PCI's Certificate of Compliance to erect Category S1 (Simple Structural Systems) for single-lift wall panels and Category S2 (Complex Structural Systems) for load-bearing members.

C. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in producing structural precast concrete units similar to those indicated for this Project and with a record of successful in-service performance.

1. Assumes responsibility for engineering structural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
2. Professional Engineer Qualifications: A professional engineer licensed in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of structural precast concrete that are similar to those indicated for this Project in material, design, and extent.
3. Participates in PCI's Plant Certification program **[at the time of bidding]** and is designated a PCI-certified plant for Group C or CA, Category C1A - Precast Concrete Products (no prestressed reinforcement).
4. Has sufficient production capacity to produce required members without delaying the Work.
5. Certification shall be maintained throughout the production of the precast concrete units. Production shall immediately stop if at any time the fabricator's certification is revoked, regardless of the status of completion of contracted work. Production will not be allowed to re-start until the necessary corrections are made and certification has been re-established. In the event certification(s) can not be re-established in a timely manner, causing project delays, the fabricator, at no additional cost, will contract out the remainder of the units to be manufactured at a PCI certified plant.

D. Testing Agency Qualifications: An independent accredited testing agency, acceptable by DelDOT and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated.

E. Design Standards: Comply with ACI 318 (ACI 318M) and the design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of structural precast concrete members indicated.

F. Quality-Control Standard: For manufacturing procedures and testing requirements and quality control recommendations for types of members required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Concrete Products."

1. Comply with camber and dimensional tolerances of PCI MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction."

G. Product Options: Drawings indicate size, profiles and dimensional requirements of precast concrete members and are based on the specific types of members indicated. Other fabricators' precast concrete members complying with requirements may be considered. Refer to Division 1 Section "Substitutions."

H. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel"; AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel"; and AWS D1.6/D1.6M "Structural Welding Code-Stainless".

I. Fire Resistance: For the EPS wall panels, provide structural precast concrete members whose fire resistance satisfy the fire resistance ratings prescriptive requirements of the governing code or has been calculated according to ACI 216.1/TMS 0216.1, “Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies”, and is acceptable to DelDOT.

J. Granite Veneer:

Inspection Notice: Notify the Engineer at least 2 weeks before inspection will be required; inspection will be required immediately prior to any intended pours or placement of concrete.

Source: Obtain stones from a single quarry with consistent color range and texture throughout, with resources to provide materials of constant nature in appearance and physical properties, including the capacity to cut materials without delaying progress of the work.

Installer: A firm which has at least five (5) years experience in work of the type required by this section. Stone veneer system installer shall assume undivided responsibility for work of this section including the design, engineering, fabrication, and installation of stone veneer system.

Fabricator: Subcontractor fabrication of stonework to a firm which has successfully fabricated stone similar to quantity specified for a period of not less than five (5) years and is equipped to provide quantities shown.

Delivery: Deliver, store and handle stone and setting materials in strict compliance with quarry/fabricator's and manufacturer's instructions and recommendations. Protect from all possible damage including but not limited to, soiling, staining, and chipping. Protect stone during storage under cover, but allow air circulation. Units observed to be damaged will be rejected.

K. Sample Units: After sample approval and before fabricating CA precast concrete members, with architectural finish and stone facing, produce sample units to establish the approved range of selections made under sample Submittals. Produce a minimum of 2 sample units approximately 16 ft^2 (1.5 m^2) in area. Incorporate full scale details of architectural features, finishes, textures and transitions in sample units.
   1. Locate units where indicated in Contract Documents or, if not indicated, as directed by the Engineer.
   2. Damage part of an exposed-face surface for each finish, color, and texture, and demonstrate adequacy of repair techniques proposed for repairs of surface blemishes.
   3. After acceptance of repair technique, maintain one sample unit at the fabricator's plant and one at the Project site in an undisturbed condition as a standard for judging the completed Work.
   4. Demolish and remove sample units when directed.

L. Range Sample Units: After sample units approval and before fabricating structural precast concrete CA units, produce a minimum of three samples, approximately (16 ft^2 (1.5 m^2) in area, representing anticipated range of each color and texture on Project's units. Maintain samples at the fabricator's plant as color and texture acceptability reference.

M. Mockups: After sample panel approval but before production of structural precast concrete units, with architectural finish and stone facing, construct full-sized mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Mockups to be representative of the finished work in all respects including sealants and precast concrete complete with anchors, connections, and joint fillers as accepted on the final Shop Drawings. Build mockups to comply with the following requirements, using materials indicated for the completed work:
   1. Build mockups in the location and of the size indicated in Contract Documents or, if location is not indicated, as directed by Engineer.
   2. Notify Engineer in advance of dates and times when mockups will be constructed.
   3. Obtain Engineer's approval of mockups before starting fabrication of precast concrete members.
   4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   5. Demolish and remove mockups when directed.

Delivery, Storage, and Handling

A. Deliver all structural precast concrete members in such quantities and at such times to assure compliance with the agreed upon project schedule and setting sequence to ensure continuity of installation.

B. Handle and transport members in a manner to avoid excessive stresses that could cause cracking or other damage.

C. Store units with adequate dunnage and bracing, and protect units to prevent contact with soil, staining, and to control cracking, distortion, warping or other physical damage.

D. Unless otherwise specified or shown on Shop Drawings, store members with dunnage across full width of each bearing point.
E. Place stored members so identification marks are clearly visible, and units can be inspected.
F. Place dunnage of even thickness between each member.
G. Lift and support members only at designated points indicated on the Shop Drawings.

Sequencing
A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

Construction Methods:

Form Fabrication
A. Form: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes, and for prestressing and detensioning operations. Coat contact surfaces of forms with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
   1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.
B. Maintain forms to provide completed structural precast concrete members of shapes, lines, and dimensions indicated in Contract Documents, within fabrication tolerances specified.
   1. Edge and Corner Treatment: Uniformly chamfered with ¾"x ¾" or as built-in on standard forms.

Stone Veneer Facings
A. Accurately position stone facings to comply with requirements and in locations indicated on Shop Drawings. Install anchors, supports, and other attachments indicated or necessary to secure stone in place. Maintain projection requirements of stone anchors into concrete substrate. Orient stone veining in direction indicated on Shop Drawings. Keep concrete reinforcement a minimum of 3/4 inch (19 mm) from the back surface of stone. Use continuous spacers to obtain uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances. Ensure no passage of concrete matrix to stone surface.
B. See Section 602 of Standard Specifications for furnishing and installing sealant backings and sealant into stone-to-stone joints and stone-to-concrete joints. Apply a continuous sealant bead along both sides and top of members at the stone/precast concrete interface using the bond breaker as a joint filler backer. Do not seal bottom edge.
   1. Fill anchor holes with epoxy filler and install anchors with 1/2 inch (13 mm) long, 60 durometer elastomeric sleeve at the back surface of the stone.
   2. Install 1/8 inch (3 mm) thick polyethylene-foam bond breaker to prevent bond between back of stone facing and concrete substrate.
C. Stone Anchor Shear and Tensile Testing: Engage accredited testing laboratory acceptable to the Engineer to evaluate and test the proposed stone anchorage system. Test for shear and tensile strength of proposed stone anchorage system in accordance with ASTM E 488 or ASTM C 1354 modified as follows:
   1. Prior to testing, submit for approval a description of the test assembly (including pertinent data on materials), test apparatus and procedures.
   2. Test 12-by-12 inch (300 by 300 mm) samples of stone affixed to testing apparatus through proposed anchorages. Provide 2 sets of 6 stone samples each; one set for shear load testing and the other set for tensile load testing.
   3. Test stone anchors of the sizes and shapes proposed for the installation.
      a. Test the assembly to failure and record the test load at failure. Record the type of failure, anchor pullout or stone breakage, and any other pertinent information, in accordance with the requirements of ASTM E 488.
D. Stone to Precast Concrete Anchorages: Provide anchors in numbers, types and locations required to satisfy specified performance criteria, but not less than two anchors per stone unit of less than 2 ft.2 (0.19 m2) in area and four anchors per unit of less than 12 ft.2 (1.1 m2) in area; and for units larger than 12 ft.2 (1.1 m2) in area, provide anchors spaced not more than 24 in. (600 mm) on center both horizontally and vertically. Locate anchors a minimum of 6 in. (150 mm) from stone edge.

E. Work platform and staging as required and erected with padding or other means to protect the concrete.
F. All veneer shall be thoroughly cleaned of mortar stains immediately after being laid. After the pointing is completed and the mortar set, the veneer shall be thoroughly cleaned and left in a neat workmanlike condition.
G. No veneer shall be constructed in freezing weather or when the stones contain frost except with the written permission of the Engineer and subject to such conditions as he may require. Such permission and the use of the methods prescribed shall not release the Contractor from his obligations to build a satisfactory structure. All work damaged by cold shall be removed and replaced. In hot or dry weather the masonry shall be satisfactorily protected from the sun.
H. Veneer elements shall be erected plumb unless otherwise shown and/or level, as required, and aligned with each other and other elements of adjacent construction. Set on lead or plastic spacer buttons.
I. Jointing: Concave 3/8" or as shown on drawings.
J. Dowel holes: Drill holes in granite in locations as shown. Provide clearance around dowels as shown and as required for grouting. Completely fill holes with grout.

Fabrication

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in members unless approved by Architect.
   1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, hangers, and other hardware shapes for securing precast concrete members to supporting and adjacent construction.
C. Cast-in reglets, slots, and other accessories in structural precast concrete members as indicated on Contract Drawings.
D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.
   1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
   2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Locate and support reinforcement by plastic tipped or corrosion resistant metal or plastic chairs, runners, bolsters, spacers, hangers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.
   3. Place reinforcing steel and prestressing tendons to maintain at least ¾ in. (19 mm) minimum concrete cover. Provide cover requirements in accordance with ACI 318 (ACI 318M) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
   4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces in accordance with ACI 318 (ACI 318M) and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce structural precast concrete members to resist handling, transportation, and erection stresses, and specified in-place loads, whichever governs.
G. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the nominal maximum aggregate size, but not less than the minimum reinforcing cover as indicated on Contract Drawings.
   1. Use a single design mixture for those members in which more than one major face (edge) is exposed.

2. Where only one face of unit is exposed and at the fabricator's option either of the following mixture design/casting techniques may be used:
   a. A single design mixture throughout the entire thickness of member.
   b. Design mixtures for facing and backup; using cement and aggregates for each type as appropriate, for consecutive placement in the form. Use cement and aggregate specified for facing mixture. Use cement and aggregate for backup mixture complying with specified criteria or as selected by the fabricator.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete members.
   1. Place backup concrete to ensure bond with face-mixture concrete.

J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
   1. Place self-consolidating concrete without vibration in accordance with PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete." If face and backup concrete is used, ensure adequate bond between concrete mixtures.

K. Comply with PCI MNL 116 procedures for hot and cold-weather concrete placement.

L. Identify pickup points of precast concrete members and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast concrete member on a surface that will not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure members until compressive strength is high enough to ensure that stripping does not have an effect on the performance or appearance of final product.

Fabrication Tolerances

A. Fabricate structural precast concrete members of shapes, lines and dimensions indicated, so each finished member complies with PCI MNL 135 product tolerances as well as position tolerances for cast-in items.

Finishes

A. Commercial (Structural) Finishes

   Grade B Finish: Fill air pockets and holes larger than 1/4 inch (6 mm) in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch (3 mm) in width that occur in high concentration (more than one per 2 in.^{2} [1300 mm^2]). Grind smooth form offsets or fins larger than 1/8 inch (3 mm). Repair surface blemishes due to dents in forms. Discoloration is permitted at form joints.

B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish, float finish, if required. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. No major imperfections, honeycombing, or defects are permitted.

C. Apply roughened surface finish in accordance with ACI 318 (ACI 318M) to precast concrete members that will receive concrete topping after installation.

D. Commercial Architectural (CA) Finishes
   1. Exposed faces shall be free of joint marks, grain, or other obvious defects. Corners, including false joints shall be uniform and straight. Finish exposed-face surfaces of structural precast concrete members to match approved mockups and as follows:
      a. Textured-Surface Finish: Impart texture by form liners to match accepted sample or mockup units for acceptable surface air voids, streaks, and honeycombs, with uniform color and texture. Formliner Type 2: Sandblast pattern, see specification 602549 - Form Liners.

Source Quality Control

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements. If using self-consolidating concrete also test and inspect according to PCI TR-6 "Interim Guidelines for the Use of Self-Consolidating Concrete" and ASTM C 1611/C 1611M, ASTM C 1712, ASTM 1610/1610M, and ASTM C 1621/C 1621M.

B. Strength of precast concrete members will be considered deficient if units fail to comply with ACI 318 (ACI 318M) concrete strength requirements.

C. Testing: If there is evidence that strength of precast concrete members may be deficient or may not comply with ACI 318 (ACI 318M) requirements, fabricator shall employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318/ACI 318M.

1. Test results shall be reported in writing on the same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports shall include the following:
   a. Project identification name and number.
   b. Date when tests were performed.
   c. Name of precast concrete fabricator.
   d. Name of concrete testing agency.
   e. Identification letter, name, and type of precast concrete member(s) represented by core tests; design compressive strength; type of failure; actual compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

D. Patching: If core test results are satisfactory and precast concrete members comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

E. Acceptability: Structural precast concrete members that do not comply with acceptability requirements in PCI MNL 116, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable. Chipped, spalled or cracked members may be repaired. The Architect reserves the right to reject any member if it does not match the accepted samples. Replace unacceptable units with precast concrete members that comply with requirements.

Execution

Preparation

A. Furnish loose connection hardware and anchorage devices for precast concrete members to be embedded in or attached to the building structural frame or foundation before starting that Work. Provide locations, setting diagrams, templates and instructions for the proper installation of each anchorage device.

Examination

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting precast concrete performance.

B. Proceed with precast concrete installation only after unsatisfactory conditions have been corrected.

C. Contractor shall notify precast concrete erector that supporting cast-in-place concrete foundation and building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast concrete members prior to proceeding with installation.

Erection

A. Install loose clips, hangers, bearing pads, and other accessories required for connecting structural precast concrete members to supporting members and backup materials.

B. Erect structural precast concrete level, plumb and square within the specified allowable erection tolerances. Provide temporary structural framing, shoring and bracing as required to maintain position, stability, and alignment of members until permanent connections are completed.
   1. Install temporary steel or plastic spacing shims or bearing pads as precast concrete members are being erected. Surface weld steel shims to each other to prevent shims from separating.
   2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   3. Remove projecting lifting devices and use plastic patchcaps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast concrete surfaces when recess is exposed.
   4. Unless otherwise indicated, provide for uniform joint widths of ¾ in. (19mm).

C. Connect structural precast concrete members in position by bolting, welding, grouting, or as otherwise indicated on approved Shop (Erection) Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
   1. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

D. Welding: Comply with applicable AWS D1.1/D1.1M, AWS D1.4/D1.4M and AWS D1.6/D1.6M requirements for welding, welding electrodes, appearance of welds, quality of welds, and methods used in correcting welding work.
   1. Protect structural precast concrete members from damage during field welding or cutting operations and provide noncombustible shields as required.
   2. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS D1.1/D1.1M, D1.4/D1.4M or D1.6/D1.6M.
   3. Clean-weld-affected metal surfaces with chipping hammer followed by brushing or power tool cleaning and then reprime damaged painted surfaces in accordance with manufacturer's recommendations.
   4. For galvanized metal, clean weld affected metal surfaces with chipping hammer followed by brushing or power tool cleaning, and apply a minimum 0.004 inch (4 mil) thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A 780/A 780M.
   5. Visually inspect all welds critical to precast concrete connections. Visually check all welds for completion and remove, reweld or repair all defective welds, if services of AWS-certified welding inspector are not furnished by Owner.

E. At bolted connections, use upset threads, thread locking compound or other approved means to prevent loosening of nuts after final adjustment.
   1. Where slotted connections are used, verify bolt position and tightness at installation. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
   2. For slip critical connections, one of the following methods shall be used to assure proper bolt pretension:
      a. Turn-of-Nut - in accordance with AISC.
      b. Calibrated Wrench - in accordance with AISC.
      c. Twist-off Tension Control Bolt - meeting ASTM F 1852.
      d. Direct-Tension Control Bolt - meeting ASTM F 1852.
   3. For slip critical connections, the method to be used and the inspection procedure to be used shall be approved by the Architect and coordinated with the inspection agency.

F. Grouting or Dry-Packing Connections and Joints: Indicate joints to be grouted and any critical grouting sequences on Shop (Erection) Drawings. Grout open spaces at keyways, connections and joints where required or indicated. Provide reinforcing steel where indicated. Retain flowable grout in place until it gains sufficient strength to support itself. Fill joints completely without seepage to other surfaces. Alternatively, pack spaces with stiff dry pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for at least 24 hours after initial set.
   1. Trowel top of grout joints on roofs smooth to prevent any unevenness that might interfere with placing of, or cause damage, to insulation and roofing. Finish transitions due to different surface levels not steeper than 1 to 12.

G. Field cutting of precast, prestressed concrete members is not permitted without approval of the Engineer.

H. Fasteners: Do not use drilled or power-actuated fasteners for attaching accessory items to precast, prestressed concrete members unless approved by Precast Engineer and Engineer of Record.

Erection Tolerances

A. Erect structural precast concrete members level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135. Level out variations between adjacent members by jacking, loading, or any other feasible method as recommended by the fabricator and acceptable to the Architect.

Field Quality Control

A. Special Inspections: DelDOT will engage a qualified special inspector to perform the following special inspections and prepare reports:
   1. Erection of precast concrete pier footing form.
   2. Erection of precast concrete EPS wall panel.

B. Testing: Owner will engage accredited independent testing and inspecting agency to perform field tests and inspections and prepare reports.
   1. Field welds will be subject to visual inspections and dye penetrant or magnetic particle testing in accordance with ASTM E 165 or ASTM E 1444. Testing agency shall be qualified in accordance with ASTM E543.
   2. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Erector's expense, will be performed to determine compliance of corrected work with specified requirements.

Repairs

A. Repairs will be permitted provided structural adequacy, serviceability and durability of members and appearance are not impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged structural precast concrete members when repairs do not comply with specified requirements.

Cleaning

A. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete members after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
   1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect adjacent work from staining or damage due to cleaning operations.
   2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

Method of Measurement:

A. The quantity of precast pier footing formwork (Item # 602528) will be measured as the number of cubic yards (cubic meters) of concrete placed and accepted. The volume will be computed using the dimensions shown on the Plans, or as ordered in writing. The stone veneer, anchors and epoxy steel reinforcing steel in precast will not be measured.

B. The quantity of precast concrete EPS wall panels (Item # 602529) will be measured as the actual number of square feet completed and accepted. The EPS fill, concrete coping, concrete grade beam supporting the wall, load distribution slab, sand bedding layer behind the precast concrete EPS wall panels will not be measured but will be incidental to the precast concrete EPS wall panels.

Basis of Payment:

A. The quantity of precast pier footing formwork (Item # 602528) will be paid for at the Contract unit price per cubic yard (cubic meter). Price and payment will constitute full compensation for furnishing all materials, forms, and falsework; for weather protection; for removal of forms to allow visual inspection of areas of doubtful soundness and bonding of concrete; for furnishing and placing anchors, bolts, and stone veneer; for grooving and removing all debris or for manual texturing; and for furnishing all equipment, tools, labor, and incidentals required to complete the work.

B. The quantity of precast wall panels (Item # 602529) will be paid for at the Contract unit price per square feet. Price and payment will constitute full compensation for surface preparation, furnishing and placing all materials including equipment, tools, all labor, and incidentals necessary to complete the work. The cost associated with the EPS fill, concrete coping, concrete grade beam supporting the wall, load distribution slab, sand bedding layer behind the precast concrete EPS wall panels will be incidental to the precast concrete EPS wall panels.

8/30/16

602549 - FORM LINERS

Description:

This work shall consist of furnishing and placing form liners in accordance with these specifications and in reasonably close conformity with the lines, grades, and dimensions as shown on the Plans or established by the Engineer. Form release agents, form stripping methods, patching materials and construction procedures shall be mutually compatible with the surface finish and concrete stain to be applied. See also 602512 REINFORCED CONCRETE LANDSCAPE WALL, 602529 PRECAST CONCRETE EPS WALL and 602771 MECHANICALLY STABILIZED EARTH RETAINING WALLS.

Materials:

Simulated Stone Form Liners: Form liners shall be used which will result in the finish detail in the Plans and approved by the Engineer. Samples shall be submitted by the Contractor for approval by the Engineer. Form liners shall be a high quality reusable product manufactured of high strength urethane. The form liner shall attach easily to the forming system and shall not compress more than 0.021 ft when poured vertically at a rate of 10 ft/hr. The liners shall be capable of withstanding anticipated concrete pour pressures without leakage causing physical or visual defects. The liners shall be removable without causing concrete surface deterioration or weakness in the substrate. Single use form liners will not be acceptable for this project.

Form liner butt joints shall be carefully blended into the approved pattern and finished off the final concrete surface. There shall be no visible vertical or horizontal seams or conspicuous form marks created by butt joining form liners. The finished texture, pattern and color shall conform to the approved sample panel and shall be continuous without visual disruption. The Engineer may reject portion of the structure for failure to comply with these requirements. Rejected portions of the structure shall be completely removed from the project at no addition cost to the Owner.

Prior to each pour, the form liners shall be cleaned and free of build-up. Each liner shall be visually inspected for blemishes and tears. Repairs shall be made in conformance with the manufacturer's recommendations.

Form liners shall be securely attached to forms in conformance with the manufacturer's recommendations and with less than a ¼ in. seam.

For the patterns required form liners shall have the capability of being turned 180 degrees to result in a minimum of twelve different pattern combinations. None of the individual combinations shall be repeated side by side. Wall panels shall be placed in vertical columns (stacks). The panels between adjacent stacks will be staggered vertically by 2' so that no horizontal joints between adjacent vertical stacks lines up.

Form or Wall Ties: When form or wall ties are used which result in a portion of the tie permanently embedded in the concrete, the Contractor shall submit the type of form ties to the Engineer for approval prior to use in this work.

Form Release Agent: The release agent shall be compatible with the surface finish and concrete stain to be applied. The release agent shall be applied in conformance with the manufacturer's recommendations.

Coloring and Surfacing Materials: The coloration of the simulated stone form shall be multi-colored and hand applied to match the appearance, texture and the full range of colors present in the Sample Panels. These colors shall be approved by the Engineer and shall include a base color, heavy accent color, light accent color, speckling color, and joint color. The coloration of the sandblast shall be as selected by the Engineer.

Concrete Stain: The coloring agent shall be a penetrating stain mix, compatible color finish designed for exterior application on new or old concrete with field evidence of resistance to moisture, alkali, acid, mildew, mold and fungus discoloration or degradation. The coloring agent shall be breathable, allowing moisture and vapor transmission. Unless otherwise specified, two coats of concrete stain shall be applied in conformance with the manufacturer's recommendations and as directed by the Engineer. The Contractor shall stain all structures, as specified by the Engineer, in the field after they are completely constructed.

Construction materials shall maintain the following minimum standards:

a. Plastic Mix (Grout):

1. Adhesive Strength: 298 psi after 28 days (Sheer Bond Adhesion Testing Method)
2. Freeze-Thaw Resistance: No cracks or delamination after 300 cycles (ASTM C-666 Method B).
3. Accelerated Weathering: No visible defects (5000 hr. exposure).
4. Salt Spray Resistance: No deterioration or loss of adhesion (300 hr. exposure).
5. Absorption: 3 ½% maximum (ASTMC-67 testing method).
6. Flexural Strength: Minimum 988 psi after 28 days (ASTM C-348).
7. Compressive Strength: Minimum 4000 psi after 28 days (ASTM C-109).

b. Penetrating Stain – Technical Data

1. Mildew Resistance: In accordance with Fed Test Method STD. 144, Method 6271
2. Weather meter: Base material tested in accordance with ASTM G-155, 1000 hours.
3. Non Volatile Vehicle: 73.4% of total N.V.
4. Viscosity: 58” 2KU.
5. Solids content: 40.3%
6. Form: viscous, opaque liquid
7. Specific gravity: 1.17
8. Weight solids: 40.3%
9. Volume Solids: 29.5%
10. LB/gallon: 9.8: low luster
11. VOC: 170 g/l
12. Viscosity (77 deg F): 58 RU “2
13. Hardness: H-2H
14. Abrasion resistance (Tabor/CF-10) 500 Cycles: 17 gram loss
15. Gloss 60 deg: low luster
16. Coverage: 250” ft/gallon
17. Scrub Test (1000 revolutions): pass
18. Ultraviolet Resistance QUV 1000”: no effect
19. Alkaline Resistance: excellent
20. Acid Resistance: good-excellent

Basis of Design Products

1. Formliner Type 1: Ashlar Pattern
   Customrock Formliner Pattern #12005 Bearpath Coursed Stone
2. Formliner Type 2: Sandblast Pattern
   Customrock Formliner Pattern #8002 Sandblast Coarse

Manufacturers

1. Customrock Formliner
   2020 West 7th Street
   St. Paul Mn 55116
   800.637.2447
   www.customrock.com

   Representative:
   Hunt Valley Distributors
   3705 Crondall Lane
   Owings Mills, Md 21117
   Jason Sparks, General Manager
   Office 410.356.9677
   Cell 410.504.7860
   jason@HuntValleyContractors.com

2. Symons by Dayton Superior
   1125 Byers Road
   Miamiburg, Oh 45342
   973.866.0711
   888.977.9600 (Find a Dealer)
   www.daytonsuperior.com

3. Grenstreak Formliners
   Sika Corporation
   201 Polito Avenue 2
   Lyndhurst, NJ 07071
   1.800.933.SIKA
   www.greenstreak.com

   Representive:
   DE Regional Representative: Bob Swope 804.347.3165
   DE Sales Assistant: Patty Stover 215.295.6600

4. Spec Formliners Inc.
   1038 E. 4th Street
   Santa Ana, CA 92701
   714.429.9500
   www.specformliners.com

   East Coast Sales: Carey Cornwell careycornwell@specformliners.com

   Or approved equal.

Construction Methods:

Shop Drawings: Prior to beginning any work, representative shop drawings for the walls shall be provided. The shop drawings shall indicate the layout of the form liners and shall be drawn at a scale sufficient to show the detail of all stone and joint patterns. The form liner shall be patterned so that long continuous horizontal or vertical lines do not occur on the finished exposed surface. The line pattern shall be of a random nature and construction joints shall be visible. Particular attention should be given to details for wrapping the form liner around corners.

The shop drawings shall be submitted to the Engineer for review and approval. If necessary, the Contractor shall revise the shop drawings at no additional expense to the Owner until the proposed form liner patterns and arrangement receive the approval of the Engineer.

Sample Panels: Once the representative shop drawings have been approved, the Contractor shall then provide and erect on site, Sample Panels of the simulated stone masonry form liner patterns and coloration. The size of the Sample Panels shall be:

1. 4' height x 10' length x 8" thick, expansion joint, construction joint and integrally cast coping.
2. 2' height x 5' length x 8" thick transportable Sample Panel showing treatment for a typical surface shall be provided with a steel eye hook imbedded in the middle of the top side to support the lifting of the panel.

The location of the Sample Panels shall be readily visible from the proposed work and placed as approved by the Engineer. Approval of Sample Panels is required by the Engineer 10 working days prior to the start of the construction of the walls. The Sample Panels approved by the Engineer shall remain on the site as a basis for comparison for the work constructed on the project. These Sample Panels shall match the referee walls (texture, size, joint dimension, stone size and coloration) by all work constructed on the project. Any Sample Panel rejected by the Engineer shall be moved from the project and a new Sample Panel submitted at no additional expense to the Owner.

The concrete finish resulting from the form liners shall be cured, patched, or sealed as determined by the Engineer. All patching material shall exactly match the color and appearance of the poured concrete surface.

Concrete surfaces outside the form liners shall meet the requirements of Section 602.

Special Surface Preparation: Work under this Section shall include surface cleaning preparation to assure the surface is free of all latency, dirt, dust, grease, efflorescence, paint and any foreign material prior to the statin application in accordance with the manufacturer's recommendations. The Contractor shall correct, at his/her own cost, any surface problems created as a direct result of the surface preparation methods used.

The Contactor is advised that sand blasting will not be allowed for cleaning concrete surfaces, as it will reduce the special surface texture specified elsewhere herein. Pressure washing with water (minimum 3000psi) is the preferred method of removing latence. If cleaned by pressure washing a pressure of 3000 psi is a rate of three to four gallons per minute using a fan nozzle held perpendicular to the surface at a distance of one to two feet. The completed surface shall be free of blemishes, discolorations, surface voids and conspicuous form marks to the satisfaction of the Engineer.

Method of Measurement:

The quantity of form liners will be measured as the number of square feet (square meters) of form linear installed and accepted.

Measurements will be made on the surface of the completed structure.

Basis of Payment:

The quantity of form liners will be paid for at the Contract unit price per square foot (square meter). Price and payment will constitute full compensation for furnishing all materials and for equipment, tools, labor, and incidentals necessary to complete the work as specified above or in the Plans.

The cost shall also include compensation for any additional concrete required to achieve the finish detailed in the Plans, additional concrete and steel reinforcing required for all test pours, additional form liners required for the test pour, and all equipment, tools, labor, and incidentals necessary to complete the work shall be included in the unit price bid.

10/7/16

602627 - PRECAST WALL CAP

Description:

The item shall consist of furnishing and installing Precast Wall Caps on the cast-in-place (CIP) reinforced concrete landscape walls and piers in accordance with the details and notes shown on the Plans, and as directed by the Engineer.

Shop Drawings:

Shop drawings shall be prepared, submitted, and approved before fabrication may begin. Drawings must illustrate all unit edges, piece lengths and radii. Drawings must illustrate entire length of walls in plan with individual cap pieces and joint locations identified. All wall caps shall be 4' in length with exception of one smaller unit which should be located at pier interface.

Submittal:

Provide three (3) approximate brick size samples of precast concrete cap. Submittals to show color, edge condition, and texture or any other unique fabrication issue. Samples to be sent to engineer for approval.

Materials:

Precast Concrete Cap:

Precast concrete cap material to be manufactured in accordance with ASTM C 1364 using the wet cast method. Cap color to be light grey.

(1) Portland Cement: Use High Early Strength Type III cement conforming to the "Standard Specification for Portland Cement", ASTM designation C-150.

(2) Water: Water used in mixing concrete shall be clean and free from deleterious amounts of acids, alkalines or organic materials.

(3) Concrete mixture shall be proportioned and designed to develop minimum compression strength of 5000 p.s.i. and a maximum absorption of 5% at 28 days.

(4) Aggregate to be quartz, granite or other non-fading, non-staining material.

Stainless Steel Pin:

3/8" dia. 4" long. Minimum two per cap segment. Epoxy dowels to wall and cap.

Mortar:

Mortar shall conform to the requirements of Section 610.

Construction Methods:

Provide all material, labor, equipment and appliances necessary to fabricate, deliver and erect all precast concrete caps.

Stainless steel pins shall be made secure in the CIP wall. Pins shall be firmly placed and all anchor holes and dowel holes shall be completely filled with epoxy.

When setting with mortar, all stones shall be thoroughly wet with clean water just prior to setting.

All joints shall be flush with precast wall cap.

The precast concrete wall caps shall be set in accordance with the approved shop drawings and as directed by the Engineer. After setting the precast concrete cap, it shall be thoroughly cleaned of all spots, concrete, mortar, etc. to present a clean surface.

Method of Measurement:

The quantity of precast wall caps will be measured as the number of linear feet installed and accepted.

Basis of Payment:

The quantity of precast wall caps will be paid for at the contract unit price per linear foot. Price and payment shall constitute full compensation for furnishing and installing all materials, equipment, labor, mortar, epoxy, grout, stainless steel pins and incidentals necessary to complete the work.

8/30/16

602668 - PORTLAND CEMENT CONCRETE STAIRS

Description:

This item shall consist of constructing a reinforced portland cement concrete stairs conforming to the configurations, sizes and dimensions as shown on the plans and these specifications.

Reinforced concrete stairs shall be constructed at the locations, lines and grades as indicated on the plans.

Materials and Construction Methods:

The reinforced concrete stairs shall conform to the applicable requirements of the following sections of the Standard Specifications:

Section No. Description
207 Excavation and Backfill for Structures
602 P.C.C. Masonry
603 Bar Reinforcement

Fabrication:

Casting shall be done in rigidly constructed forms designed to produce dimensionally correct members with uniform surfaces per drawings.

Provide finished edges, which are straight or uniformly radial as noted on the plans, true to size and shape, and within specified casting tolerances. Radial stairs that exhibit anything other than a uniformly smooth radial edge will be subject to rejection by the Engineer.

Make exposed edges sharp, straight, radial, and square. Make flat surfaces into a true plane with directional washes as noted on plans.

Stair shadow lines grooves shall be clean and a consistent dimension as noted on the drawings.

Curing:

Form curing by moisture retention until concrete reaches adequate strength for removal of product from forms, a minimum of 3,500 psi.

Method of Measurement:

The number of square tread feet of reinforced concrete stairs to be paid for under this item shall be the number of square surface tread feet of reinforced concrete stairs constructed in place, completed and accepted, measured horizontally along the center of the stair from end to end of each stair.

Basis of Payment:

The number of linear feet of reinforced Portland cement stairs as measured above, shall be paid for at the contract unit price per Square Foot of tread surface bid for "Portland Cement Concrete Stairs", which price and payment shall constitute full compensation for all shoring, backfilling, compaction, formwork, concrete reinforcement, concrete surface finishing and material, labor, equipment, tools and all other incidentals required to complete the work.

8/30/16

602707 - SILICONE ACRYLIC CONCRETE SEALER

Description:

This work consists of surface preparation, furnishing all materials, and application of a silicone acrylic concrete sealer to any concrete surface. The work shall be performed as indicated on the Plans, in accordance with these Specifications, and as directed by the Engineer.

Materials:

The concrete sealer shall consist of methyl methacrylate-ethyl acrylate copolymer resins and toning pigments suspended in solution of all times by a chemical suspension agent and solvent. Laminar silicates, titanium dioxides, and inorganic oxides may be used for toning pigments. Use of vegetable or marine oils, paraffin materials, stearates or organic pigments in the formulation shall not be permitted.

The Sealer shall be opaque, non-film forming, and penetrating silicone acrylic compound. The sealer shall pass NCHRP 244 Series-2, salt spray resistance requirements. The materials must be local OTC-VOC compliant.

The Contractor shall provide Materials and Research Section one (1) quart sample from each batch of the silicone acrylic sealer compound supplied for chemical identification and testing.

The manufacturer shall supply a Materials Safety Data Sheet and a letter of certificate compliance of batch & lot of each shipment of the concrete sealer materials. The contractor shall also provide a manufacturer analysis report of the materials used with the specified batch shipped to the job site.

The color of the compound shall be off white (Federal Color #37925 of FED-STD-595B) or as specified on the plans.

Surface Preparation:

All new concrete surfaces, texturing, saw cutting, repointing and grooving shall be completed before the surface is prepared for sealer. All concrete that is to be sealed shall be cured for at least 28 days after casting or for the length of time specified in the manufacturer's instruction, whichever is longer. After 28 days, concrete surface shall be lightly sand or shot blasted, followed by vacuum cleaning in accordance with ASTM D 4258 & SSPC-SP-13 requirement to completely remove any applied curing compound, and to make surface lightly rough for penetration of sealer.

For existing concrete, all previous sealers and paints, all salt, efflorescence, laitance, and other foreign matter, and all loose material shall be completely removed using one or a combination of different preparation methods as specified in ASTM D-4258 and SSPC-SP 13.

In addition, both new and existing concrete shall receive a high pressure (3000-5000 psi) water washing at a flow of more than 4 gallons per minute, with zero degree of rotary nozzle. The contractor shall also allow the surface to dry for a minimum of 24 hours prior to the coating application after high-pressure washing. All surface preparation work shall be completed and approved by the Engineer before sealer the application can commence.

Construction Methods:

The sealer shall be used as supplied by the manufacturers without thinning or alteration unless specifically required in the manufacturer's instructions and verified by Engineer.

The silicone acrylic concrete sealer shall be applied to all exposed concrete surfaces as shown on the plans.

Concrete curing compounds, form release agents, and concrete hardeners may not be compatible with recommended coatings. Check for compatibility by applying a test patch of the recommended coating system, covering at least 20 to 30 square feet.

The concrete sealer material shall be applied using coverage rate and equipment in accordance with the manufacturer's recommendations.

A minimum of two coats shall be applied; all applications shall be performed under dry conditions with application-spread rate as recommended by the manufacturers.

The sealer shall be applied within the ambient temperature range as recommended by the manufacturer, when no rain is expected within a minimum of 12 hours following the application, and there are no high winds that would cause an improper application. If rain has preceded the application, the surface shall be allowed to dry at least 24 hours before waterproofing application begins.

Follow manufacturer's recommendation for coating thickness. No drips, runs, or sags will be allowed during application. Natural bristle brush, roller, or spray can be used to perform the application. Follow manufacturer's recommendation during application. No thinning of materials is permitted; all application procedures, and drying time between coats must be as per manufacturer's recommendations.

The Contractor shall perform surface preparation and application of the concrete sealer material so as not to endanger any private and/or public property, pedestrians, workmen, and vehicles on, beneath or adjacent to the structure.

Method of Measurement:

The quantity of "Silicone Acrylic Concrete Sealer" will be measured as the actual number of square feet of surface area covered with silicone acrylic concrete sealer, completed, and accepted.

Basis of Payment:

The quantity of "Silicone Acrylic Concrete Sealer" will be paid for at the Contract unit price per square feet. Price and payment will constitute full compensation for furnishing all materials, furnishing and removing scaffolding as required, surface preparation, application of the concrete sealer material, disposal of discarded materials, and for all labor, tools, equipment, and all necessary incidentals to complete the work.

5/3/16

602770 - LIGHTWEIGHT FOAMED CONCRETE FILL
LOW DENSITY-CONTROLLED LOW STRENGTH MATERIAL (LD-CLSM)

Description:

This work shall consist of furnishing and placing lightweight foamed concrete fill –low density - controlled low strength material (LD-CLSM) of the appropriate type at the locations indicated on the plans and where directed by the Engineer. The work shall be done in accordance with these specifications and in conformity with the lines, grades, thicknesses, and typical sections shown on the plans or established by the Engineer in writing.

Definitions:

a. **LD-CLSM:** A self-leveling and self-compacting, cementitious material with an unconfined compressive strength of 1,200-psi or less.

b. **Density:** Material property that relates to the unit weight or mass of the materials.

c. **Strength:** Material property that relates to the ability of the hardened material to support gravity loads or stresses at a given age.

d. **LD-CLSM Air Generating Admixture:** A chemical admixture specially formulated to entrain air into LD-CLSM.

e. **Preformed Foam:** Preformed foam created by diluting a liquid foam concentrate with water and passing through a foam generator. Preformed foam density is typically between 2.5 and 4.0-pcf.

f. **Hardening Time:** Period of time for a LD-CLSM mixture to reach a state in which it will support a specific load.

Materials:

Materials shall meet the requirements of the following:

a. **Portland Cement:** Portland cement shall comply with ASTM C150, Type I, II, or III.

b. **Fly Ash:** Fly ash shall conform to AASHTO M 295.

c. **Granulated Blast Furnace Slag:** Granulated blast furnace slag shall comply with AASHTO M 302.

d. **Fine Aggregate:** Fine aggregate shall comply with AASHTO M 6.

e. **Coarse Aggregate:** Coarse aggregate shall comply with AASHTO M 80.

f. **Lightweight Aggregate:** Lightweight aggregate shall comply with AASHTO M 195.

g. **Water:** Mixing water shall be potable and free of deleterious amounts of acids, alkali, salts, oils, and organic materials that would adversely affect the setting or strength of the concrete.

h. **Chemical Admixtures:** Chemical admixtures shall comply with AASHTO C 494 and may be used in accordance with the manufacturer's recommendations as applicable for job conditions.

i. **Foaming Agent:** The foaming agent shall conform to the requirements of ASTM C-869.

j. **LD-CLSM:** The LD-CLSM shall conform to ACI Committee Report 229R-13, LD-CLSM using preformed foam, with an in-service density of 60 to 65-pcf and a minimum compressive strength after 28-days of 320-psi.

The Contractor shall be responsible for designing the mix so that each type of LD-CLSM meets the corresponding criteria listed above. The Contractor shall verify the LD-CLSM will have no environmental impacts and will not have any negative impacts to the reinforcement materials and facing components. The Contractor shall submit reports documenting the physical properties of the LD-CLSM to the Engineer for approval at least 30-working days prior to the placement of the LD-CLSM.

Sampling and Testing:

During the initial placement of the LD-CLSM, the density will be determined at the point of placement and the mix shall be adjusted by the Contractor, as required, to obtain the specified in-service density. Thereafter, the density will be monitored by the Engineer at 30-minute intervals during placing. The Contractor shall adjust his operations as necessary to maintain the specified in-service density.

Specimens for determination of the compressive strength will be taken by the Engineer at the point of placement. Sampling will be in accordance with the procedures as follows:

a. Four representative samples (6-inch x 12-inch cylinders) shall be taken at the point of placement for each day's pour for each lift, or every 3,500-cubic feet, whichever is more frequent. Samples shall be marked for clear identification, and all pertinent field information will be recorded on the field report, including the station limits and elevation limits of the placement. Slump and air content shall not be measured.

b. Samples shall be obtained by overfilling the cylinders by pouring concrete down the insides of the cylinders, allowing air to escape during filling. DO NOT ROD THE SAMPLES. The sides and bottom of the cylinder molds shall be tapped to close any accidentally entrained air voids. Strike off the top of the cylinder (not more than three times) and cover.

c. Samples shall be placed in a location where they will not be disturbed nor subjected to temperatures below 44ºF or above 84ºF. Excessive handling may damage the test cylinders.

d. After 24-hours, the Engineer will ship the cylinders along with the corresponding field test reports to the testing facility for storage. At 28-days, the cylinders will be compression tested in accordance with ASTM D 4832.

e. Failure to meet the in-service density or the strength criterion specified for the LD-CLSM may require removal and replacement of that entire lift and all overlying lifts at the Contractor's expense, based on an engineering evaluation performed by the Engineer.

Construction Methods:

Mixing and placing operations shall be under the supervision of the representative of the supplier. The LD-CLSM shall be placed in lifts not to exceed 2-feet unless otherwise approved by the Engineer. Subsequent lifts shall be placed only after a minimum 12-hour waiting period has been observed. The LD-CLSM should not be driven on by any vehicle or construction equipment for at least 48-hours after placement.

The LD-CLSM shall be placed on supporting surfaces which have been cleaned of loose debris, sand, dust, or other foreign materials to the satisfaction of the Engineer. Surfaces against which the LD-CLSM is to be placed shall not be frozen and shall be free of ice and snow. The ambient temperature shall be at least 35ºF and rising at the time of placement.

Qualifications:

The Contractor shall procure the services of a representative of the supplier to be on site full time during the placement of the LD-CLSM. The representative of the supplier shall be regularly engaged in the placement of the LD-CLSM including the placement of mass fills having a minimum of 5,000-cubic yards in the past three years. LD-CLSM shall have been successfully applied on three projects, which have demonstrated satisfactory performance for at least three years. The Contractor shall submit a project list to the Engineer complying with the above requirements a minimum of 30 working days prior to the start of the work.

Method of Measurement:

LD-CLSM including all material, labor, equipment, expendables, etc., incidentals to their installation and testing to be paid for under this item shall be the number of cubic yards complete in place and accepted.

Basis of Payment:

The payment will be full compensation for furnishing, installing, testing and for all materials, labor, tools, equipment, and incidentals necessary to complete the installation of LD-CLSM in conformance with the plans and Specifications.

6/27/16

602771 - MECHANICALLY STABILIZED EARTH RETAINING WALLS

Description:

This work shall consist of the design and construction of mechanically stabilized earth (M.S.E.) retaining walls in accordance with the AASHTO definitions of mechanically stabilized earth walls employing tensile reinforcements in the soil mass. The M.S.E. retaining wall shall be constructed in conformance with these specifications and to the lines, grades, and dimensions shown on the Plans or as established by the Engineer. Design details for these structures shall be as submitted for approval.

The M.S.E. retaining wall shall be designed in conformance with the 2007 AASHTO LRFD Bridge Design Specifications, 4th Edition including all current Interims and the requirements specified on the Plans.

The following additional specific design requirements shall be met by the developed plans:

a. All retaining wall components shall be designed for a minimum service life of 100 years.

b. Completed walls shall have a concrete facing with the following finish: Formliner Type 2, Sandblast Pattern, see specification 602549 FORM LINERS.

Design Requirements:

The design of the internal stability of the MSE wall shall be the responsibility of the wall manufacturer. Design constraints imposed by external (overall) stability, such as allowable bearing pressure due to the combined effects of vertical and lateral loads, minimum length of reinforcing elements, as set forth herein, shall be the responsibility of the Contractor.

Working drawings bearing the fabricator's or supplier's title block and design calculations sealed by a professional engineer registered in the State of Delaware shall be submitted for review and approval by the Engineer at least 4 weeks before work is to begin. Working drawings and design calculations shall include the following:

(a) Existing ground elevations that have been verified by the Contractor for each location involving construction wholly or partially in original ground.

(b) Layout of wall that will effectively retain the earth but not less in height or length than that shown for the wall system in the Plans.

(c) Complete design calculations substantiating that the proposed design satisfies the design parameters in the Plans and in the special provisions.

(d) Complete details of all elements required for the proper construction of the system, including complete material specifications.

No work or ordering of materials shall commence until approval of the working drawings has been given by the Engineer. Acceptance of the Contractor's working drawings shall not relieve the Contractor of his responsibility under the contract for the successful completion of the work. All work pertaining to Working Drawings for MSE retaining walls shall be done at no additional cost to the Department.

Internal Stability: The internal stability of a mechanically stabilized earth structure shall be the responsibility of the wall supplier. Internal stability issues include, but are not limited to, pullout (or geotechnical) failure of the soil reinforcing elements, tensile failure of the soil reinforcing elements, failure of panel/reinforcement connections, failure through the backfill material within the reinforced mass, and failure along a reinforcing element surface within the reinforced soil mass.

Sliding, overturning, and bearing capacity shall be evaluated by the wall supplier. The allowable bearing capacity at the MSE walls shall be determined by the Contractor and submitted for approval by the Engineer.

Failure Plane: The so-called failure plane shall be taken as coincident with the locus of the points of maximum tensile force which separates the reinforced mass into an active zone between the face of the wall and the line of maximum tensile forces, and a resistant zone behind the maximum tensile forces line. The location of the so-called failure plane shall be adjusted, where necessary, to account for the effects of significant externally applied loads, such as those due to a bridge abutment footing supported directly on the mechanically stabilized backfill.

Resistance Factors for Permanent MSE Walls:

0.9 for pullout of tensile reinforcing elements.

1.0 for sliding of the reinforced soil mass along the interface between the reinforced mass and the underlying native soil. The passive resistance of the soil in front of the embedded portion of the wall shall not be included in evaluating lateral stability of the reinforced mass.

0.75 for failure at the facing panel/reinforcing element connection based on the maximum allowable reinforcement tension at the end of the design service life.

Panel/Reinforcement Connections: All connections shall be positive structural connections subject to the galvanizing and metal loss rates, for metal reinforcing elements, and allowable tensile stresses given in Stresses in Reinforcing Elements. The structural adequacy and pullout capacity of the connections shall be demonstrated by test data from pullout and flexural tests on full size panels in which all connections are loaded simultaneously. The test data shall be provided by the manufacturer.

Drainage: Drainage shall be as designed by the Contractor or as directed by the Engineer. Internal and external drainage shall be evaluated for all structures to prevent saturation of the backfill or to intercept any surface flows containing aggressive elements such as de-icing salts. Internal drainage of the mechanically stabilized backfill shall be considered where the anticipated rate of surface infiltration due to precipitation exceeds the vertical permeability of the backfill material.

Length of Reinforcing Elements: The length of the reinforcing elements shall be constant over the entire height of any wall section. The minimum reinforcement length shall be as shown on the plans and not less than eight (8) feet in accordance with AASHTO. In addition, the length of the reinforcing elements shall be sufficient to satisfy all the design criteria with respect to both internal and external stability.

Stresses in Reinforcing Elements: The reinforcing elements shall be designed to have a minimum design life of 100 years with all material and other resistance factors intact at the end of the design life of the mechanically stabilized earth structure.

Unless otherwise indicated by the Engineer, the following metal loss rates shall be used in determining the useful area of metal soil reinforcement remaining at the end of the nominal service life:

Loss of Galvanizing (first 2 years):	0.58 mil./year
Loss of Galvanizing (2 years - depletion):	0.16 mil./year
Carbon steel (after zinc depletion):	0.47 mil./year

The allowable tensile stress in the longitudinal wires of the mesh reinforcing elements shall not exceed fifty-five (55) percent of the nominal yield stress of the steel, provided that the yield stress does not exceed 65 kips/sq.in. The maximum tension in any reinforcing element shall not exceed the product of the maximum allowable tensile stress and the area of steel remaining at the end of the nominal service life.

Stresses at Panel/Reinforcement Connections. The horizontal earth pressure used to design the connections and facing panels shall be equal to the maximum horizontal stress computed at each reinforcement level, but in no case shall it be less than eighty-five (85) percent of the maximum horizontal pressure. In the case of rigid panel/reinforcement connections the allowable stress in the reinforcement at the connection shall be reduced to allow for bending stresses induced in the connection due to relative vertical movement between the facing panels and the reinforced backfill.

Internal Horizontal Stresses: For MSE wall systems with quasi-inextensible reinforcing elements, the horizontal stress at each reinforcement level shall be computed by multiplying the corresponding vertical stress by an earth pressure coefficient, K. The vertical stress shall be computed using a layer-by-layer approach following Meyerhof's analysis for eccentrically loaded footings; i.e., the resulting vertical stress at any reinforcement level is a function of the vertical stress due to the self weight of the overlying backfill material and the increase in vertical stress due to the overturning effects of the lateral load from the random fill retained by the mass of reinforced backfill.

The value of the earth pressure coefficient, K, shall be assumed equal to the at-rest (K_o) value at the top of the wall decreasing linearly to the Rankine active value (K_a) at a depth of 20 feet. At depths in excess of 20 feet, the value of K shall be taken as K_a. For normally consolidated soils, $K_o = 1 - \sin\varphi$, where φ is the angle of shearing resistance of the backfill material. For typical values of φ, K_o may be assumed equal to $1.5K_a$.

Pullout Resistance (Anchorage) Factors: Non-dimensional anchorage factors (denoted as A_c) as determined by laboratory or field pullout tests on reinforcing elements shall be based on the interpreted failure load at a maximum displacement of three-quarters (3/4) of an inch. The anchorage factor, A_c, shall be computed from the expression

$$A_c = \frac{\text{Load at 3/4-inch displacement}}{p_v dbN}$$

where p_v = vertical stress (due to self weight of backfill only) at the reinforcement level, d = diameter of transverse wires, b = width of transverse wires for a 6-inch spacing of longitudinal wires, N = number of transverse wires.

The spacing between transverse wires shall not be less than six (6) inches. The non-dimensional anchorage factor shall be assumed to decrease linearly from 40 at the top of the wall to 15 at a depth of 20 feet. At depths greater than 20 feet the anchorage factor shall be taken equal to 15.

Materials:

The Contractor shall make arrangements to purchase or manufacture the concrete facing panels, reinforcing mesh or strips, attachment devices, and all other necessary components. Materials not conforming to this section of the specifications shall not be used without written consent from the Engineer.

Steel Reinforcing Mesh. Reinforcing mesh shall be shop fabricated of cold drawn steel wire conforming to the minimum requirements of A 82 and shall be welded into the finished mesh fabric in accordance with A 185. Galvanization shall be applied after the mesh is fabricated and conform to the minimum requirements of A 123.

Steel Reinforcing Strips. Reinforcing strips shall conform to the physical and mechanical properties of ASTM A 572, Grade 65 steel. Galvanizing shall conform to the minimum requirements of AASHTO M111 (ASTM A 123).
Steel Connectors. Connectors shall be fabricated from cold drawn steel wire conforming to the minimum requirements of A 82. Pins shall be fabricated from A 36 steel. Connectors and pins shall be galvanized to conform to the minimum requirements of A 123.

Filter Fabric. Where required by design, filter fabric shall be placed behind the facing units. Filter fabric shall be woven polypropylene fabric, meeting the requirements of M 288 for a Class I geotextile having an Ultraviolet Stability of 70% strength retention after 500 hours as tested by D 4355. Slit film geotextile shall not be allowed. Filter fabric shall be adhered to back face of panels using an adhesive supplied by the manufacturer.

Backfill. Multiple types of backfill are required for the construction of the MSE walls. All backfill material used in the structure volume shall be reasonably free from organic or otherwise deleterious materials and shall be as specified on the plans. Placement limits are shown on the plans. The material requirements for each backfill type are as follows:

Select Backfill. Select backfill shall conform to DelDOT No. 57 Stone.

Free draining stone conforming to DelDOT No. 57 stone or approved equal shall be placed to an elevation as specified in the plans of the MSE embankment.

In addition, the select backfill material shall conform to the following requirements:

a) Plasticity Index: The Plasticity Index (P.I.), as determined by AASHTO T- 90 (ASTM D-4318), shall not exceed 6.

b) The material shall be substantially free of shale or other soft, poor durability particles. Testing in accordance with AASHTO T-104 shall be performed to verify a magnesium sulfate soundness loss of less than 30% after four cycles.

c) Electrochemical Requirements - The backfill materials shall meet the following criteria:

Requirements	Test Methods
Resistivity >3,000 ohm-cm	AASHTO T-288-91
pH 5-10	AASHTO T-289-91
Chlorides <100 parts per million	AASHTO T-291-91
Sulfates <200 parts per million	AASHTO T-290-91
Organic Content <1%	AASHTO T-267-86

If the resistivity is greater or equal to 5000 ohm-cm, the chloride and sulfates requirements may be waived.

The Contractor shall furnish to the Engineer a Certificate of Compliance certifying that the backfill materials comply with this section of the specifications prior to backfill placement. A copy of all test results performed by the Contractor, which are necessary to assure compliance with the specifications, shall also be furnished to the Engineer. Backfill not conforming to this specification shall not be used without the written consent of both the Engineer and the wall supplier.

Concrete: Concrete for the facing, leveling pad, moment slab and barrier shall conform to the requirements of Section 602 of the Specifications.

Construction Methods:

The selected MSE wall manufacturer shall provide a representative on site at the outset of the wall construction and periodically throughout construction of the wall and at the direction of the Engineer. The wall manufacturer's representative shall be present at a pre-construction conference to provide an overview of the wall system and a detailed construction procedure to the contractor and the Engineer.

Wall Excavation. Excavation shall be in accordance with the requirements of the general specifications and in reasonably close conformity with the limits shown on the Plans. Temporary excavation support as required shall be the responsibility of the Contractor. The base of the excavation shall be completed to within +/- 3 inches of the staked elevations unless otherwise directed by the Engineer.

Foundation Preparation. The foundation for the structure shall be graded level for a width 1 foot beyond the length of the reinforcement elements or as shown on the Plans. Prior to wall construction, the foundation shall be proofrolled under the observation of the Engineer. Any unsuitable foundation material as determined by the Engineer shall be excavated to the determined depth and replaced with Borrow Type B and shall be compacted in accordance with Backfill Placement as described below.

At each panel foundation level, a precast reinforced or a cast-in-place unreinforced concrete leveling pad of the type shown on the plans shall be provided. The leveling pad shall be cured a minimum of 12 hours before placement of wall panels.

Wall Erection. The wall system components shall be constructed in accordance with the wall system supplier's recommendations and construction manual. The wall shall be constructed vertical and within the specified tolerances. The overall vertical tolerance of the wall and the horizontal alignment tolerance shall not exceed 3/4-inch per 10 feet. Bulging in the vertical or horizontal direction shall be limited to 2 inches as measured from the theoretical wall line. The Engineer shall be notified of any bulging areas that exceed this limit.

Backfill Placement. Backfill placement shall closely follow erection of each course of concrete facing units. Backfill shall be placed in such a manner as to avoid any damage or disturbance to the wall materials or misalignment of the facing. Any wall materials that become damaged or disturbed during backfill placement shall be removed and replaced at the Contractor's expense or corrected as directed by the Engineer. The Engineer will be the sole authority as to the acceptability of any repairs to damaged wall materials. Any misalignment or distortion of the wall elements due to placement of backfill outside the limits of this specification shall be corrected as directed by the Engineer.

Backfill within the zone of soil reinforcements shall be compacted to 95% maximum dry density and optimum moisture content, as determined by AASHTO T 99, by at least four (4) passes of a heavy roller having a minimum dynamic force of 20 tons impact per vibration and a minimum frequency of 16 hertz.

The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer. The water content of the wall backfill shall not deviate from the optimum water content by more than 2%. Backfill material with a placement moisture content in excess of the optimum moisture content shall be removed and reworked until the moisture content is uniformly acceptable throughout the entire lift. The maximum lift thickness after compaction shall not exceed 10 inches regardless of the vertical spacing between layers of soil reinforcements. The Contractor shall decrease this lift thickness as required to obtain the specified density.

Prior to placement of the soil reinforcements, the backfill elevation after compaction within the zone of soil reinforcements shall be 2 inches above the connection elevation from a point approximately 24 inches behind the facing to the free end of the soil reinforcements unless otherwise shown on the Plans.

Compaction within 3 feet of the facing shall be achieved by at least three (3) passes of a lightweight mechanical tamper, roller or vibratory system. Care shall be exercised in the compaction process to avoid misalignment of the facing. Heavy compaction equipment shall not be used to compact backfill within 3 feet of the wall face. At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing to direct runoff of rainwater away from the wall face. In addition, the Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

Leveling Pad. The concrete leveling pad at the concrete facing shall be unreinforced and constructed to the elevation and width shown on the Plans. The leveling pad shall be constructed on compacted, drained subgrade.

Utilities. The contractor shall accommodate the passage of utilities through the reinforced embankment material. The soil reinforcements shall be placed to permit the installation and operation of, and access to, the utilities constructed within the embankment while satisfying the design requirements of the MSE wall. The MSE wall manufacturer shall provide a construction sequence for installation of utilities within the reinforced embankment which does not jeopardize the integrity and stability of the reinforced soil mass.

Moment Slab and Barrier. The moment slab and barrier shall be constructed according to the details shown on the plans.

Toe protection. The toe of the wall shall be embedded in accordance with the Plans and shall be protected as required for the life of the structure to avoid undermining the wall face.

Method of Measurement:

MSE Wall design and construction including all material, labor, equipment, expendables, etc., incidental to their installation and testing to be paid for under this item shall be the number of square feet of the wall surface area shown on the plans complete in place and accepted. The wall height is measured from the top of the leveling pad to the top of the cast-in-place coping. The concrete leveling pad is included in this pay item.

Temporary excavation support as required will not be measured and will be incidental to the construction of the pertinent Retaining Wall.

Basis of Payment:

The payment will be full compensation for all components of the MSE Wall and shall include full compensation for designing, fabricating, furnishing, installing and for all materials, labor, tools, equipment, and incidentals necessary to complete the installation in conformance with the plans and Specifications.

8/30/16

602774 - MASONRY FOR LIGHT POLE FOUNDATION (CY)

Description:

This work shall consist of all labor, materials, equipment, and services necessary to perform all operations to complete the installation of Custom 6A pole base foundations for light poles. The work shall be completed in accordance with the plans, Delaware Department of Transportation's Specifications for Road and Bridge Construction dated August 2001 (Standard Specifications), and this Special Provision. The work involves installing constant-diameter pole base foundations (drilled shafts) through Coastal Plain sediments and Piedmont Residuum. High water tables may be present.

Materials:

Materials shall meet the following requirements:

a. Portland Cement Concrete

Portland cement concrete shall be 4500-psi minimum (Class A) and shall meet the requirements specified in Section 602 and 812, in the Delaware Department of Transportation's Specifications for Road and Bridge Construction (August 2001). Where not otherwise specified, ACI 336.1-94 shall be followed. Water used in mixing concrete shall conform to Section 803 of the Standard Specifications.

Concrete shall remain workable and maintain a 4-inch slump for up to four hours after placing. If free fall methods are utilized for placement, the maximum coarse aggregate size shall be reduced to 3/8-inch. A slump value range of 5 1-inch shall be provided for all uncased holes and a slump range of 6 1.5-inch shall be provided for cased holes. A minimum slump of 6-inch with the addition of a retarder is required when a casing is being withdrawn. An acceptable water reducing and retarding admixture shall be added to the concrete to produce the specified slump. Under no circumstances shall the admixture cause segregation of the concrete. If any admixtures are added to the concrete at the site, the admixture must be added to the concrete by a qualified Contractor-furnished technician. Immediately after the addition of the admixture, the drum shall be turned a minimum of thirty revolutions, at mixing speed, until the concrete is thoroughly mixed. The technician shall then test the slump and consistency of the concrete mixture. Under no circumstances shall the Contractor add additional water to the concrete mixture to reach the desired slump.

b. Reinforcing Steel

Deformed reinforcing bars shall be in accordance with the sizes, spacing, dimensions, and details shown on the plans and shall conform to AASHTO M31, Grade 60, and the requirements of Section 603 and 604 of the Specifications.

c. Casing

Casing shall be metal, smooth, clean, watertight, and of ample strength to withstand both handling and driving stresses and the pressure of both concrete and the surrounding earth materials. Thickness of the casings shall not be less than 0.25-inch. The inside diameter of casing shall not be less than the specified size of the shaft. No extra compensation will be allowed for concrete required to fill an oversized casing or oversized excavation. All casings shall be removed from shaft excavations. Permanent steel casings shall not be used.

d. Slurry

Use of slurry shall not be permitted.

e. Ground Rod and Clamp

Ground rods shall be copper clad, approved by the Underwriter's Laboratory, and be supplied with approved clamps for connecting the grounding conductor to the rod. Ground rods shall be ¾ inch diameter by 10 foot, sectional, unless otherwise specified on the Plans.

f. Conduit sweeps

Conduit sweeps shall meet the requirements for galvanized steel rigid conduit in Section 745 of the Delaware Department of Transportation's Specifications for Road and Bridge Construction (August 2001).

g. Anchor Bolts

Anchor bolts will be supplied by the same entity that supplies the poles. Anchor bolts shall have a minimum yield strength of 55,000 psi.

Contractor Qualification:

This work shall be performed under the supervision of the Contractor's superintendent, who will be fully knowledgeable and experienced, as defined herein, in the construction of pole base foundations of similar sized shafts and geotechnical conditions using both cased and slurry methods. Further, the Contractor and the Contractor's superintendent performing the work shall document at least five years previous experience within the last eight years constructing pole bases, with at least two years at the current firm. The Contractor's equipment shall have the capacity to undertake the work and shall be sufficient to complete the work within the specified contract time.

The Contractor shall provide documentation of his qualifications, experience record, prior project references, and the availability of the equipment needed to perform the required work. All prior project references shall be currently available personnel who can verify the quality of the contractor's previous work and shall include current name, address, and telephone number. This documentation shall reference the experience of the pole base Contractor and the pole base Contractor's superintendent in responsible charge of the pole base operations. This documentation shall reference successful construction of similar sized shafts in the following conditions:

a. Experience in successfully installing pole bases of the size shown in the Plans. The minimum experience shall consist of ten similar-sized projects in the past five years. Descriptions of projects must include a point of contact with the owner that is familiar with the project.

b. Experience in cleaning shaft bottoms when working under wet conditions.

Equipment:

The Contractor shall furnish all equipment and instrumentation necessary for installation of the pole base foundations.

The excavation and drilling equipment shall have adequate capacity including power, torque, and down thrust to excavate a hole of the maximum diameter shown on the plans and to a depth of 15-feet or 20 percent beyond the depths shown in the contract documents, whichever is greater.

The excavation and tools shall be of adequate design, size, and strength to perform the work shown in the contract documents or described herein. When the material encountered cannot be drilled using conventional earth augers with soil or rock teeth, drilling buckets, and/or over-reaming tools, the Contractor shall provide special drilling equipment including but not limited to: rock core barrels, rock tools, air tools, blasting materials, and other equipment as necessary to construct the shaft excavation to the size and depth required.

Provide a descriptive listing of available equipment that is fully capable of cleaning shaft bottoms when shafts are excavated under wet conditions.

Site Information:

Test Boring Log sheets are included in the contract documents for use by the Contractor. Data on subsurface conditions is not intended as representations or warranties of continuity of such conditions. It is expressly understood that the Department will not be responsible for interpretations or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor. The Contractor may make additional test borings and other exploratory operations at no additional cost to the Department.

A geotechnical engineering report titled Final Foundations Report, dated July, 2015 for the Christina River Bridge has been prepared for this project by Rummel, Klepper, and Kahl, LLP (RK&K). This report was prepared to establish design guidelines only and should not be considered part of the contract documents nor as a warranty of subsurface conditions. This report may not be sufficient for use by specialty contractors. Contractors or prospective bidders may contact the Delaware Department of Transportation to review a copy of this report.

Submittals:

The Contractor shall submit to the Engineer for review and approval, an installation plan for the construction of pole base foundations not less than thirty days before the start of work as detailed in this Special Provision. The submittal shall include at least the following:

a. List of proposed equipment to be used including cranes, drills, augers, bailing buckets, final cleaning equipment, tremie or concrete pumps, casing, and other appurtenances.

b. Details of overall construction operation sequence and the sequence of shaft construction in bents or groups, including scaled plan and profile showing the location, size and movements of equipment setup and operations. The completion of any required integrity and loading tests shall be noted in this construction operation sequence.

c. Submit project experience and resumes in accordance with Contractor Qualification.

d. Details of shaft excavation and stabilization methods.

e. Method of monitoring verticality of the shaft excavation during excavation and details of proposed corrective measures to be implemented as necessary.

f. Very specific details of methods to clean the shaft excavation. Details shall include at least three alternative bottom cleaning methods with descriptions of equipment to be used when installing drilled shafts with wet methods. Include details of method for identifying type of bearing material for consistency with design assumptions prior to placement of concrete.

g. Details of reinforcement placement including support and centralization methods.

h. The concrete mix design, including admixtures to be used. Details of concrete placement, curing, and protection.

i. A copy of the proposed report format for planned shaft inspections. Record information for each shaft and details of any required load or integrity tests.

j. Other information shown on the plans or requested by the Engineer.

The Contractor will not be permitted to start construction of any pole base foundation, until the complete installation plan submittal as described above has been received, reviewed and written approval to begin construction has been issued by the Engineer.

The Contractor will not be permitted to start the construction of pole base foundations for which working drawings are required until the Engineer has approved such drawings. Such approval will not relieve the Contractor of responsibility for results obtained by the use of these drawings or any of his other responsibilities under the contract.

Submittals during construction shall include record information for each shaft and details of any required loading or integrity tests as required.

Construction Methods:

a. Protection of Existing Structures

All reasonable precautions shall be taken to prevent damage to all existing structures, utilities, and the public. These measures shall include but are not limited to, selecting construction methods and

procedures that will prevent excessive caving of the shaft excavation, monitoring, and controlling the vibrations from the driving of casing or sheeting, drilling of the shaft, or from blasting, if permitted. The Contractor shall verify that there are no subsurface utilities in close proximity of each shaft before beginning excavation activities.

b. Construction Sequence

Where drilled shafts are to be installed in conjunction with embankment placement, they shall be constructed after the placement of the fill.

Excavation of adjacent drilled shafts or other structures or utilities within a radius of three shaft diameters will not be permitted until concrete has been in place for at least 48 hours.

c. Methods of Construction

Excavations required for shafts shall be performed through whatever materials are encountered, to the dimensions and elevations shown on the plans or otherwise required by the Standard Specifications and Special Provisions. The method used shall be suitable for the intended purpose and materials encountered. The dry method or temporary casing method will be used as necessary to produce sound, durable concrete foundation shafts that are free of any defects. Wet method may only be used after the Engineers approval. When a particular method of construction is required in the contract documents, that method shall be used. If no particular method is specified for use, the Contractor shall select and use the method, as determined by site conditions, subject to approval of the Engineer, which is needed to properly accomplish the work.

The estimated lengths shown on the plans and in the geotechnical reports should be considered approximate. Additional shaft lengths might be required depending on actual subsurface conditions. Shorter shaft lengths than indicated on the plans may only be constructed with the written approval of the Engineer.

1. Dry Construction Method

The dry construction method shall be used only at sites where the ground-water table and site conditions are suitable to permit construction of the shaft in a relatively dry excavation (i.e., less than 3-inch of water accumulates above the final base elevation over a one-hour period when no pumping is permitted), and where the sides and bottom of the shaft are stable and may be visually inspected prior to placing the concrete.

The dry method consists of drilling the shaft excavation, removing accumulated water and loose material from the excavation, placing temporary casing, inspecting the bearing stratum, removing temporary casing, placing the reinforcing steel if required, and placing the shaft concrete in a relatively dry excavation. If caving occurs or if there is excess seepage into the drilled shaft, the drilling should be continued using a casing to maintain the integrity of the hole. Concrete shall be placed in accordance with Construction Methods, sub-section I, of this Special Provision.

2. Wet Construction Method

The wet construction method shall not be used.

3. Temporary Casing Construction Method

The temporary casing construction method shall be used at all sites where excessive caving or seepage could occur. When a nearly impervious formation is reached, a temporary casing shall be placed in the hole and sealed in the nearly impervious formation. As an alternative to use of the wet excavation method, temporary casing may be installed by drilling, driving, or vibratory procedures in advance of excavation to the lower limits of the caving material. Slurry may not be used. Significant caving shall be considered to be more than 50% increased volume over theoretical shaft volume, for a section exceeding 10-feet of shaft. Casing shall be installed to the final base elevation to allow inspection of the bearing stratum.

After the reinforcing steel cage has been placed, fill the excavation with concrete. Before the casing is withdrawn and while the casing is being withdrawn, the level of fresh concrete in the casing shall be at such a level that all the fluid trapped behind the casing is displaced upward without contaminating the shaft concrete. Placement of the concrete and pulling of the temporary casing shall be conducted in accordance with Construction Methods, sub-sections I and J, of this Special Provision.

4. Alternative Construction Methods

The Contractor may propose alternative methods to prevent caving and control ground water. Such proposals, accompanied by supporting technical data, shall be submitted in accordance with the Submittals section of this Special Provision. Written approval from the Engineer is required before the use of alternative construction methods.

d. Excavations

The bottom elevation of drilled shafts shown on the plans may be adjusted during construction if the Engineer determines that the foundation material encountered during excavation is unsuitable or differs from that anticipated in the design of the drilled shaft. The Contractor shall take soil samples when shown on the plans or as directed by the Engineer to determine the character of the material directly below the shaft excavation. The Engineer will inspect the samples or cores and determine the final depth of required shaft excavation.

The Contractor shall maintain a construction method log during shaft excavation. The log shall contain information such as the description and approximate top and bottom elevation of each soil or rock material, seepage or groundwater, and remarks.

Excavated materials, which are removed from the shaft excavation and any drilling fluids used, shall be disposed of off site in accordance with local environmental regulations and the contract documents or as directed by the Engineer.

1. Unclassified Excavation

Drilled shaft excavation is designated as unclassified; the Contractor shall provide the necessary equipment to remove and dispose of any materials encountered in forming the drilled shaft excavation to the dimensions shown on the plans or as directed by the Engineer. No separate payment will be made for excavation of materials of different densities and character.

The Contractor shall provide tools such as augers fitted with either soil or rock teeth, and drilling buckets attached to drilling equipment of the size, power, torque, and down thrust approved for use by the Engineer. Material normally classified as decomposed rock, weathered, rock, disintegrated rock, or rock shall be considered as unclassified excavation. The Contractor shall provide appropriate tools such as, but not limited to, equipment listed in the Equipment section of this Special Provision in order to install the drilled shafts to their design depths.

e. Obstructions

The Contractor shall remove surface and subsurface obstructions at drilled shaft locations. Such obstructions may include man-made materials, such as old concrete foundations, and natural materials, such as boulders. Boulders are defined as stones with a least dimension greater than 1-foot. Special tools and/or procedures shall be employed by the Contractor after the hole cannot be advanced more than 1-foot in thirty minutes using approved equipment operating at maximum power, torque, and down thrust, using conventional augers fitted with soil or rock teeth, drilling buckets, and/or under-reaming tools. Such special procedures/tools may include but are not limited to: chisels, boulder breakers, core barrels, air tools, hand excavation, temporary casing, and increasing hole diameter. Blasting shall not be permitted unless specifically approved in writing by the Engineer.

f. Lost Tools

Drilling tools that are lost in the excavation shall not be considered obstructions and shall be promptly removed by the Contractor without compensation. All costs due to lost tool removal shall be borne

by the Contractor including but not limited to costs associated with hole degradation due to removal operations or the time the hole remains open.

g. Excavation Inspection

The Contractor shall provide details of shaft construction to the Engineer for review. The Contractor shall provide equipment for checking the dimensions and alignment of each shaft excavation. The Contractor shall determine the shaft dimensions and alignment under the observation and/or direction of the Engineer. Final shaft depth shall be measured after final cleaning.

Shaft cleanliness and the bearing surface condition will be evaluated and approved by the Engineer. The Contractor shall provide safe access and egress to the Engineer for inspection of the bottom of the excavation prior to placement of reinforcing steel and concrete. After the Contractor has prepared the bottom of the shaft excavation, the Contractor shall notify the Engineer. The Contractor shall coordinate schedules for excavation inspection by the Engineer.

The Contractor shall not permit any worker to enter the shaft excavation for any reason unless: both a suitable casing has been installed and the water level has been lowered and stabilized below the level to be occupied, and adequate safety equipment and procedures have been provided to workers entering the excavation. The Contractor shall follow OSHA guidelines for confined space entry.

Prior to placement of reinforcing steel and concrete, the Contractor shall ensure that loose material from the bottom and sides of excavation have been removed and that shaft is within the specified tolerances. Specified tolerances are listed in Construction Methods, sub-section K, of this Special Provision. The shaft excavation shall be cleaned to remove all accumulated sediment and water.

The Contractor shall be responsible for correcting drilled shafts that are not constructed within the specified tolerances. Remedial measures, including engineering analysis and redesign, to correct for out-of-tolerance drilled shaft foundations, shall be performed at no additional cost to the Department.

h. Reinforcing Steel Cage Construction and Placement

The reinforcing steel cage consisting of the steel shown on the plans plus cage stiffener bars, spacers, centralizers, and other necessary appurtenances shall be completely assembled and placed as a unit immediately after the shaft excavation is inspected and accepted and prior to shaft concrete placement. Prior to installation of the steel cage in the shaft excavation, inspect and clean the reinforcing steel of materials that prevent effective bonding. Clear spacing between bars of the rebar cage shall be at least five times the size of the maximum coarse aggregate. Hooks at the top of the rebar cage shall not be bent outward if temporary casing will be used. Similarly, interior hooks must be designed to permit adequate clearance for a concrete tremie pipe (i.e., 12-inch minimum), if concrete is to be tremied into place. Where clearance is a problem, hooks may be placed on dowels that may be rotated after concrete placement or casing removal and repositioned after the tremie is removed. The concrete must remain fluid during dowel repositioning. Shafts that require a large amount of reinforcing steel shall use bundled longitudinal bars to maintain the minimum clear spacing requirement. The assembled rebar cage outside diameter shall be at least 6-inches smaller than the drilled hole diameter, which corresponds to at least 3-inches of concrete cover over the rebar on all sides.

The reinforcing steel in the shaft shall be tied and supported so that the reinforcing steel will remain within allowable tolerances until the concrete will support the reinforcing steel. When concrete is placed by tremie methods, temporary hold-down devices shall be used to prevent uplifting of the steel cage during concrete placement. Concrete spacers or other approved noncorrosive spacing devices shall be used at sufficient intervals not exceeding 5-feet along the shaft excavation. At least three spacers shall be evenly distributed around the circumference of the reinforcing steel at each elevation where used.

i. Concrete Placement, Curing, and Protection

All concrete placement, consolidation and curing activities shall conform to the recommendations of Section 602 and 812 of the Standard Specifications, except as otherwise specified herein.

Concrete shall be placed as soon as possible after reinforcing steel cage placement. Concrete placement shall be continuous in the shaft to the top elevation of the shaft. Placement shall continue after the shaft is full until good quality concrete is evident at the top of the shaft.

Concrete to be placed in dry shafts less than 50-feet in length may be placed by allowing the concrete to free fall into the excavation, provided that the concrete does not hit the reinforcing steel or the sides of the excavation. This is subject to performance satisfactory to the Engineer during construction. Limit the segregation of the concrete by placing the concrete through the use of a centering tube, sectionalized pipe or other means to direct the free fall of the concrete so that it does not strike the sides or reinforcement of the shaft. If water has infiltrated the base of the excavation, it shall be removed prior to placement of the concrete. No more than 1-inch of standing water shall be allowed in the base of an excavation at the time of concrete placement to prevent segregation of the concrete. The Engineer shall have the final decision as to the allowable amount of water in the base of the excavation. The Engineer may require the Contractor to have a small sump pit in the base of the excavation to allow removal of any accumulated water.

Concrete to be placed in water shall be placed through a tremie or concrete pump. The tremie shall be supported so as to permit free movement or permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be sealed closed at the start of work so as to prevent water or slurry from entering the tube before the tube is filled with concrete. After placement has started the tremie tube shall be kept full of concrete to the bottom of the hopper. If water enters the tube after placement is started, the tremie shall be withdrawn, the discharge end resealed, and the placement restarted. The flow of concrete shall be continuous until the work is completed. The discharge end of the tremie shall always be located a minimum of 5-feet below the level of the already placed concrete.

Tremie pipes shall be a minimum of 10-inch diameter. Tremie pipes shall not have aluminum parts that will react with concrete. Pump hoses shall be a minimum of 4-inch diameter. All tremie pipe or pump hoses and connections shall be watertight.

The concrete placing rate shall be not less than 30 cubic yards of concrete per each one-hour period. The concrete mix shall be of such design that the concrete remains in workable plastic state throughout the placement of the concrete for the entire drilled shaft.

All concrete, except for that placed under water, shall be vibrated to a depth of 5-feet below the ground surface except where soft uncased soil remaining in the excavation will possibly mix with the concrete. After placement, any exposed surfaces of the shaft concrete shall be protected to allow proper curing.

For at least 48-hours after shaft concrete has been placed, no construction operations that will cause soil movement adjacent to the shaft, other than mild vibration, shall be conducted.

j. Casings and Forms

When the shaft extends above ground or through a body of water, the portion of the shaft exposed above ground or through a body of water may be formed with removable concrete forms except when a permanent form is specified. Removable forms shall be stripped from the shaft in a manner that will not damage the concrete. Forms can be removed when the concrete has attained sufficient strength provided: curing of the concrete is continued for the full 72-hour period in accordance with the specifications and the concrete has reached 75-percent of its design compressive strength as determined from concrete cylinder breaks.

Temporary casings shall be removed while the concrete remains workable. The removal of temporary casing shall not be allowed until the level of the concrete placed in the shaft is great enough to withstand the pressure exerted by the surrounding soil, water or drilling fluid. After concreting begins, removal of the casing should begin within 1-hour, before the concrete begins to set. Telescoping casing may be used, but the bottom end of the temporary casing shall be located a minimum of 5-ft below the level of already placed concrete. If the concrete begins to set prior to removal of the casing, the removal of the casing should cease, and the casing should be cut off at its current elevation and remain in the ground permanently. No payment shall be given for any casing not retrieved.

Movement of the casing by rotating, exerting downward pressure and tapping to facilitate extraction or extraction with a vibratory hammer will not be permitted. Casing extraction shall be at a slow, uniform rate with the pull in line with the shaft axis. Do not damage or displace reinforcing cage when withdrawing casing.

k. Construction Tolerances

The following construction tolerances shall be maintained in constructing drilled shafts.

1. The center of the drilled shaft shall be within 3-inches of the plan position in the horizontal plane at the plan elevation for the top of the shaft.

2. The vertical alignment of the shaft excavation shall not vary from the plan alignment by more than 0.25-inch per foot.

3. After all the shaft concrete is placed; the top of the reinforcing steel cage shall be no more than 6-inches above and no more than 3-inches below plan position.

4. When casing is used, the outside diameter of the casing shall not be less than the shaft diameter shown on the plans. When casing is not used, the minimum diameter of the drilled shaft shall not be more than 1-inch less than the diameter shown on the plans.

5. The top elevation of the shaft shall be within 1-inch of the plan top of shaft elevation.

6. The bottom of the shaft excavation shall be normal to the axis of the shaft within 1-inch per foot of shaft diameter.

7. The reinforcing steel shall be placed so that the outer edges of the reinforcing cage are located uniformly a minimum of 3-inches inside the perimeter of the design shaft size.

Drilled shaft excavations constructed in such a manner that the concrete shaft cannot be completed within the required tolerances are unacceptable. Correction methods shall be submitted by the Contractor for the Engineer's approval. Approval will be obtained before continuing with the drilled shaft construction. Materials, engineering and work necessary to effect correction for out-of-tolerance drilled shaft excavations shall be furnished at no cost to the Department.

l. Conduit Sweeps

The end of the conduit sweeps in the ground shall be extended outside the concrete and any forms or sheeting by 12 inches and capped or connected to the existing or proposed conduit. If the conduit is to be capped underground for future use, it shall be sealed with a galvanized threaded conduit plug. Tape is NOT an approved conduit plug. The location of the conduits shall be marked on the base with arrows drawn in the wet concrete within 6 inches of the outer edge.

m. Record Information

The Contractor shall provide the following minimum record information. For each drilled shaft foundation installed, record on drilled shaft installation logs the location, alignment, dimensions, elevation of the top and bottom, depth of the bearing stratum penetration, description of the materials encountered at all elevations, elevation of the water table during excavation, condition of the bottom of the excavation, concrete data, verticality and deviation of shaft or reinforcing steel from the plan location, and other data called for on the report form or pertinent to the drilled shaft. Record the theoretical volume of excavation, volume of concrete placed versus depth, and total volume of concrete placed. Report observed irregularities to the Engineer within eight hours of discovery. Record the time drilling started and stopped and any significant stoppages or delays. Record the time concreting started and stopped.

Minimum Record Information shall be in accordance with FHWA Publication No. NHI-10-016 "Drilled Shafts" or Association of Drilled Shaft Contractors' "Drilled Shaft Inspector's Manual" (1989). A copy of the inspection report planned for use shall be submitted to the Engineer for approval. Submit draft record information for each completed shaft to the Engineer within

twenty-four hours of completion. Submit final record drawings of each drilled shaft installed no more than three weeks after completion of the work. Submit records on a weekly basis, or more frequently if variation occurs.

n. Site Operations

The Contractor shall conduct his operations in a neat and orderly manner. Equipment and materials shall not be placed or stored beyond limits approved by the Engineer and shall promptly be removed when no longer needed. All materials, water, slurry, and auger cuttings shall be confined to the specified work area so as not to migrate from the specified work area.

o. Construction Adjacent to Freshly Drilled Shafts

No construction activity, including drilling, within a radius of three shaft diameters of a freshly drilled shaft shall take place until the concrete shaft has cured for at least 48- hours and the Engineer has provided written approval.

Method of Measurement:

The quantity of "Masonry for Light Pole Foundation" will be measured per cubic yard installed and accepted.

Basis of Payment:

The payment for the item "Masonry for Light Pole Foundation" as called for by the contract shall be made at the contract unit price(s) per cubic yard complete in place and accepted, which price and payment will constitute full compensation for furnishing and fabricating and placing all materials, clearing and grubbing the areas, normal excavation in accordance with Section 207, concrete and reinforcing bars, construction of foundations, backfilling and compaction, grading, sodding if required to restore the site to its original condition or as required by the Plan, and for all labor, equipment, tools and incidentals necessary to complete the work.

9/6/16

602785 - PORTLAND CEMENT CONCRETE MASONRY, 4,500 PSI

Description:

This work shall consist of furnishing and placing Portland cement concrete for structures and incidental construction.

Materials:

Materials for concrete structures shall conform to the Standard Specifications, Section 602 & 812, except as modified herein.

Class A concrete shall have a Design Compressive Strength, f'_c at 28 days of 4,500 psi

Construction Methods:

All construction shall be performed in accordance with Section 602 & 812 of the Standard Specifications and as modified herein.

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 the proposed mix design, casting procedures, and materials.

The Contractor shall use a Specialty Engineer following the procedure outlined in Section 207 of the ACI Manual of Concrete Practice to formulate, implement, administer and monitor a temperature control plan, making adjustments as necessary to ensure compliance with the Contract Documents. The measures and procedures intended for use to maintain a temperature differential of 35º F [20º C] or less between the interior core center and exterior surface(s) of the designated mass concrete elements during curing shall be described. The concrete peak temperature shall be limited to a maximum of 160ºF.

The Contractor shall submit both the mass concrete mix design and the proposed mass concrete plan to monitor and control the temperature differential to the Engineer for acceptance 90 days prior to the first pour of mass concrete. The concrete mix design must be prepared, stamped and signed by a Professional Engineer registered in the State of Delaware. The Engineer will review the submittal for acceptance. Ground granulated blast furnace slag or fly-ash may also be used in the mix to reduce the heat of hydration. Slag or fly-ash may be used as a cementitious replacement material for cement up to a maximum limit of 75% by weight of total cementitious material in the mix. Slag and/or fly-ash shall be from a source approved by the Engineer, shall be compatible with the type of cement used and thoroughly blended in the mix. Other precautions for reducing the heat of hydration may be taken, such as the addition of controlled quantities of ice in lieu of equal quantities of mixing water or cooling tubes. However, the mix shall contain no frozen pieces of ice after blending and mixing components.

All constituent materials shall be compatible with the proposed cements, workability enhancing additives and water reducing agents as necessary to provide concrete satisfying all requirements of the Contract Documents.

The Contractor shall provide temperature monitoring devices to record temperature development between the interior core center and exterior surface(s) of the elements in accordance with the accepted mass concrete plan. The devices shall operate in the range of 32º F to 42ºF with an accuracy of ±2º F. He shall read the monitoring devices and record the readings at intervals no greater than 6-hours. The readings shall begin when the mass concrete placement is complete and continue until the maximum temperature differential (not maximum temperature) is reached and a decreasing temperature differential is confirmed as defined in the temperature control plan. The contractor shall furnish a copy of all temperature readings to the Engineer. If the 35º F [20º C] differential has been exceeded, he shall take immediate action, as directed by the Specialty Engineer, to retard further growth of the temperature differential.

A Specialty Engineer shall be used to revise the previously accepted plan to ensure compliance on future placements. No mass concrete shall be placed until the Engineer has accepted the mass concrete plan(s). When mass concrete temperature differentials are exceeded, the Contractor shall provide all analyses and test results deemed necessary by the Engineer for determining the structural integrity and durability of the mass concrete element, to the satisfaction of the Engineer.

Defective Work

Provisions for defective work shall conform to section 602.25 of the Standard Specifications except as modified herein.

Method of Measurement:

The quantity of Portland cement concrete masonry, substructure 4,500 psi shall be measured in accordance with Section 602.26 of the Standard Specifications except as modified herein.

Basis of Payment:

The quantity of Portland cement concrete masonry, substructure 4,500 psi shall be paid in accordance with Section 602.27 of the Standard Specifications except as modified herein.

No separate payment shall be made for materials, labor, equipment and incidental items associated with controlling the heat of hydration for Mass Concrete. These items shall be deemed to be included in the payment under this item of work.

6/27/16

602798 - PREPRODUCTION DMM TEST PROGRAM
602799 - PRODUCTION DMM
602800 - DMM QC/QA PROGRAM

Description:

1.01 General:

The Work covered by this Section includes furnishing all necessary labor, equipment, and materials necessary to plan, design, and construct the deep mixing and associated testing, monitoring, sampling, and recording to meet the performance requirements outline in the plans and this specifications.

1.02 References:

The following publications form a part of this specification to the extent indicated by the references. The latest publication as of the issue date of this specification should govern, unless indicated otherwise.

A. Federal Highway Administration. (2012). Deep Mixing Manual for Embankment and Foundation Support, U.S. Department of Transportation, Washington, DC.
B. ASTM C150. (2012). "Standard Specification for Portland Cement," Book of Standards Volume 04.01, ASTM International, West Conshohocken, PA.
C. ASTM C192. (2012). "Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory," Book of Standards Volume 04.02, ASTM International, West Conshohocken, PA.
D. ASTM C618-08a. (2012). "Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete," Book of Standards Volume 04.02, ASTM International, West Conshohocken, PA.
E. ASTM C821-09. (2009). "Standard Specification for Lime for Use with Pozzolans," Book of Standards Volume 04.01, ASTM International, West Conshohocken, PA.
F. ASTM C989-09. (2012). "Standard Specification for Slag Cement for Use in Concrete and Mortars," Book of Standards Volume 04.02, ASTM International, West Conshohocken, PA.
G. ASTM D2166. (2006). "Standard Specification for Unconfined Compressive Strength of Cohesive Soil," Book of Standards Volume 04.08, ASTM International, West Conshohocken, PA.
H. ASTM D4380. (2012). "Standard Test Method for Density of Bentonitic Slurries," Book of Standards Volume 04.08, ASTM International, West Conshohocken, PA.
I. ASTM D5084. (2010). "Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter," Book of Standards Volume 04.08, ASTM International, West Conshohoken, PA.

1.03 Definitions:
The technical and construction terms used in this specification are outlined in this section.

Admixtures: Ingredients in the grout other than binder, bentonite, and water. Admixtures can be fluidifiers, dispersants, or retarding, plugging, or bridging agents that permit efficient use of materials and proper workability of the grout.

Bentonite: Ultra-fine natural clay principally comprising sodium cation montmorillonite.

Binder: Chemically reactive material (i.e., lime, cement, gypsum, blast furnace slag, flyash, or other hardening reagents) that can be used for mixing with in situ soils to strengthen the soils and form DMM columns. Also referred to as stabilizer or reagent. In U.S. practice, binder slurry is frequently referred to as grout or slurry.

Binder content: Ratio of weight of dry binder to dry weight of soil to be treated.

Binder factor: Ratio of weight of dry binder to volume of soil to be treated.

Binder factor in-place: Ratio of weight of dry binder to volume of mixture, which is the volume of the soil to be treated plus the volume of the slurry for the wet method or the volume of the dry binder for the dry method.

Binder slurry: Stable colloidal mixture of water, binder, and admixtures that assists in loosening the soils for effective mixing and strengthening the in situ soil upon setting.

BRN: Total number of mixing blade rotations per meter of shaft movement. BRN has been developed for ensuring uniformity of products produced only by WRE/ DRE systems. For horizontal cutter systems (e.g., CSM), revolutions per minute are typically reported as an indicator of mixing energy (not applicable for chainsaw-type mixers (e.g., TRD)).

Column: Pillar of treated soil produced in situ by a single installation process using a mixing tool, typically a rotating auger, to make a round column. A rectangular barrette produced by twin horizontal mixing shafts is also a column. See "element" and "wall," which are related geometric terms.

Deep mixing equipment: Deep mixing equipment with various mixing tools including single vertical shaft mixing tools, multiple vertical shaft mixing tools, horizontal rotating circular cutters, chainsaw-type cutters, etc.

DMM: In situ ground treatment in which soil is blended with cementitious and/or other binder materials to improve strength, permeability, and/or compressibility characteristics (synonymous terms (some proprietary) include DSM, deep mixing, CDSM, and soil cement mixing).

Dry mixing: Process of mechanical disaggregation of the soil in situ and its mixing with binders with or without fillers and admixtures in dry powder form. Binders are delivered primarily on tool retrieval.

Element: This is an inclusive term that refers to a DMM element produced by a single stroke of the mixing tools at a single equipment location. A column produced by a single-axis machine, a set of overlapping columns produced by a single stroke of a multiple-shaft mixing tool, and a rectangular barrette produced by a mixing tool with horizontal axis rotating cutter blades are each considered an element. An element consisting of overlapping columns produced by a single stroke of a multiple-shaft mixing tool is sometimes referred to as a "panel." A chainsaw-type mixing tool that travels as it mixes produces a continuous wall, which is not an element.

Engineer: The representative of the design engineer or of the project owner (owner). This person may either be a subconsultant to the owner or a member of the owner's staff.

Filler: Non-reacting materials (i.e., sand, limestone powder, etc.).

Load Transfer Platform: A geogrid reinforced bridging layer constructed of graded aggregate base above the DMM columns to help transfer the load from the retaining walls and embankment to the DMM columns.

Mix design: Ratios of soil, binder, water, and additive quantities required to meet the design requirements of the project.

Mixing process: Mechanical disaggregation of the soil structure and dispersion of binders and fillers in the soil.

Mixing tool: Equipment used to disaggregate the soil and distribute and mix the binder with the soil. Consists of one or several rotating units equipped with several blades, arms, and paddles with or without continuous or discontinuous flight augers, horizontal rotating cutter blades, or chainsaw-type cutters.

Penetration (downstroke): Stage/phase of mixing process cycle in which the mixing tool is delivered to the appropriate depth (disaggregation phase) for withdrawal injection and disaggregation and mixing for penetration injection. (Not applicable for chainsaw-type mixers (TRD).)

Penetration/retrieval speed: Vertical movement per unit time of the mixing tool during penetration or withdrawal. (Not applicable for chainsaw-type mixers (TRD).)

Restroke: Additional penetration and withdrawal cycle of the mixing tool to increase the binder content and/or the mixing energy. (Not applicable for chainsaw-type mixers (TRD).)

Retrieval: Withdrawal of mixing tool from bottom depth to the ground surface. Binder may be injected during retrieval, which also imparts additional mixing energy.

Rotation speed: Number of revolutions of the mixing tool per unit time.

Soil-cement: Product of DMM consisting of a mixture of the in situ soil and binder. Also referred to as treated soil or deep mixed material.

Strength: Dependent on application, various strengths may be used to assess the quality of deep mixed material. For design, "strength" usually means shear strength, but during QC/QA, "strength" usually means unconfined compressive strength. For clarity, the intended type of strength should always be identified when using this term.

Stroke: One complete cycle (penetration and withdrawal) of the mixing process.

Volume ratio: Ratio of the volume of slurry injected (in wet mixing) to the volume of soil to be treated.

Wall: Group of overlapping elements arranged to form a continuous wall. Continuous walls can also be constructed using a chainsaw-type of mixing device. Walls can be referred to as shear walls, cutoff walls, or excavation support walls depending on the application. A shear wall can also be referred to as a buttress.

Water: Fresh water that is free of deleterious substances that adversely affect the strength and mixing properties of the grout and is used to manufacture grout.

Water-to-binder ratio: Weight of water added to the dry binder divided by the weight of the dry binder. In wet mixing, the water-to-binder ratio of the slurry is determined from the weights of water and dry binder used to manufacture the slurry in a plant at the ground surface. In either wet or dry mixing, the total water-to-binder ratio is the weight of water in the mixture divided by the weight of dry binder. For wet mixing, the total water-to-binder ratio is the weight of slurry water plus the weight of soil water divided by the weight of dry binder. For dry mixing, the total water-to-slurry ratio is the weight of soil water divided by the weight of dry binder.

Wet mixing: Process of mechanical disaggregation of the soil in situ and its mixing with slurry consisting of water and binders with or without fillers and admixtures. Binder is delivered on mixing tool penetration for vertical and horizontal axis mixing tools.

Withdrawal (upstroke): Stage or phase of retrieval of the mixing tool in which the final mixing occurs for penetration injection and initial mixing for withdrawal injection. Disaggregation occurs during the penetration for both penetration injection and withdrawal injection. (Not applicable for chainsaw-type mixers (TRD).)

Withdrawal rate: The average up-hole retrieval rate of the mixing tool.

1.04 Project Description and Performance Requirements:

A. The purpose of the DMM is to improve the subsurface soils and provide support for the MSE walls for the approach ramp and to improve the slope stability.
   1. The DMM shall be designed to achieve a minimum Factor of Safety of 1.5 for the slope stability of the MSE wall approach ramp and limit the total settlement of the approach ramp to within 0.5-inches.
   2. The DMM construction at the abutment shall be completed prior to the installation of the drilled shaft foundation for the abutments and wingwalls.

B. Allowable geometric parameters for DMM construction:

Table 1- Geometric parameters for DMM construction			
Parameter	**Area**	**Minimum and/or Maximum**	**Value**
Top Elevation of DMM Element	Areas 1 through 8	Minimum	**EL +1.0**
Bottom Elevation of DMM Element	Areas 1 through 8	Maximum	EL -40.0
Column Diameter, d	Areas 1 through 8	Minimum and Maximum	Min = 3-ft Max = 5-ft
Grid or Lattice Pattern Clear Spacing between shear walls	Area 1	Maximum	5.0-ft
Shear Wall Length, B	Areas 3 and 6	Minimum	26.5-ft
	Areas 4 and 7	Minimum	26.5-ft
	Areas 5 and 8	Minimum	23.0-ft
Column Overlap Ratio, e/d	Areas 1, 3 through 8	Minimum	0.3
Clear Spacing Between Shear Walls, s_{shear}-d	Areas 3 and 6	Maximum	5.0-ft
	Areas 4 and 7	Maximum	6.0-ft
	Areas 5 and 8	Maximum	8.0-ft
Area Replacement Ratio at Shear Walls, $a_{s,shear}$	Areas 3 and 6	Minimum	0.4
	Areas 4 and 7	Minimum	0.36
	Areas 5 and 8	Minimum	0.3
Clear Spacing in Center of Embankment, s_{center}-d	Area 2	Maximum	3.0-ft
Area Replacement Ratio in Center of Embankment, $a_{s,center}$	Area 2	Minimum	0.25

C. The Contractor shall submit design calculation and plans prepared and stamped by a professional engineer licensed in the State of Delaware for the element size and layouts of the DMM that meet the minimum and maximum values of parameters listed in Table 1. The calculations must be submitted to the engineer for review and possible approval after the contract is awarded. The owner/engineer is not obligated to accept designs that fall outside the geometric limits in the plans and specifications.

D. The purpose of the load transfer platform (LTP) is the help transfer the load from the MSE walls and embankment to the DMM columns.

1. The LTP shall have a minimum thickness equal to or greater than one half the clear span between columns (s-d).
2. A minimum of three layers of geogrid reinforcement shall be used to design the LTP.
3. Minimum distance between the layers of reinforcement shall be 6-inches.

E. The Contractor shall submit design calculation and plans prepared and stamped by a professional engineer licensed in the State of Delaware for the thickness and reinforcement of the LTP that meet the requirements of Section 1.04 D.

1.05 Qualifications of Contractor:

A. The DMM contractor must have previous successful experience with at least three DMM projects within the last five years for the soil conditions and project scope similar to that of the project being bid. Include a brief description of each Project and the owner's contact person's name and current phone number for each project listed.

B. The DMM contractor must assign a project manager who has had significant experience on at least five DMM projects, to the Engineer for approval. Include a detailed summary of the project manager's experience in DMM. Include a brief description of each Project and the owner's contact person's name and current phone number for each project listed.

C. The DMM contractor must assign a project engineer to supervise the construction of the DMM work. The project engineer must have had significant experience on at least five DMM projects and is registered professional Engineer in the State of Delaware. The project engineer shall be responsible to supervise the design and preparation of the drawings and to review QC/QA records and as-built drawings to confirm that the DMM work meets the design intent.

D. The DMM contractor must assign a full-time project superintendent with at least five projects and at least 130,000 yd^3 of total treatment volume in DMM construction. Include a brief description of each Project and the owner's contact person's name and current phone number for each project listed.

E. The DMM contractor must provide at least one DMM equipment operator with at least 1 year of experience with the equipment and DMM construction. Include a brief description of each Project and the owner's contact person's name and current phone number for each project listed.

F. Written requests for substitution of these key personnel must be submitted 7 days prior to personnel changes. Documentation must be submitted to the owner that demonstrates that the substitute meets the requirements listed. Substitution may not be made until written approval is provided by the owner.

1.06 Site Information:

A Final Foundation Report was prepared for the project. This report was prepared to help develop the substructure design only and is not considered part of the Contract Documents or a warranty of subsurface conditions. Data on subsurface conditions are not intended as representations or warranties of continuity of such conditions. The data are made available for the convenience of the Contractor, and it is expressly understood that the Department will not be responsible for interpretations or conclusions drawn there from by the Contractor.

1.07 Construction Site Survey:

A. Prior to bidding, the contractor should review the available subsurface information and visit the site to assess the site geometry, equipment access conditions, location of existing structures, and above-ground utilities and facilities.

B. The Contractor should field locate and verify the locations of all utilities prior to starting work. The Contractor should maintain uninterrupted service for those utilities designated to remain in service throughout the work. The contractor should notify the engineer of any utility locations different from those shown in the plans that may require relocation of deep mixed elements or structure design modification.

1.08 Submittals:

A. Contractor experience profile: The contractor must submit documentation evidencing the experience requirements outlined in the Qualification of Contractors, prior to execution of the Contract.

B. Bench-scale testing report: The contractor must submit results from bench-scale tests conducted. The report should provide all data collected, including, at a minimum, descriptions of sampling techniques used, boring logs, classifications of all major soil strata to be mixed, site groundwater conditions, binder materials used, mixed design proportions, laboratory mixing techniques used, and curing curves for unconfined compressive strength versus time for each major soil type. Discussion of tests results should be provided, including proposed mix designs for use in the field.

C. Field validation program plan: At least 30 days before the start of the field validation program, the contractor should submit a field validation program plan that contains descriptions of the construction procedures, equipment, and ancillary equipment to be used for mixing and binder proportioning and injection; mix design parameters and associated soil strata to be evaluated; operational and material parameters to be monitored during field validation; layout of the DMM elements to be constructed; a summary of QC/QA samples to be collected and tested; and examples of the forms that will be used to document the work.

D. Deep mixing work plan: Based on the results of the preconstruction testing (bench-scale and field validation program), at least 30 days prior to the start of deep mixing work, the contractor must submit a deep mixing work plan for review and approval. This plan must include the following items:

1. Detailed descriptions of sequence of construction and all construction procedures, equipment (catalog cut sheets), and ancillary equipment to be used to penetrate the ground, proportion and mix binders, and inject and mix the site soils.

2. Proposed mix design(s), including binder types, additives, fillers, reagents, and their relative proportions, and the required mixing time, water-to-binder ratio of the slurry (for wet mixing), binder factor (for dry and wet mixing), and volume ratio (for wet mixing) for a deep mixed element.

3. Proposed injection and mixing parameters, including mixing slurry rates, slurry pumping rates, air injection pressure and volume flow rates, mixing tool rotational speeds, and penetration and withdrawal rates.

4. Methods for controlling and recording the verticality and the top and bottom elevation of each element.

5. The necessary procedure and measurement to confirm the end-bearing when DMM elements are required to penetrate into a bearing layer.

6. Working drawings and calculations for the DMM elements showing the site location of the DMM project as well as the dimensions, layout, and locations of all DMM elements. Drawings should indicate the identification number of every element if a multi-shaft mixing tool is used and every column if a single-auger mixing tool is used. Calculations and drawings should demonstrate that the element layout, depth, and quantity meet the specification requirements. The design calculations should be performed and stamped by a professional engineer who is registered in State of Delaware.

7. Sample daily production report, including the items described in section 1.8.

8. Details of all means and methods proposed for QC/QA activities, including surveying, process monitoring, sampling, testing, documenting, and marking schedule milestones.

9. Names of any subcontractors used for QC/QA activities. An independent laboratory must be used for QC/QA testing and must be approved by the owner/engineer.

E. Material certifications: Certificates of compliance must be submitted as proof of conformance to materials standards and requirements for each truckload of binder, admixtures, and steel, as needed.

F. Production records: By the end of the next business day following each deep mixing shift, the contractor should submit a daily production report in the approved format. The report should be completed and signed by the contractor's project superintendent. The report should contain at a minimum the following information:

1. Project name.

2. Day, month, year, and time of work shift (beginning and end).

3. Name of field superintendent in charge of the work for the contractor.

4. Deep mixing equipment (rig number) in operation during the shift and specific activities conducted by said equipment.

5. Type of mixing tool.

6. Treatment zone and reference drawing number.

7. Elevation of top and bottom of treatment zone.

8. Element number, diameter, and location coordinates.

9. Date and time (start and finish) of element.

10. Location of each completed column/element installed during the work shift and all zones completed to date on a plan of suitable scale to clearly show the location of the elements.

11. Mix design (not applicable for dry mixing).

12. Slurry specific gravity measurements (not applicable for dry mixing).
13. Binder slurry injection rate (gal/min (L/min)) plotted at each 3-ft (1-m) depth interval for the full depth of the treated zone. Variations in volumes should be noted.
14. Mixing tool rotation speed in revolutions per minute versus depth.
15. Penetration/withdrawal rates of the mixing tool in ft/min (m/min) plotted at each 3 ft of depth (not applicable for TRD).
16. Element verticality measurements.
17. Plots of BRN and binder factor versus depth for each element plotted at least every 3 ft of depth. The total number of rotations should be reported for CSM (not applicable for TRD).
18. For TRD, the vertical and horizontal rates of cutter chain travel should be reported along with the slurry injection rate. From these data, the average binder factor as a function of position can be calculated and reported.
19. A description of obstructions, interruptions of binder injections, or other difficulties during installation and their resolution.
20. Other pertinent observations including but not limited to binder escapes, ground settlement or heave, collapses of the treatment zone, and any unusual behavior of any equipment during the deep mixing process.
21. For both wet grab samples and coring, provide collection date, time, plan location, elevation, and identification numbers of all deep mixed samples, including unsuccessful attempts to retrieve samples.
22. For coring operations, provide the coring method, equipment, and personnel; recovery percentage and percent treatment (percent of run length that is treated) for each core run; sample collection, handling, and storage details; and name of person responsible for logging and collecting cores and samples to be tested.
23. Quantities of all binder materials delivered to the site plus a reconciliation showing the amount actually injected.
24. Summary of any down time or other unproductive time including time, duration, and reason.
25. Detailed results of all testing.

G. QC/QA records: Calibration data must be submitted for all measurement devices used for binder production, deep mixing operational monitoring, and laboratory testing. Within 3 business days of completing any QC/QA testing, the contractor should submit the test results, including original data sheets from the laboratory and an evaluation of the compliance of the test results with project acceptance criteria. Equipment should be calibrated prior to initial use and repeated every 3 months.

H. As-built field measurement data: After completion of the project, the contractor must submit as-built field measurement data indicating surveyed as-built plan locations of each DMM element, including the element center (per site specific coordinates), the element dimension, the column verticality, and the top and bottom elevations of each element to the accuracy required by the project specifications.

1.09 Preconstruction Meeting:

A. Hold a DMM preconstruction meeting at least five Working Days prior to the Contractor beginning any shaft construction Work at the site to discuss investigative boring information, construction procedures, personnel, and Equipment to be used, and other elements of the accepted Deep Mixing Work Plan. If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved Deep Mixing Work Plan, an additional conference may be held at the request of the Engineer before any additional DMM construction operations are performed.

Materials and Equipment:

2.01 Material:

A. Cement binder materials should conform to ASTM C150 low-alkali type II PCC. Type III PCC should not be used. Slag cement should conform to ASTM C1157. All cement should be homogeneous in composition and properties and should be manufactured using the same methods at each plant by each supplier. Tricalcium aluminate content should not exceed 8 percent.

B. Water used in drilling, mixing cement grout, and other applications should be potable.

C. Admixtures will not be allowed unless the contractor submits documentation demonstrating the effects of the admixture and the admixture is approved by the engineer.

D. Binder slurry should be a stable homogeneous mixture of approved binder, approved admixtures, and water. The ratios of various components may be proposed for modifications by the contractor but should not be implemented until reviewed and accepted by the engineer. Any proposed deviations from the submitted and approved mix design should be resubmitted for the engineer's approval. Revalidation through laboratory or field testing is necessary for changes that exceed 10 percent of previously approved mix designs. Regardless of such changes, the contractor is responsible for satisfying the acceptance criteria.

E. Soil-binder mixture should be a stable mixture of binder slurry and in situ soil. The Contractor should propose the ratios and quantities of various components.

F. The load transfer platform above the DMM should be constructed of reinforced graded aggregate and should conform to Section 821 – Graded Aggregates Type B (Crusher Run).

2.02 Equipment:

A. Deep mixing equipment should be of sufficient size, capacity, and torque to perform the required deep mixing to the desired depths. Characteristics of deep mixing equipment are as follows:

1. The equipment should be capable of advancing through previously installed elements to achieve designed overlapping or remixing as needed and be sufficient to maintain the necessary revolutions per minute and penetration rate at the maximum depth to achieve thorough mixing.

2. The mixing and injection equipment should be sufficient to adequately blend and distribute the binder with the in situ soils to provide the required strength.

3. The mixing tools should be adequately marked to allow the engineer to confirm the penetration depth to within 1 ft during construction. If rigs with varying mixing tool lengths are used, the shortest tools should extend to the lowest element termination elevations indicated in the plans.

4. All equipment should have monitoring equipment to permit accurate and continuous monitoring, recording, and controlling of mixing tool depth, location, binder volume flow rates and factors, binder injection pressures and quantities, tool rotational speeds, tool advancement, and withdrawal rates.

5. The monitoring equipment should be calibrated at the beginning of the project, and the data should be submitted to the owner. Calibration should be repeated every 3 months.

6. The owner/engineer should have access to monitoring equipment.

B. Binder materials handling and storage:

1. The Contractor should measure, handle the transport, and store bulk binder in accordance with the manufacturer's recommendations.

2. Dry materials should be stored in dry containers. The binder should be adequately protected from moisture and contamination while in transit and when stored at the project site.

3. Dry materials should be transported to the project site and placed in the onsite storage tanks using a closed system. Any air evacuated from the storage tanks during the loading process should be filtered before being discharged to the atmosphere.

4. Material that has become caked due to moisture absorption should not be used. Binder materials containing lumps or foreign matter of a nature and in amounts that may be deleterious to the injection operation should not be used. In each instance in which the binder source is changed, the batch plant silos should be completely emptied before storing binder from the new source. Mixing binders from different sources in the same silos is not permitted.

5. Equipment used for proportioning during binder production should be calibrated prior to initial use and repeated every 3 months or every time the batch plant is relocated, whichever is sooner. Calibration records must be submitted to the owner in accordance with section 1.08.

6. Positive displacement pumps should be used to transfer the slurry to the injection point. The contractor should demonstrate that the equipment can uniformly deliver binder at suitable rates in accordance with the construction plan.

2.03 Products:

A. Geometric tolerance: DMM elements installed should meet the geometric tolerance outlined in section 3.06.

B. Strength: The strength of treated soils should meet the strength criteria outlined in section 3.06.

C. Uniformity: The uniformity of treated soils should meet the uniformity criteria outlined in section 3.06.

<u>Execution:</u>

3.01 General:

Deep mixed elements should be constructed to the lines, grades, and cross sections indicated in the plans and should meet the strength and uniformity requirements specified in section 3.06. The contractor should establish consistent procedures during construction to ensure that the acceptance criteria are satisfied. The procedures should be established based on the results of the field validation program.

3.02 Field Validation Program:

A. Prior to production, the contractor must construct a test section at the location shown in the plans to verify that the contractor's proposed equipment, procedures, and mix design can uniformly mix the onsite soils and achieve the product requirements outlined in the acceptance criteria in section 3.06.

B. The Contractor should submit the results of the field validation program to the owner as outlined in section 1.08.

C. Laboratory bench-scale testing should be used to identify initial mix designs for use in the field validation program. Bulk soil samples from the site should be obtained by the contractor. A suite of three mix designs is required for each major soil stratum encountered to the expected termination depth of the elements.

D. The test section should be installed at the location indicated in the plans. The contractor should submit a plan drawing showing the locations of the test section elements. At least three elements should be installed with different mixing parameters for each element. Each element should extend from the top elevation to the bottom elevation (or required penetration into bearing layer) if different mixing parameters are used. At least one full-depth core should be obtained from each element or group of elements installed using the same mixing parameters.

E. The contractor should obtain full-depth core samples from the test elements in accordance with the QC/QA requirements outlined in section 3.06. Test samples should be submitted to an approved independent laboratory for testing. The contractor may propose other sampling techniques to obtain continuous samples of the deep mixed material which, if approved by the engineer, could be submitted as further evidence of compliance with the acceptance.

3.03 Binder Preparation (Wet Method):

A. The Contractor should mix dry binder and water in the slurry plant to produce a uniform suspension of binder in the water.

B. The slurry should be held in the agitation tank for a maximum holding time of 4 hours. Holding time is calculated from the beginning of the initial mixing.

C. Slurry density must be measured in accordance with the requirements outlined in section 3.06. If the slurry density is outside the tolerance required by the mix design, the Contractor should recalibrate monitoring equipment and perform additional testing as required by the engineer at no additional cost to the owner. The contractor may also adjust binder or water quantities appropriately and retest at no additional cost to the owner. The specific gravity of the binder slurry measured during production may not deviate by more than 3 percent from the established specific gravity.

D. Monitoring data should be recorded in the daily production report.

3.04 Locating Elements:

A. Before beginning installation, the contractor should accurately stake the location of the deep mixed elements shown in the plans using a licensed surveyor. The contractor should provide an adequate method for locating elements to allow the engineer to verify the as-built location of the elements during construction. The contractor will not be compensated for elements that are located outside of the tolerances specified in section 3.6. The owner will review the location of misaligned elements to determine if the elements interfere with the proposed construction. If the owner determines that misaligned elements will interfere with construction, the contractor should correct the alignment. The method of correction should be submitted by the contractor to the owner/engineer for review and approval.

B. If an obstruction is encountered that prevents drilling advancement, the contractor should immediately notify the engineer and investigate the location and extent of the obstruction using methods approved by the engineer. The contractor should propose remedial measures to clear the obstruction for approval by the engineer. The contractor will be compensated for removal or clearing of obstructions with prior approval from the owner. If the element cannot be installed at the design location due to obstructions, the element should be relocated as directed by the engineer.

3.05 Mixing:

A. The equipment, installation procedures, materials, and sampling and testing methods established during the field validation program should be used for production. The contractor may request that the established mix design, equipment, installation procedure, or test methods be modified; however, the engineer may require additional testing or a new test section at no additional cost to the owner to verify that acceptable results can be achieved. The contractor should not employ modified mix designs, equipment, installation procedures, or sampling and testing methods until approved by the engineer in writing.

B. If the contractor must modify established methods due to equipment breakdowns, manpower changes, or improved conditions, a new test section should be installed at no cost to the owner.

C. Installation of each column should be continuous. If an interruption of more than 1 hour occurs, the element should be remixed while injecting binder at the design rate for the entire height of the element at no additional cost to the owner.

D. Binder slurry injection rate: The contractor should record in the daily production report on a real-time basis the weight of dry binder or the volume of binder slurry injected for each 3 ft (measured vertically) during penetration and withdrawal for each element. If the weight of dry binder or the volume of binder slurry injected per vertical foot is less than the amount required to meet the binder factor or volume ratio established during the field validation program, the element should be remixed, and additional binder should be injected at the design binder injection rate to a depth at least 3 ft below the deficient zone at no additional cost to the owner. The binder factor should be recorded and plotted versus depth, and the records should be visible to the operator on a screen during construction so that proper adjustments may be made in real time.

E. Rotational speed and penetration/withdrawal rates: The necessary rotational speeds and penetration/withdrawal rates for the various soil layers encountered should be determined during the field validation program. The penetration and withdrawal rates must be monitored on a real-time basis. If the BRN is more than 15 percent below the value determined to be reliably acceptable from the field validation program, the column/element section must be remixed while injecting grout at the design binder injection rate.

F. Vertical alignment: The contractor should monitor and control the vertical alignment of the mixing tool stroke in two directions (longitudinal and transverse to the element alignment). Vertical alignment should be maintained within 1 percent of plumb during the element installation.

G. Element top and bottom elevations:

1. Elements should be installed in accordance with the line and grades shown in the Plans.

2. The total depth of penetration should be measured either by observing the length of the mixing shaft inserted below a reference point on the mast or by subtracting the exposed length of shaft above the reference point from the total shaft length. Care should be taken to note ground surface heave that may affect reference points for measuring mixing shaft length. The contractor should note and record on the daily production report the final depth of the stroke. The equipment should be adequately marked to allow the engineer to confirm the penetration depth during construction.

3. If the elevations of the top of competent soils are found to be different from those estimated, the engineer may direct the contractor to shorten or deepen the elements. Measurements of torque, down pressure, and/or the change in rotational speed may be used as indications of termination depth if a suitable correlation can be develop by the contractor to the satisfaction of the engineer. The contractor will be compensated based on the decreased or increased amount of deep mixing as termination depths vary. The contractor should not be compensated for any portions of the elements that are above the top elevations or below the bottom elevations shown on the plans unless approved by the engineer.

H. Bottom Mixing:

The Contractor should conduct bottom mixing as established in the field validation program.

I. Control of Spoils:

The Contractor should control and dispose of all waste materials produced as a result of the mixing operation in accordance with the project requirements.

3.06 QC:

A. The Contractor should provide all the personnel and equipment necessary to implement the QC/QA requirements of the project. The engineer will review daily production reports and QC/QA test reports to verify that QC/QA procedures are being properly implemented.

B. Deep mixing work plan: The contractor's deep mixing work plan should include descriptions of all QC/QA activities and reporting as outlined in section 1.08. After the field validation program is conducted, the contractor may revise the QC/QA procedures, if approved by the engineer. The contractor should maintain the established and approved QC/QA procedures throughout production to ensure consistency in the deep mixing installation and to verify that the work complies with all requirements indicated in the approved working drawings.

C. Daily production records should be submitted as outlined in section 1.08.

D. Binder slurry density: The contractor should measure the specific gravity of the binder slurry at least twice per shift per slurry plant using the methods outlined in ASTM D4380 (not appropriate for dry mixing). The specific gravity of the binder slurry measured during production may not deviate by more than 3 percent from the established specific gravity. If the slurry density deviates by more than 3 percent, the contractor should recalibrate monitoring equipment and perform additional testing as required by the engineer at no additional cost to the owner. The contractor may also adjust binder or water quantities appropriately and retest at no additional cost to the owner.

E. The Contractor should make simple routine checks of material quantities such as counting the number of bags or truckloads of binder materials that have been used. These quantities should be recorded in the daily production report.

F. Wet sampling and testing (not appropriate for dry mixing):

1. The Contractor should perform all wet sampling in the presence of the engineer. The contractor should notify the engineer at least 1 business day in advance of beginning sampling operations.

2. The Contractor should propose locations for wet sampling while considering input from the owner/engineer. Sample locations should be distributed uniformly both laterally and vertically within the deep mixed zone. Sampling depths should be selected to ensure that wet samples are retrieved from every main soil stratum underlying the site.

3. The Contractor should report the information required in the daily production report (see section 1.08) for all attempts, successful and unsuccessful, to obtain wet samples.

4. The Contractor should collect a minimum of three wet bulk samples (each sample is taken at one selected depth at one location) for each mix design used in each test section. At least one wet bulk sample (one selected depth at one location) should be collected from within each main soil layer from elements produced using each mix design.

5. One wet bulk sample (one selected depth at one location) should be retrieved every 2 production days or for every 2,000 yd^3 of treated soil, whichever produces the higher sampling frequency.

6. Wet bulk samples should be collected using a bailer-type sampling tool or similar.

7. Eight test specimens from each wet bulk sample should be made with 3-inch diameter and 6-inch length using the following general procedures:

   a. Pour the sample into a container, screening for oversized lumps (gravel versus unmixed soil). Place the sample in specimen molds in three to five layers. Tap, vibrate, or rod the specimens to remove trapped air bubbles. Use care to avoid additional mixing or kneading action as much as possible on the sample during screening and specimen preparation so that the sample is representative of in-place mixing conditions.

   b. Measure and describe the volume and composition of oversized lumps.

   c. Seal the specimen to prevent moisture from entering or leaving, and store the specimen in a humid environment in accordance with ASTM C192.

   d. The Engineer may request additional test specimens for QA testing.

G. Coring:

1. The Contractor should perform all coring operations in the presence of the Engineer. The contractor should notify the engineer at least 1 business day in advance of beginning sampling operations.

2. The Contractor should determine the time interval between element installation and coring except that the interval should be no longer than required to conduct 28-day strength testing.

3. The full-depth samples should be obtained along a vertical alignment located one-fourth of a column diameter from the column center. If it is difficult to avoid drilling out of the column at this coring location, the contractor may drill one-fourth of a column diameter along the centerline of an element or shear wall so the core enters the adjacent column in the same element.

4. Core samples should be retrieved using standard triple-tube or equivalent continuous coring techniques.

5. Samples should have a diameter of at least 2.5 inches, and each core run should be at least 3 ft in length.

6. For each field validation test section, the contractor should collect at least one full-depth core for each mix design at locations defined by the owner/engineer.

7. The Contractor should collect one full-depth core from 3 percent of elements or 860 ft^2 of treated area, whichever produces a larger number of cored elements. The cores should be drilled at locations defined by the owner/engineer. An element is defined as the treated soil produced by one setup of either a single- or multiple-axis machine.

8. The Contractor should photograph each core run.

9. Upon retrieval, the contractor should provide the cores to the engineer for logging and test specimen selection.

10. Following logging, the engineer will select at least five specimens from each full-depth continuous core for strength testing. Each test specimen should have a length-to-diameter ratio of 2 or greater.

11. Immediately following logging and test specimen selection by the engineer, the Contractor should seal the entire full-depth sample, including the designated test specimens, in plastic wrap to prevent drying and transport the sealed sample to the laboratory. The samples should be protected against drying and mechanical damage prior to and during transport.

12. The samples should be stored in a moist room in accordance with ASTM C192 until the test date.

13. Samples must not be submerged in water during curing unless they are sealed in a watertight plastic bag (e.g., a Ziploc® bag) with as much air removed as possible prior to sealing to void swelling.

14. The Contractor should retain portions of the samples that are not tested until completion and acceptance of all DMM work for possible future inspection and confirmation testing by the engineer. If a large volume of samples cannot be reasonably stored on the job site, cores from columns deemed satisfactory may be disposed of prior to project completion if approved by the engineer.

15. All core holes should be filled with cement grout that will obtain a 28-day unconfined compressive strength equal to or greater than the 28-day unconfined compressive strength of the deep mixed material.

H. Strength testing:

1. Strength testing should be conducted by an independent testing laboratory retained by the contractor and approved by the engineer.

2. Testing for unconfined compressive strength should be conducted in accordance with ASTM D2166, except that loading should continue on all specimens until the cylinders break sufficiently to examine the interior of the specimen.

3. The broken specimen should be photographed so that the engineer may document any apparent segregation, lenses, and pockets in the specimen.

4. For field validation testing, unconfined compressive strength testing should be performed on specimens from wet grab samples 3, 7, 28, and 56 days or more after mixing.

5. For full production work, unconfined compressive strength testing should be performed on specimens from wet grab samples 7 and 28 days after mixing.

6. For specimens obtained by coring, unconfined compressive strength testing should be performed 28 days after mixing.

7. Laboratory permeability testing should be performed on cylinders at 7 and 28 days for the test section and usually only at 28 days for the production elements. Laboratory permeability testing should be conducted in accordance with ASTM D5084.

I. Uniformity evaluation: The contractor should provide the continuous core samples to the engineer for logging and assessing uniformity in accordance with the acceptance criteria outlined in section 3.06.

J. Both the Contractor's testing and the engineer's testing (if performed) must demonstrate that the required strengths are met prior to accepting the work. The contractor should conduct additional coring and testing required to demonstrate the acceptability of the DMM product due to non-conformance at no additional cost to the owner.

K. Geometric acceptance criteria:

1. The Engineer should make the sole determination as to whether the test results satisfy the geometric acceptance criteria.

2. The horizontal alignment of the DMM element should be within 4 inches of the planned location at the top of design DMM layout.

3. The overlap between any two adjacent elements should be at least 18 percent of the cross sectional area of a single column.

4. Vertical alignment within 1 percent of plumb should be maintained during the DMM column installation.

5. The top of the column should extend upward to the designated elevation or higher.

6. The bottom of the DMM column should extend at least to the depth indicated on the construction drawings or to a specified penetration into the bearing layer or as modified by the engineer in the field.

L. Strength acceptance criteria:

1. The Engineer should make the sole determination as to whether the test results satisfy the following strength acceptance criteria.

2. The specified unconfined compressive strength of the deep mixed material as determined by ASTM D2166 at 28 days curing time should be 120 psi (to be defined by the engineer).

3. 80 percent of unconfined compressive strength test results as determined by ASTM D2166 from each tested deep mixed element should equal or exceed the specified strength. If a strength specimen falls below the specified strength due to an obviously unrepresentative lump of unmixed soil in the specimen, the engineer has the option to select another specimen from the same core run and allow the contractor's laboratory to test the replacement specimen and substitute the strength from the replacement specimen for the strength from the unrepresentative specimen that failed to satisfy the strength requirement. Only one such retest will be allowed per core run.

4. To prevent a weak layer at one elevation in the DMM foundation system, strengths below the specified strength are not permitted within 10 ft of the same elevation in more than two nearby cored elements. "Nearby cored elements" refer to cored elements without an intervening cored element that has a passing test result in the suspect elevation zone.

5. 90 percent of all of the test results across the site should equal or exceed the specified strength.

M. Uniformity criteria:

1. The Engineer should make the sole determination as to whether the test results satisfy the uniformity acceptance criteria.

2. Full-depth continuous core samples retrieved by the contractor from the DMM element should be used to evaluate uniformity.

3. Core recovery (expressed as a percentage) should be reported for each run and is equal to the total length of recovered core divided by the total core run length. Length of recovered core includes lengths of treated and untreated soil.

4. Percent treatment is calculated as the total length of recovered core minus the sum of the lengths of unmixed or poorly mixed soil regions or lumps that extend across the entire diameter of the core divided by the total core run length expressed as a percentage. Percent treatment must be at least 80 percent for every 5 ft core run. If 80 percent treatment cannot be confirmed by coring in coarse sandy or gravelly soil, optical televiewer logs can be used to confirm uniformity.

5. If the Contractor uses core runs shorter than 5 ft (e.g., 3 ft), then the recovery and percent treatment can be calculated taking into equal amounts of core run length on either side of the short core run length to make up a total 5-ft run length for calculation purposes.

N. Non-conformance:

1. The Contractor is responsible for correcting the location or alignment of misplaced elements that will adversely affect the project quality. The Contractor should correct misaligned elements that interfere with the project in a manner acceptable to the owner.

2. If the strength and uniformity acceptance criteria are not achieved for production elements, the contractor should submit a proposed plan for investigating, remixing, or repairing failed sections for review and approval by the engineer.

3. To prove acceptability of the failed element, the Contractor may core elements on both sides of the failed element. If those two cores meet the criteria, then the element should be accepted. If the additional cores fail, then the contractor can propose additional investigations and remedial measures, which the engineer will review and has the option to accept or reject depending on whether the proposed remedial measures meet the design intent. Examples of such investigations and remedial measures include the following:

   a. In the case that the treated soil meets the uniformity criteria but fails to meet the strength criteria, the elements or zone could be assigned a lower strength level. The contractor could propose installing additional elements to compensate the strength required by the design intent. If the treated soil fails to meet the uniformity criteria, the elements need to be remixed or replaced.

   b. If the treated soil that failed to meet the uniformity criteria is concentrated in a narrow elevation range forming weak planes or zones, the contractor could propose redrilling and remixing to 3 ft below the deficient zone. If redrilling and remixing cannot be done efficiently, the contractor must replace the elements to the full depth. If the treated soil in the narrow elevation meets the uniformity criteria but fails to meet the strength criteria, the contractor could propose to redrill and remix the deficient zone or to assign a lower strength level to the deficient zone and install additional elements to compensate for the strength deficiency.

   c. If the treated soil that failed to pass cannot be isolated in a specific zone, the contractor must provide remedial measures for all elements constructed during all rig shifts that occurred between passing elements.

   d. Remedial measures are subject to coring and application of the specification acceptance criteria.

Method of Measurement:

A. The Preproduction test program for DMM including all material, labor, equipment, expendables, etc., incidental to their installation and testing will not be measured but will be paid for at the Contract lump sum price. All excavation and dewatering required for the construction of DMM columns will not be measured and will be incidental to the installation and testing.

B. The production DMM including design, all material, labor, equipment, expendables, load transfer platform will not be measured and will be paid for at the Contract lump sum price. All excavation and dewatering required for the construction of the DMM within the geometric limits as shown in the plans and specifications will not be measured and will be incidental to the construction of the DMM.

C. The QC/QA testing including coring, sample preparation, storing, and testing will not be measured and will be paid for at the Contract lump sum price.

Basis of Payment:

A. The payment will be full compensation for all components of the DMM and shall include full compensation for designing, fabricating, furnishing, installing and for all materials, labor, tools, equipment, and incidentals necessary to complete the Work in conformance with the plans and Specifications.

B. The Engineer will pay for accepted work at the Lump sum price as follows

ITEM	DESCRIPTION	UNIT
602798	Preproduction Test Program	LS
602799	Production DMM	LS
602800	DMM QC/QA Program	LS

605607 - JACKING BRIDGE

Description:

This work includes the jacking of superstructure after post-tensioning of the girders during construction and as suggested on the Plans and as specified herein, or as directed by the Engineer. This section will only be applicable when Contractor's proposed sequence of construction involve jacking operation of the bridge.

Materials:

Jacks used for jacking operations shall have the rate capacity shown clearly on the manufacturer's name plate attached to each jack.

Construction Methods:

All field welding shall be done by the shielded metal-arc process. All requirements of the Specifications shall be adhered to, except that the requirements for radiographic and ultrasonic inspection will be waived if a visual inspection by the Engineer indicates the welds are satisfactory.

Areas under the jacks shall be thoroughly cleaned to provide a flat, clean jacking surface.

It is the Contractor's sole responsibility to ensure that he uses the correct scheme and jack capacity as shown on the Plans. Therefore, any damage resulting from the Contractor's misuse of the jacking scheme to any portion of the structure that is to remain in place shall be repaired by him to the complete satisfaction of the Engineer, all at the Contractor's sole cost.

When no longer required, as determined by the Engineer, all materials used for the temporary supports shall become the property of the Contractor and shall be disposed of by him clear of the site.

Jacking Requirements and Restrictions:

The following requirements and restrictions shall be closely adhered to by the Contractor during jacking sequences.

The Engineer or his representative shall be present during all jacking operations and shall check all pertinent dimensions and requirements as set forth on the Plans and herein to ensure that all pertinent stipulations are met before commencement of the actual jacking.

The jacking operation shall be performed such that all girders at a pier or abutment are lifted simultaneously. Jacking shall continue until bearings can be reset.

The girders shall not be jacked up more than 3/8", maximum girder differential shall be 1/8".

Jacks shall be equipped with locking rings which will prevent movement in the event that hydraulic pressure is lost.

Jacking loads shall not exceed the unfactored dead load reactions shown on contract plans.

Jacks with a higher capacity than those listed in the Plans may be allowed, but the Contractor shall be responsible for monitoring the jack load to ensure the safety of the structure.

The jack system shall be equipped with a gage to directly read the jack force in pounds or kips or shall be accompanied by a chart with which the dial reading can be converted into pounds. Direct reading gages are preferred.

The jack hydraulics may not be used to support the load after jacking. All load must be transferred to the jacking beam and stool supports after jacking.

Method of Measurement and Basis of Payment:

Jacking, including all materials, labor, and equipment necessary for jacking the bridge and removing the jacking assemblies, will be measured and paid for at the contract Lump Sum price bid for the item 605607 - Jacking Bridge.

This item includes jacking bearing plates, hydraulic jacks, any temporary blocking or shims, all labor and any additional materials required to jack the bridge.

5/4/16

605659 - STRIP SEAL EXPANSION JOINT 3"
605660 - STRIP SEAL EXPANSION JOINT 4"

Description:

This work consists of furnishing of all materials and necessary labor to remove existing strip seal(s), clean the joint(s), and install prefabricated neoprene strip seal(s) of the size(s) specified on the Plans in existing expansion joint system(s) on roadway and/or sidewalk at locations specified on the Plans and in accordance with these specifications.

Materials:

The elastomeric material shall be 100% virgin Polychloroprene (Neoprene). The strip seal shall be an extruded neoprene material meeting the requirements of ASTM D 2628 modified to omit the recovery test. The elastomeric material shall have the following physical properties as determined by applicable ASTM tests:

ASTM STANDARD	PHYSICAL PROPERTIES	PERFORMANCE REQUIREMENTS
D2240 (Modified)	Hardness	60±7 points, Durometer (Type A)
D412	Tensile Strength Ultimate Elongation	2000 psi (14 MPa), min. 250%, min.
D395 (method B)	Compressive Set 70 hr. @ 212°F (100° C).	40%, max.
D573	Compressive Set 212°F (100° C).	40%, max.
D1630	Abrasion Resistance	Index of 200 or greater Permissible
D1149	Oxone Resistance 20% strain 300 pphm in air, 70h @ 140°F (60° C). (wiped) with tolune to remove surface contamination)	No cracks

ASTM STANDARD	PHYSICAL PROPERTIES	PERFORMANCE REQUIREMENTS
D471	Oil Swell, ASTM Oil #3, 70 h @ 212°F (100° C)., Weight change	45%, max.
D2240	Low Temperature Stiffening max. 7 days @ 14°F (-10° C).	+15 points Durometer (Type A)

Construction Methods:

Installation of the prefabricated strip seal, and application of adhesives, shall be in accordance with the manufacturer's written recommendations and instructions and as specified herein. Special tools for insertion of seals shall be provided by the manufacturer as may be required. The strip seal shall be furnished in one piece for the full width of the joint.

Method of Measurement:

The quantity of strip seal expansion joint will be measured as the actual number of linear feet (linear meters) of each size furnished and installed, measured along the centerlines of the slab joints.

Basis of Payment:

The quantity of 3" strip seal expansion joint will be paid for at the Contract unit price per linear foot (linear meter) for size under item 605659. Price and payment will constitute full compensation for furnishing and installing all materials and for all material, labor, equipment, tools and incidentals required to complete the work.

The quantity of 4" strip seal expansion joint will be paid for at the Contract unit price per linear foot (linear meter) for size under item 605660. Price and payment will constitute full compensation for furnishing and installing all materials and for all material, labor, equipment, tools and incidentals required to complete the work.

8/30/16

605725 - ELASTOMERIC WATERPROOF COATING

Description:

This work consists of surface preparation, furnishing all materials, and application of a high performance elastomeric urethane coating to the surface of post tensioning pour backs, both new and existing. The work shall be performed as indicated on the Plans, in accordance with these Specifications, and as directed by the Engineer.

Materials:

The use of a prime coat is dependent upon the requirements of the manufacturer's waterproofing system. The polyurethane chemistry may be either waterborne aromatic (moisture - curing) or aromatic (moisture-sensitive). The thickness of the coating system shall be 30 to 45 mils. The cured coating system must meet the following requirements:

PROPERTY	TEST VALUE	TEST METHOD
Hardness, Shore A	Between 60 and 90	ASTM D 2240
Tensile Strength	= 750 psi	ASTM D 412
Elongation	= 400%	ASTM D 412
Tear Strength	> 70 pli	ASTM C 957
Abrasion Resistance H-18 wheels 1,000 gm/wheel	= 350 mg loss/1,000 revs	ASTM C 957
Crack Bridging 1,000 Cycles	System Passes	ASTM C 957
Elongation Recovery	= 94%	ASTM C 957

The high performance elastomeric urethane coating shall be Uroflex 65 Elastomeric Urethane with B-2 Primer as manufactured by Pilgrim Permocoat, Inc, 402 South 22ND Street, Tampa, Florida 33605, Phone 813-248-3328; or approved equal.

Construction Methods:

The sealer shall be used as supplied by the manufacturers without thinning or alteration unless specifically required in the manufacturer's instructions and verified by Engineer.

All new grout pour-backs that are to be coated shall be cured for at least 28 days after casting or for the length of time specified in the manufacturer's instruction, whichever is longer.

Assure concrete, permanent grout caps or other substrates are structurally sound and dry. Remove all laitance, grease, curing compounds, surface treatments, coatings and oils by grit blasting to establish the anchor pattern. Blow the surface with compressed air to remove the dust or water.

Prior to application of the coating system on the structure, construct a 2 ft x 4 ft grout test block with a similar surface texture to the surfaces to be coated. Apply the coating system to the vertical face of the test block. Determine the number of coats required to achieve a coating thickness of 30 to 45 mils without runs and drips. Application by spray or roller is permitted. Have the coating manufacturer representative on site to supervise and comment on the application of the elastomeric coating to the test block.

Following cleaning of the surface, apply a primer or adhesion promoter as required or recommended by the selected manufacturer. Once the primer has cured, apply the elastomeric coating in accordance with the manufacturer's recommendations and the approved procedures utilized on the test block.

The concrete sealer material shall be applied using coverage rate and equipment in accordance with the manufacturer's recommendations.

Method of Measurement:

The quantity of Elastomeric Waterproof Coating will be measured by the square foot of area treated and accepted.

Basis of Payment:

The quantity of Elastomeric Waterproof Coating will be paid for at the Contract unit price per square foot. Price and payment will constitute full compensation for furnishing all materials, furnishing and removing scaffolding as required, surface preparation, application of the concrete sealer material, disposal of discarded materials, and for all labor, tools, equipment, and all necessary incidentals to complete the work. Preparation of the test block will be considered incidental to the application of the Elastomeric Waterproof Coating.

3/4/16

606501 - METAL BRIDGE RAILING

Description:

This work consists of furnishing all materials and erecting galvanized steel tube rails attached to galvanized steel posts, including all tapered end sections and hardware conforming to these specifications and as shown on the Plans. All steel tubes, posts, plates, nuts and bolts shall be hot dipped galvanized and painted unless noted otherwise.

Materials:

Steel guardrail tubes and splice tubes shall conform to the requirements of ASTM A-501 or A-618 and shall be hot-dipped galvanized in accordance with AASHTO M-111 (M-111M), after fabrication. All butt welds shall be full penetration and ground smooth.

Steel guardrail posts and plates shall conform to the requirements of AASHTO M-270 Grade 36 (M-270M Grade 250) and shall be hot-dipped galvanized in accordance with AASHTO M-111 (M-111M), after fabrication.

Bolts, nuts and washers shall conform to the requirements of AASHTO M-164 (M-164M) and shall be zinc coated in accordance with AASHTO M-232 (M-232M).

All exposed elements of the guardrail system shall be primed and painted with an epoxy coating. The prime coat shall be a two component polyamide epoxy coating Series 66 epoxoline primer as manufactured by TNEMEC Company, Inc. or Ply- Tile 520 Epoxy Coating as manufactured by MAB Paints & Coating or approved equal. The top coat shall be a two component catalyzed aliphatic urethane series 73 Endura-Shield III enamel as manufactured by TNEMEC Company, Inc. and color shall be TNEMEC Gloss Black, or Ply - Thane 800 Coating as manufactured by MAB Paints & Coating and color shall be MAB Gloss Black or approved equal.

Construction Methods:

Prior to applying coating, all hot-dipped galvanized material shall be thoroughly cleaned in accordance with the Steel Structures Painting Council Standard, SSPC SP-7. All coatings shall be applied by airless or conventional spray. Primer coat thickness shall be 3.0 to 4.0 mils (75 to 100 µm), minimum DFT. Top coat thickness shall be 2.0 to 3.0 mils (50 to 75 µm), minimum DFT. Coatings shall be applied under the following conditions. The minimum temperature of the air, steel and coating shall be 60°F (15°C), humidity 70% maximum and dew point not within 5°F (3°C) of the air temperature. Fabricator shall handle, pack, and ship, in such a manner as to minimize damage to the finish. The Contractor shall take equal precautions. Suitable touch-up material shall be readily available for the Contractor's use. The Contractor shall supply to the Owner one-half pint (0.25 liter) of touch up material.

Posts shall be set normal to grade, true to line and grade as shown on the Plans and as directed. Posts shall be spaced as shown on the Plans and grouted at the base with a high strength non-shrink grout. Anchor bolts shall be set prior to pouring the concrete and shall be firmly held in place by a template. The portions of anchor bolts which will be exposed above the concrete shall be given a protective coating of grease or oil before the concrete is poured.

The rails shall be so erected as to form a smooth continuous rail conforming to the required line and grade. Provide an expansion joint splice at each tapered end and one in the straight section of rail on each side of the bridge. Rails shall be continuous over two or more posts.

All bolts shall be drawn tight. Bolts shall be sufficiently long to extend at least 1/4″ (6) beyond the nuts, except where required for adjustments, and then bolts shall not extend more than 1/2″ (12 mm) beyond nuts. The Contractor shall burr the last thread of all bolts to prevent removal of such bolts.

Method of Measurement:

The quantity of metal bridge railing will be measured as the actual number of linear feet (linear meters) of railing, installed and accepted. Bridge Railing will be measured by the linear foot (linear meter) from end to end of rail including tapered end sections.

Basis of Payment:

The quantity of metal bridge railing will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for furnishing and placing all materials, including tapered end sections, tubes, galvanized steel post, plater, grout and all hardware, burring of bolts, for all labor, equipment, tools, and incidentals necessary to complete the item.

6/27/16

606503 - STEEL HAND RAILING

Description:

This work consists of furnishing and installing steel pedestrian rail as shown on the Construction Plans. It includes fabricating, furnishing and installing all required connectors, hardware and accommodations for such. All steel tubes, posts and plates shall be hot dipped galvanized and painted unless otherwise noted.

Shop Drawings:

Shop drawings shall be prepared, submitted, and approved before fabrication may begin. Shop drawing and subsequent fabrication of railing to meet BOCA, OSHA, and ADA requirements. All shop drawings for the railing should also illustrate connections, attachments, and details for the lighted handrail attachment. Drawings should also include information on all proposed coatings.

Materials:

The handrail posts, pickets, "W" panel, and plates shall be of steel as further noted on the plans. Steel shall conform to the requirements of AASHTO M-270 Grade 36 (M-270M Grade 250) and shall be hot-dipped galvanized in accordance with AASHTO M-111 (M-111M), after fabrication.

Bottom channels shall be cold rolled steel as further noted on the Plans.

Panel shall have Custom Vector "W" waterjet cutout as noted on the Plans.

Fittings/Fasteners: Bolts, nuts and washers shall conform to the requirements of AASHTO M-164 (M-164M) and shall be 316 stainless steel in accordance with AASHTO M-232 (M-232M).

All exposed elements of the handrail system shall be primed and painted with an epoxy coating. The prime coat shall be a two component polyamide epoxy coating Series 66 epoxoline primer as manufactured by TNEMEC Company, Inc. or Ply- Tile 520 Epoxy Coating as manufactured by MAB Paints & Coating or approved equal. The top coat shall be a two component catalyzed aliphatic urethane series 73 Endura-Shield III enamel as manufactured by TNEMEC Company, Inc. and color shall be TNEMEC Gloss Black, or Ply - Thane 800 Coating as manufactured by MAB Paints & Coating and color shall be MAB Gloss Black. All burrs to be ground off to provide a smooth finish. Two topcoats shall be applied. The grout for the base connections shall be the non-shrink, non-metallic type. The grout shall be either Super Por-Rok Grout manufactured by Minwax, Construction Products Division (15 Mercedes Ave., Montvale, N.J. 07645 tel. no. 201-391-0253) or Sure-Grip Utility Grout manufactured by Dayton Superior Corp.(Phila., PA tel. No. 215-532-7786) or an approved equal.

The square shapes, channels, and hand railing shall conform to ASTM designation A-36.

Construction Methods:

Fabricate handrails.

Prefabricate components in shop with joints tightly fitted and secured as much as possible.

Supply components required for anchorage of fabrications as indicated on drawings. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

Welding Components shall be seal joined pieces by matching joints in adjoining phase.

Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Smooth exposed edges to small uniform radius.

Accurately form components to each other.

Accommodate for expansion and contraction of members without damage to connections or members.

Prior to applying coating, all hot-dipped galvanized material shall be thoroughly cleaned in accordance with the Steel Structures Painting Council Standard, SSPC SP-7. All coatings shall be applied by airless or conventional spray. Primer coat thickness shall be 3.0 to 4.0 mils minimum DFT. Top coat thickness shall be 2.0 to 3.0 mils minimum DFT. Coatings shall be applied under the following conditions. The minimum temperature of the air, steel and coating shall be 60 F, humidity 70% maximum and dew point not within 5 F of the air temperature.

Posts shall be set normal to follow evenly the profile (elevation and radii) of the barrier, true to line and grade as shown on the Plans and as directed. Posts shall be spaced as shown on the Plans anchored with anchor bolts as noted on the plans. Anchor bolts shall be set prior to pouring the concrete and shall be firmly held in place by a template. The portions of anchor bolts which will be exposed above the concrete shall be given a protective coating of grease or oil before the concrete is poured.

The top rails shall be so erected as to form a smooth continuous rail conforming to the required line and grade. Provide an expansion joint splice at each tapered end and one in the straight section of rail on each side of the bridge. Rails shall be continuous over two or more posts.

All bolts shall be drawn tight. Bolts shall be sufficiently long to extend at least ¼" beyond the nuts, except where special high-crown acorn nuts have been specified at the post bases. Where bolt extensions are required for adjustments, and then bolts shall not extend more than ½" beyond nuts. The Contractor shall burr the last thread of all bolts to prevent removal of such bolts.

Place PVC sleeves in final position before pouring concrete for the barrier. After the concrete is cured, install handrails plumb as shown on the Plans. Place grout in sleeves around posts. Steel railing and incidental parts shall be carefully handled and stored on blocking, racks, or platforms to prohibit contact with ground and shall be protected from corrosion or damage. Materials shall be kept free from dirt, oil, grease, and other foreign matter. Suitable touch-up material shall be readily available for the Contractor's use. The Contractor shall supply to the Owner one-half pint of touch up material. Damaged material shall be repaired or replaced as directed by the Engineer at the Contractor's Expense.

Method of Measurement:

The quantity of steel handrail will be measured as the number of linear feet (linear meters) of steel handrail installed and accepted.

Basis of Payment:

The quantity of steel handrail will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for furnishing and placing all materials, including tubes, galvanized steel post, plates, "W" shape panels and all hardware, and painting burring of bolts, for all labor, equipment, tools, and incidentals necessary to complete the item.

8/30/16

606504 - ALUMINUM HANDRAIL

Description:

This work consists of furnishing and installing aluminum handrail as shown on the contract Plans. It includes furnishing and installing all required connectors and hardware. The requirements of Section 606 METAL BRIDGE RAILING shall apply except as modified by this section

Materials:

Railing:

Aluminum-Alloy Casting - ASTM B 26/B 26M, Alloy SG70A-T6 or ASTM B 108, Alloy SG70A-T6.

Aluminum-Alloy Bolts - ASTM B 211/B 211M, Alloy 2024-T4.

Aluminum-Alloy Nuts - ASTM B 211/B 211M, Alloy 6061-T6.

Nylon Washers - 1/8 inch thick by 1-inch minimum outside diameter with 480 inch-pounds maximum allowable applied

Bolt Heads - Regular hexagon, ANSI B18.2.3.5M (ANSI B18.2).

Nuts. Finished hexagon, ANSI B18.2.4.6M (ANSI B18.2) - Threads, Class 6, 6g, or 6H (Threads, Class 2, 2A, or 2B).

Aluminum Alloy Balusters - ASTM B 221/B 221M, Alloy 6061-T4.

Post assembly and panel to post aluminum washers - ASTM B 209, Alloy 2024-T3.

Cast Aluminum Post Base - ASTM B 26/B 26M, Alloy SG70A-T6 or ASTM B 108/ B 108M, Alloy SG70A-T6.

Anchor bolts, nuts and washers for anchor bolts to be hot-dip galvanized as per ASTM A 153

Construction Methods:

Before fabrication, submit shop drawings for review and acceptance. Before erection, coat surfaces of aluminum alloys in contact with other metals, stone masonry, or concrete, using approved caulking compound. After erection and alignment, seal openings between metal surfaces and concrete, using approved caulking compound.

After the concreting and other operations have been completed, thoroughly clean the railing. Remove accumulations of oil, grease, dirt, or foreign materials, using a solvent cleaner.
Assemble, as shown on the accepted shop drawings. Make cuts true, smooth, and free from burrs or ragged edges. Fillet-drill all re-entrant cuts, before cutting. Do not flame cut.

To facilitate bending, the Contractor may heat material to a temperature of 400 °F for a period not exceeding 15 minutes.

Drill rivet and bolt holes, or subpunch 3/16 inch smaller than the nominal diameter of the fastener; then ream to size.

Method of Measurement:

The quantity of aluminum handrail will be measured as the number of linear feet (linear meters) of aluminum handrail installed and accepted.

Basis of Payment:

The quantity of aluminum handrail will be paid for at the Contract unit price per linear foot (linear meter). Price and payment shall constitute full compensation for furnishing and installing all materials necessary to complete the item.

11/10/15

606505 - LED ILLUMINATED HANDRAIL

Description:

This work consists of furnishing and installing a LED illuminated handrail system. Work includes, but is not limited to, furnishing and installing handrail, LED pods, conduits, electrical junction boxes, wiring, soft start relays, and remote LED driver.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman.

Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Materials:

Submittals. Submit shop drawings and product data for approval.

1. Show sections and plans of stairs, dimensions and assembly of components.
   a. Railings
   b. Handrail
   c. Brackets
   d. Reinforcements
   e. Anchors
   f. Welded and bolted connections

2. Show all field connections.

3. Provide setting diagrams for installation of weld plates for attachment of rails to structure.

4. Indicate all required field measurements

5. Indicate component details, materials, finishes, connection and joining methods, and the relationship to adjoining work.

6. Submit manufacturer's installation instructions.

7. Samples: Submit duplicate samples of railing showing style and finish. One approved sample will be returned to contractor.

Handrail.

1. Material: QQ-S-766 Stainless Steel, Type 304

2. Shape: Round, 1.9 inch diameter, available in curved and straight sections.

3. Post Mounting: Stainless steel bent tube brackets with wall flanges as shown on the Contract Plans.

4. ETL and cETL listed LED.

5. Rail Height: As shown on the Contract Plans.

6. Fasteners: All mechanical fasteners used in the assembly of stainless steel railings shall be manufactured from stainless steel.

7. Brackets: Stainless Steel

LED Lighting Pods.

1. General

   a. All luminaires shall embody the highest standards of electrical and mechanical design, materials and workmanship, and shall be subject in all respects to the approval of the Engineer.

   b. All luminaires shall be installed complete with lamps by the manufacturer specified or an equal approved by the engineer.

   c. Manufacturers' packaging shall be marked to include identification by type, quantity of contents, and manufacturer's component designation.

   d. Lighting standards shall meet or exceed the requirements of the 2009 edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals".

   e. Use new materials, equipment and installations, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.

   f. Provide LM-79 photometric test reports for all LED luminaires. LM-79 luminaire photometric reports shall be produce by an independent test laboratory and include the following:

      i. Name of test laboratory. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program.
      ii. Report number
      iii. Date
      iv. Complete luminaire catalog number. Catalog number tested must match the catalog number of the luminaire submitted, except for variations which do not affect performance.
      v. Description of luminaire, LED light source(s), and LED driver(s)
      vi. Goniophotometry
      vii. Colorimetry

   g. Provide LM-80 lumen maintenance test report for each LED luminaire.

   h. Luminaire shall have external and internal labels per ANSI C136.15 and ANSI C136.22, respectively. Internal label shall identify the manufacturer, year and month of manufacture and the manufacturer's part number.

   i. Luminaires shall be listed for wet locations.

2. Warranty

   a. Provide manufacturer's standard form in which manufacture agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship, corrode, fade, stain, or chalk due to the effects of weather or solar radiation within specified warranty period.

   b. Warranty period for luminaires: Minimum five years from date of Substantial Completion.

3. Source: Selected high brightness LED

4. Life (L70/ 70% brightness): 50,000 hours

5. Light Output: Standard Output, 4000K

6. Lumens/Unit: 154 lumens

7. Color Rendering Index (CRI): Minimum CRI of 84.

8. Beam Angle: Asymmetric

9. Housing: Extruded Aluminum/Investment Cast Stainless Steel

10. Mounting: Clip System

11. Listings: ETL Listed for wet or dry locations to UL 1598, UL 8750, and CSA22.2

12. Spacing: Approx. 2 ft. on center

13. Input Voltage: 24V

14. Power Consumption: 2 W/unit

15. Power Supply: 24V/100W

16. Temperature Range: -40°C through +60° C

17. Product Rating: Interior and Exterior Applications, ETL Class 2 circuit.

LED Power Drivers.

1. UL Class 2, IP 66 rated

2. Input voltage: 120V-277V

3. Power output: 100 Watts at 24V DC

4. LED Pods per driver: Must be able to accommodate up to 30 LED pods per power driver.

5. Soft start relay: one per power driver

6. Maximum THD = 20%

7. Minimum Power factor of 0.90

8. Surge Protection = 4.0 KV

9. Minimum Operating Ambient Temperature = -40 °C

10. Maximum Allowable Case Temperature = 90 °C

11. Lead-wire distance at full load: Must be able to span 71 feet using 12 AWG wire.

Construction Methods:

Quality Assurance.

1. Regulatory Requirements

   a. Components and installation are to follow current ADA and ICC/ANSI A117.1 guidelines.

2. Certifications

   a. Furnish certification that all components and fittings are furnished by the same manufacturer or approved by the primary component manufacturer.

3. Pre-Installation Meeting

   a. Prior to the beginning of work, conduct a pre-job conference at the job site.

   b. Provide seven calendar days advance written notice ensuring the attendance by competent authorized representatives of the fabricator, DelDOT, and subcontractors whose work interfaces with the work of this section.

   c. Review the specifications to determine any potential problems, changes, scheduling, unique job site conditions, installation requirements and procedures and any other information pertinent to the installation.

   d. Record the results of the conference and furnish copies to all participants.

Delivery, Storage and Handling.

1. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.

2. Storage on site:

   a. Store material in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending.

   b. Store material in a clean, dry location away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin, or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

   c. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of material.

Fabrication.

1. Form all changes in rail direction by radius elbows.

2. Cut material square and remove burrs from all exposed edges, with no chamfer.

3. Make exposed joints butt tight and flush.

4. Close exposed ends of handrail by use of appropriate end cap.

5. Verify dimensions on site prior to shop fabrication.

Handrail Installation.

1. Install in accordance with shop drawings and manufacturer's instructions at location indicated on the Contract Plans.

2. Erect work parallel to rake of steps, rigid, and free from distortion or defects detrimental to appearance or performance.

3. Protect railing system and finish from damage during construction.

4. Installation shall be by a qualified handrail installer.

5. All handrail pieces shall be pre-fabricated in as few pieces as possible by the manufacturer and shall be delivered to the site.

6. On-site fabricator shall be available to make field adjustments to railings (trimming, splicing, etc).

7. Repair damaged finish as directed by the Engineer.

LED Light Pod Installation.

1. General.

    a. Luminaires shall be installed complete with all equipment, materials, parts, attachments, devices, hardware, cables, and supports necessary to make a safe, complete and fully operative installation. Manufacturer of each luminaire shall supply complete installation instructions including diagrams, illustrations, etc. The Contractor shall install in strict conformance with such instructions.

    b. Each luminaire shall be installed at location shown on the plans or as indicated in these specifications. Where field conditions require deviation from location shown, the Engineer shall be so notified by the Contractor and final installation made as directed by the Engineer.

    c. Install in accordance with manufacturer's shop drawings.

    d. Thoroughly clean any dirt and residue from luminaires prior to installation.

    e. Install components plumb and level, accurately fitted, free from distortion or defects.

    f. Protect luminaires from damage and defacement until acceptance by Owner. Replace any damaged or defaced fixtures with new units prior to acceptance at no additional cost to the Owner.

2. Installation

    a. Install in accordance with manufacturer's instructions.

    b. Internally wire handrail on-site.

    c. Ensure all holes in the handrail are de-bured inside and out.

    d. Connect internal handrail wiring to LED pod and push wire and LED pod into the hole.

Power Driver.

1. Install remote power drivers in electrical cabinet located behind the stair connection between the Riverwalk and New Sweden Bridge.

2. Connect the driver to AC power using location appropriate electrical terminations

3. Ground the driver and enclosure using mounting studs inside of the electrical cabinet.

4. Install lead-in cable between the driver and first LED Light Pod in the handrail through underground conduit and railing post as shown on the Contract Plans.

5. Install soft-start relay in the handrail prior to the first LED light pod in the series.

Electrical Testing. The system shall be tested in accordance with Item 746653 – Electrical Testing.

Method of Measurement:

The quantity of LED Illuminated Handrail will be measured as the lump sum item to include stainless steel railing and mounting brackets, LED light pods, internal handrail wiring, lead-in cables, soft start relays, and power drivers which will be furnished, installed, operational and accepted.

Basis of Payment:

The quantity of LED Illuminated Handrail shall be paid at the lump sum price of all components furnished and installed. Price and payment will constitute full compensation for furnishing and installing all materials, including stainless steel railing and mounting brackets, LED light pods, internal handrail electrical wiring, lead-in cables, soft start relays, and power drivers. The price will also include all labor, tools, equipment, testing and incidentals to complete the work.

Underground conduit will be measured and paid for separately under the applicable conduit item(s).

Electrical wiring between the control cabinet and LED drivers will be measured and paid for separately under the applicable cable item(s).

4/14/2016

606510 - HANDRAIL, TYPE 1

Description:

This work consists of furnishing and installing the pedestrian curved steel handrail on the stairs as shown on the Construction Plans. It includes fabricating, furnishing and installing all required connectors, hardware and accommodations for such. Top of stair guard panels as illustrated on the plans shall be incidental to the steel handrail. All steel tubes, posts and plates shall be hot dipped galvanized and painted unless otherwise noted.

Shop Drawings:

Shop drawings shall be prepared, submitted, and approved before fabrication may begin. Shop drawing and subsequent fabrication of railing to meet BOCA, OSHA, and ADA requirements. All shop drawings for the railing should also illustrate connections, attachments, and details for the lighted handrail attachment. Drawings should also include information on all proposed coatings.

Materials:

The handrail posts, pickets, and plates shall be of steel as further noted on the plans. Steel shall conform to the requirements of AASHTO M-270 Grade 36 (M-270M Grade 250) and shall be hot-dipped galvanized in accordance with AASHTO M-111 (M-111M), after fabrication.

Bottom channels shall be cold rolled steel as further noted on the plans.

Steel handrail tubes and splice tubes shall conform to the requirements of ASTM A-501 or A-618 and shall be hot-dipped galvanized in accordance with AASHTO M-111 (M-111M), after fabrication. All butt welds shall be full penetration and ground smooth with no apparent fabrication defects

Fittings/Fasteners: Bolts, nuts and washers shall conform to the requirements of AASHTO M-164 (M-164M) and shall be 316 stainless steel in accordance with AASHTO M-232 (M-232M).

All exposed elements of the handrail system shall be primed and painted with an epoxy coating. The prime coat shall be a two component polyamide epoxy coating Series 66 epoxoline primer as manufactured by TNEMEC Company, Inc. or Ply- Tile 520 Epoxy Coating as manufactured by MAB Paints & Coating or approved equal. The top coat shall be a two component catalyzed aliphatic urethane series 73 Endura-Shield III enamel as manufactured by TNEMEC Company, Inc. and color shall be TNEMEC Gloss Black, or Ply - Thane 800 Coating as manufactured by MAB Paints & Coating and color shall be MAB Gloss Black. Two topcoats shall be applied.

The square shapes, channels, and hand railing shall conform to ASTM designation A-36.

Construction and Fabrication Methods:

Prefabricate components in shop with joints tightly fitted and secured as much as possible.

Supply components required for anchorage of fabrications as indicated on drawings. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

Welding Components shall be seal joined pieces by matching joints in adjoining phase. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Smooth exposed edges to small uniform radius. Accurately form components to each other. Accommodate for expansion and contraction of members without damage to connections or members.

Prior to applying coating, all hot-dipped galvanized material shall be thoroughly cleaned in accordance with the Steel Structures Painting Council Standard, SSPC SP-7. All coatings shall be applied by airless or conventional spray. Primer coat thickness shall be 3.0 to 4.0 mils minimum DFT. Top coat thickness shall be 2.0 to 3.0 mils minimum DFT. Coatings shall be applied under the following conditions. The minimum temperature of the air, steel and coating shall be 60 F, humidity 70% maximum and dew point not within 5 F of the air temperature.

Fabricator shall handle, pack, and ship, in such a manner as to minimize damage to the finish. The Contractor shall take equal precautions. Suitable touch-up material shall be readily available for the Contractor's use. The Contractor shall supply to the Owner one-half pint of touch up material.

Posts shall be set normal to follow evenly the profile (elevation and radii) of the step wing retaining walls, true to line and grade as shown on the Plans and as directed. Posts shall be spaced as shown on the Plans anchored with anchor bolts as noted on the plans. Anchor bolts shall be set prior to pouring the concrete and shall be firmly held in place by a template. The portions of anchor bolts which will be exposed above the concrete shall be given a protective coating of grease or oil before the concrete is poured.

The top rails shall be so erected as to form a smooth continuous rail conforming to the required line and grade. Provide an expansion joint splice at each tapered end and one in the straight section of rail on each side of the bridge. Rails shall be continuous over two or more posts.

All bolts shall be drawn tight. Bolts shall be sufficiently long to extend at least ¼" beyond the nuts, except where special high-crown acorn nuts have been specified at the post bases. Where bolt extensions are required for adjustments, and then bolts shall not extend more than ½" beyond nuts. The Contractor shall burr the last thread of all bolts to prevent removal of such bolts.

Method of Measurement:

The quantity of pedestrian steel handrail will be measured as the number of linear feet of steel handrail installed and accepted.

Basis of Payment:

The quantity of metal bridge railing will be paid for at the Contract unit price per linear foot. Price and payment will constitute full compensation for furnishing and placing all materials, including tubes, galvanized steel post, plates, and all hardware, and painting burring of bolts, for all labor, equipment, tools, and incidentals necessary to complete the item.

5/4/16

614508 - WATER MAIN AND ACCESSORIES

Description:

The items shall consist of furnishing, transporting and installing the City of Wilmington water main and accessories in accordance with the locations, details and notes on the Plans, and as directed by the Engineer. The work shall be performed in accordance with these Special Provisions, Delaware Standard Specifications, and the requirements of the Standards and Specifications of the City of Wilmington. In case of conflict between these Special Provisions, Delaware Standard Specifications, and the Standards and Specifications of the City of Wilmington, the Standards and Specifications and all other requirements of the City of Wilmington shall prevail. The City of Wilmington from hereafter shall be addressed as the Owner. The existing water mains shall be abandoned or salvaged as specified on the Plans.

Materials:

All the materials including pipe, fittings, and all other accessories as listed under this Special Provisions, shall conform to the material and quality requirements of the Standards and Specifications of the Owner of the utility. The Owner shall have right to inspect and reject the materials, if his specifications requirements are not met. It is recommended that the Contractor should contact the Owner of the utility and get himself familiarized with the applicable requirements of the materials required under this contract before submitting his bid.

The contractor shall be responsible for providing materials including pipe, fittings, and all other appurtenances necessary to make permanent connections to existing utility facilities of whatever material type encountered.

Portland Cement Concrete required for the job shall be Class B, and shall conform to Section 812 of the Delaware Standard Specifications.

Polyethylene encasement required to prevent pipe corrosion shall conform to ANSI/AWWA C105/A21.5-93.

Special Requirements:

The Contractor's attention is directed to the following special requirements.

The owner shall have the sole right of determining at what times and in what order the Contractor shall undertake work, of making connections and modifications to the existing water system. Prior notice, a minimum of forty-eight (48) hours shall be given to the owner for inspection and supervision by the Contractor of his intention to begin work involving the water line relocations. No work shall be started by the Contractor until he has received permission from both the Engineer and the owner to proceed. The Contractor shall immediately notify both the Engineer and the owner of all delays.

It is of prime importance that the Contractor, in the performance of his work, does not disrupt the operation of the existing water facilities in any manner or at any time, without the express prior approval of the owner. The Contractor shall construct, disinfect, maintain and remove, following construction, such temporary water bypasses as may be required during construction to maintain water mains in service. No separate payment shall be made for such temporary water bypasses.

The Contractor will be permitted to close down specific water mains and services for a period of time not exceeding four (4) hours after obtaining approval from the owner in order to make connections as shown on the Plans. The schedule for making connections will be so arranged that the water users will be out-of-service for a minimum period of time. The Contractor will receive no additional compensation for working during off-peak hours, including premium time charges.

Before any shutdown, as specified above, the Contractor must give the utility owner and local 911 Center and Fire Department forty-eight (48) hours notice; and the Contractor must also furnish written notice to all water users in the area, a minimum of
forty-eight (48) hours in advance of the closing of any water valves which may interrupt customer water service.

Shutdowns shall not be permitted if tapping sleeves and valves are specified for making the connections.

Any and all emergency repairs required during the period of this contract shall be the responsibility of the Contractor. The owner will notify the Contractor by telecommunication and the Contractor shall be required to attend the repair immediately. In the event the owner is unable to contact the Contractor for immediate emergency repair work in length of time as determined by the owner, the owner reserves the right to attend to any or all emergency repair work, and to submit the costs of repair directly to the Contractor for complete payment.

All materials and work, or parts thereof, which are unsatisfactory as to any or all requirements of the owner or the Engineer, and/or as specified herein, shall be removed and replaced or repaired in an acceptable manner by the Contractor at his own expense.

The Contractor shall guarantee that all workmanship, materials, and work performed under the contract, shall be in strict accordance with the Drawings, Specifications, and other Contract Documents. This guarantee shall be for a period of two years from and after the date of completion and acceptance of the work. The Contractor shall repair, correct or replace as required, promptly and without charge, all work, equipment and material, or parts thereof, which fail to meet the above guarantee, or which in any way fail to comply with or fail to be in strict accordance with the terms and provisions and requirements of the contract during such two-year period.

Construction Methods:

All work in connection with construction of water mains and water service connections shall conform to the applicable requirements of the Standard Specifications of the owner of the utility, except as modified by the Plans and these Special Provisions. In case of conflict, the Specifications of the owner of the utility shall prevail.

Excavation and Trenching - Excavation shall be performed in accordance with Section 208 - Excavation and Backfill for Pipe Trenches, except as amended herein. The bottom of the trench shall be cut true and even, so that the barrel of the pipe will have a bearing for the full length. The trenches for water mains shall be excavated to such depth as will provide pipe elevations as indicated on the Water Main Relocation Profiles. The trenches for water service connections shall be excavated to the minimum standard depth or to such depth as required to connect to existing mains or service pipes.

Payment for excavation and backfill shall be in accordance with Section 208 of the Standard Specifications.

The Engineer and the owner shall have the right to limit the amount of trench opened in advance of pipe laid, and the amount of pipe laid in advance of backfilling. They shall be empowered at any time to require the refilling of open trenches over completed pipelines, if in their judgment, such action is necessary and the Contractor shall therefore have no claims for extra compensation, even though to accomplish such refilling, he is compelled to temporarily stop excavation or other work at any place.

If work is stopped on any trench or excavation for any reason and the excavation is left open for an unreasonable length of time (in the opinion of the Engineer) in advance of construction, the Contractor shall, if so directed, refill such trench or excavation at his own expense and shall not again open said trench until he is ready to complete the work therein.

Where rock is encountered and blasting is required for trenching, all rock excavation work shall be performed in accordance with Subsection 107.11 of the Standard Specifications and as modified; and the trench shall be excavated an additional six inches (6") below grade. After the excavation is completed, a bed six inches (6") in depth of Borrow Type C shall be placed in the bottom of the trench, leveled off and thoroughly tamped. In absence of item for Rock Excavation under this contract, a fixed price of $135.00 per cubic yard shall be paid for rock excavation.

Installation of Pipe and Fittings - The laying and jointing of water pipe shall be in accordance with the requirements of the owner's Specifications. All pipe and fittings shall be thoroughly cleaned before laying, and shall be kept clean until acceptance of the work. No pipe may be installed except under the supervision of the owner's inspector.

At the close of the work each day, the end of the pipe shall be tightly closed to prevent dirt, foreign substances, or small animals from entering the line until laying is again resumed.

Pipe and fittings shall be carefully handled and lowered into the trench. Special care shall be taken to make sure all pipes are well bedded on solid foundation. Any defects due to settlement shall be made good by the Contractor at his expense.

Where the manufacturer's recommended pipe joint deflection is exceeded, mechanical joint bends shall be required and installed to the satisfaction of the owner and the Engineer at no extra expense.

Thrust blocks of Portland Cement Concrete Class B of adequate size and weight shall be used on all pressure piping for all fittings and all bends including and in excess of 11 - 1/4 degrees unless specifically called for otherwise on the Plans. Thrust blocks (buttresses) shall conform to the details shown on the Plans and/or the owner's Standard Specifications. No separate payment shall be made for thrust blocks, couplings, service saddles and other required incidentals; and payments for these shall be included in water main pipes.

No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the owner or the Engineer shall deem that there is danger of frost penetration at the bottom of the excavation, unless all requirements as to the minimum length of open trench and promptness of refilling are observed.

The Contractor shall keep all excavation free from water or other liquids during the progress of the work; and backfilling of trenches shall meet the applicable requirements of Sections 208 and 210 of the Standard Specifications.

Pressure Testing - Water main relocations shall be pressure-tested by the Contractor and approved by the Engineer and the owner of the utility. All equipment and labor required to perform the tests shall be furnished by the Contractor. Testing shall be conducted as specified and as required by the owner.

Upon completion of the relocation and before connecting into the existing water main, the ends of the relocated line shall be adequately plugged and the system shall be tested at a hydrostatic pressure equal to 25% in excess of the average static head and proved tight at this pressure. Under this pressure, leakage shall be held to a maximum of seventy (70) gallons per twenty-four (24) hours per inch of diameter per mile of pipe. The Contractor shall install any taps required at all high points on the line to expel trapped air prior to the actual tests. Following the tests, all such taps shall be tightly plugged with suitable threaded brass plugs. All costs of tapping and plugging the line for this purpose shall be borne by the Contractor.

Water for testing purposes shall be furnished by the owner at the Contractor's expense. The Contractor shall furnish and install adequate pumping and gauging equipment to develop the required hydrostatic pressure and to measure the pressure and amount of water lost by leakage. Duration of the pressure test shall not be less than two (2) hours. All visible leaks shall be repaired regardless of total leakage as shown by test.

If inspection or test shows defects, including visible leaks, such defective work or material shall be replaced at the expense of the Contractor, and inspection and tests shall be repeated. All repairs shall be made with new material; failure to meet the tests specified above will be sufficient cause to reject the work until the defects are satisfactorily repaired. All expenses and costs incurred in carrying out the specified tests shall be

borne by the Contractor at no extra cost to the owner or to the State and shall be included in the contract unit price per linear foot bid for the various sizes of installing water main.

Sterilization of Main - Prior to the final connection of the newly installed pipe into the existing water main, and with the plugs used in the pressure test still in place on the installed pipe, the entire installed system shall be sterilized, using one of the procedures as specified in AWWA Standard C601-54 and as required by the owner of the utility.

The Contractor shall provide an adequate blowoff for use in flushing of the main. Before the water is turned on for use by the consumer from the relocated mains, the owner will conduct bacteriological tests on water samples taken from the blowoff. All expenses incurred in the making of these tests by the owner will be borne by the Contractor. No water shall be turned on for use by the consumer from the newly installed water main until the owner gives final sanitary approval.

Before the final connection is made, all surfaces of the relocated line, and the existing water main that are to become part of the closing joint, including all gaskets and glands, shall be thoroughly cleaned, and shall be treated with a 5% solution of Sodium Hypochlorite. Extreme care is to be exercised in order to prevent the entrance of any contaminants into the main.

All expenses and cost incurred in carrying out the specified sterilization work shall be borne by the Contractor at no extra cost to the owner or the State and shall be included in the contract unit price per linear foot bid for the item Installing Water Main for the various sizes.

Abandoning and/or Removing Existing Water Mains - All existing water mains which are to be abandoned and are located within the limits of excavation shall be removed and become the property of the Contractor. Adjacent pipe openings shall be plugged as required in accordance with the Subsection202.04 of the Standard Specifications.

Final Location Drawings - Within thirty (30) days after completion of required work, the Contractor shall submit an accurate print or prints showing the horizontal and vertical location of mains, bends and other appurtenances to the Engineer and the owner.

Method of Measurement:

The measurement of payment shall be for the installation of the materials listed in the breakout sheet in accordance with the units indicated as Each and the number of Linear Feet of pipe(s) of specified diameter(s) excluding the portion of pipe inserted inside the accessories installed in place, complete and accepted.

Basis of Payment:

The quantity of mains and accessories will be paid for at the Contract lump sum. Price and payment shall constitute full compensation for furnishing, transporting and installing the materials, concrete buttresses, pressure testing, sterilizing the water mains and connecting to the existing water main, maintaining service as required and for all labor, equipment, tools and necessary incidentals to achieve and accept operational water main. No separate payment shall be made for salvaging or abandoning or removing and disposing of existing water mains and cost for such required work shall be incidental to the respective sizes for installing water main. A breakout sheet attached to the Proposal lists the different elements of work or materials involved in completing this item. The Contractor shall fill in a unit price for each item and the cost (unit price times the proposed quantity). The Lump Sum cost for Item 614508, shall be derived from the total sum of the cost of all items listed. The breakout sheet shall be attached to the Bid Proposal. Failure to submit the breakout sheet with the Bid Proposal will result in the bid being declared non-responsive and rejected. The Department reserves the right to delete from the Contract one or more items listed and the right to add or subtract from the quantity of each item. The total price to be paid will be adjusted in accordance with the Contractor's unit prices as required above. There will be no extra compensation or increase in unit prices in the breakout sheet if such additions and/or deletions are made to the quantities.

3/8/16

614604 - INSTALLING LANDSCAPE WATER SYSTEM

Description:

This item shall consist of furnishing all materials and modifying the existing irrigation system necessary due to the project's construction in accordance with the locations and notes as shown on the plans and as directed by the Engineer.

Materials and Construction Methods:

Prior to project excavation in the area of the existing irrigation system, the Contractor shall gain approval from the Engineer on his/her plan to prepare the irrigation system for temporary discontinuity in an effort to minimize the effort required to make the system functional following project excavation.

Following final grading of the proposed construction, the Contractor shall make all necessary adjustments/modifications to provide a functional water system in the areas as shown on the plans or as directed by the Engineer. The Contractor shall coordinate with the owner of the irrigation system to secure existing plans/specifications and to provide the work and materials to modify the existing irrigation system at the locations shown on the plans. The Contractor shall coordinate with the owner for compatible materials and sizes prior to ordering the materials. All plumbing work by the Contractor to be performed by a licensed plumber and will be in accordance with the Standard Specifications of the owner.

The Contractor shall coordinate with the Engineer to factor in future planting locations during the design and installation of the landscape water system modification to ensure these areas will have adequate irrigation in the future.

Following installation and acceptance, the Contractor shall prepare and provide an as-built record plan of the system adjustment/modification to the owner.

Method of Measurement:

The quantity to be paid for will be at the Contract lump sum price, completed and accepted.

Basis of Payment:

Payment for furnishing and installing all materials shall be paid for at the contract unit price bid for "Installing Landscape Water System" which price and payment shall constitute full compensation for furnishing and placing all materials, for excavation and embankment to place the water system, for preparing the as-built record plan, for all labor, tools, equipment, hardware, plumbing parts and incidentals necessary to have a fully operational, safe and functional irrigation system.

6/27/16

618533 - NAVIGATION LIGHTS FOR FIXED BRIDGES

Description:

Furnish and install navigation lighting systems, including all wiring, junction boxes, conduit, wiring devices, lights, attachments to the bridge structure, etc., as shown in the plans and in compliance with Code of Federal Regulations (CFR), Title 33, Part 118, which is further clarified in U.S. Coast Guard (USCG) Publication "A Guide to Bridge Lighting". Navigation lights must operate from sunset to sunrise and during periods of low visibility.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman. Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Schedule and arrange electrical work in a neat, well-organized manner without interference with the work scheduling of other trades.

Catalog Cuts. Submit catalog cuts and shop drawings for approval.

Materials:

Meet the equipment and material requirements as shown in the Contract Documents.

Furnish and install only materials and equipment of new stock meeting ANSI, NEC, NEMA, and UL requirements, and approved by the Engineer, except where the Contract Documents allow or specify the use of other than new equipment.

Furnish and install marine type products manufactured of corrosion resistant materials.

Navigation Lights.

Location: The upstream and downstream sides of the channel margins shall be marked with 180 degree bridge mounted red channel margin marker lights. The lights shall be securely mounted on the bridge to show 90 degrees on either side of a line parallel to the axis of the channel so as to be visible from an approaching vessel.

The upstream and downstream sides of the center of the channel shall be marked with 360 degree bridge mounted green channel center marker lights. The lights shall be in line with the axis of the center of the channel so as to be visible from an approaching vessel.

Housing: The housing shall be suitable for a marine environment. Furnish unpainted housings of heavy duty cast aluminum or bronze construction with a 1 1/2 to 2 inch threaded conduit opening on the bottom. Construction shall be rain tight and fully gasketed. The light assembly shall be designed for heavy duty, long life service. The design shall provide ready access for lamp service.

Lens: Furnish and install fixtures with lenses that are standard marine molded, single-piece fresnel type, rigid, heat resistant glass or U.V. resistant polycarbonate and inside diameter of 7 to 8 inch. Furnish all stainless steel closure bolts, lens tie rods, and attachment hardware for a complete and accepted installation.

Lamps: Lamps shall be 120V AC, LED array with a minimum of 50,000 hour life and bright enough to meet the visibility requirements of CFR Title 33, Part 118. Mount LED arrays on an internal shock and vibration isolator. In the event of failure of one or more individual LEDs, the remaining LEDs shall continue to operate.

Swivel: Provide a cast aluminum or bronze swivel assembly and mounting bracket, complete with stainless steel pivot, watertight "O" ring seal, bronze bearings, cable entrance fitting, and stainless steel service chain rated for a minimum 225 pounds load. The swivel design shall provide for all wiring to be completely contained inside the light assembly. The dimension from the center of swivel to focal plane of lens shall allow for visibility of the luminaire below the bridge girder in accordance with Coast Guard requirements.

Stem: Use a 1 1/2 or 2 inch galvanized pipe or stainless steel pipe as a hanger stem. Furnish and install a 60% counterweight if stem exceeds 5 feet in length.

Latch: An automatic latch shall hold the luminaire securely in normal operations and service positions. A firm pull on the service chain shall automatically release the latch, allowing the fixture to pivot. As the luminaire is raised, the latch shall automatically engage to hold the light in the service position.

Mounting: The base shall be cast of the same material as the fixture head. The light assembly shall mounted via four ½ inch diameter bolts through the base and junction box.

Service Chain: A stainless steel, #24 sash type service chain shall be provided to facilitate raising and lowering the luminaire for service. The grab-loop on the chain shall be securely mounted to the bridge as shown on the plans so that it is easily accessible by maintenance personnel for service.

Junction Box: The assembly shall be equipped with a junction box and a gasketed access cover. The junction box shall be of the same material as the fixture assembly and shall match the navigation light base footprint. Orientation of the junction box shall be capable of rotation in 90 degree increments.

Conduit. Conduit shall be as specified elsewhere in these Contract Documents.

Barrier Junction Wells. 10"x8"x6" P.C.C. Barrier Junction Wells shall be as specified in Item 744529 – P.C.C. Barrier, Junction Well.

Wiring. Cable shall be as specified elsewhere in these Contract Documents.

Construction Methods:

Store navigational lights and appurtenances in a manner which will prevent damage until such time as they are actually installed. Immediately prior to installation, navigation lights and appurtenances shall be inspected for damage by the Engineer. All material which the Engineer determines is damaged or otherwise unusable shall be repaired by the Contractor or replaced in-kind by the Contractor. The Engineer shall make the final determination as to whether damaged material shall be repaired or replaced. Material which the Engineer has determined is not usable shall be removed from the work site by the contractor.

Installation. Install conduit and barrier junction wells in the bridge parapet walls and bridge deck as shown on the plans. Route conduit and wiring to the navigational lights as shown on the plans.

Navigation lights shall be installed in the manner indicated on the contract plans and per the manufacturer's recommendations. Location and color shall be in accordance with the U.S. Coast Guard requirement and the contract plans.

Testing. Testing of the navigation lighting system shall be in accordance with Item 746653 – Electrical Testing.

Method of Measurement:

The quantity of Navigation Lights for Fixed Bridges will be paid for will be lump sum.

Basis of Payment:

Price and payment will be full compensation for all work specified in this Section. Payment will be made under: "Navigation Lights for Fixed Bridges" - lump sum.

Conduit, cable and barrier junction wells will be paid under separate pay items as listed elsewhere in the Contract Documents.

08/30/2016

618534 - CONSTRUCTION VIBRATION MONITORING

Description:

The work to be performed under this section includes, but is not limited to, monitoring the existing structures or utilities for vibration during all construction operations that have the potential to produce vibrations at damaging levels or as directed by the Engineer. Locations to be monitored include, but are not limited to: all structures and utilities within 100-ft of any construction operations as described above.

Submittals:

1. Detail showing actual seismograph locations.

2. Description of the vibration monitoring equipment to be used.

Materials:

1. Equipment: The Contractor shall provide a minimum of one seismograph to measure and record ground motion caused by construction under the Contract.

   The seismograph shall be attached or located immediately adjacent to the nearest utility, or on top of the nearest pipeline, as approved by the Engineer. The seismograph equipment shall be an Everlet seismograph, GeoSonic 3000 LC seismograph, or equivalent, capable of producing a permanent record of the three components of ground motion in terms of particle velocity. The instrument shall be capable of internal dynamic calibration. The Contractor shall submit the latest manufactures calibration for the specific machine to be used in the field to the Engineer at least 30-days prior to the field work beginning. The manufactures calibration should be within the last 6-months. The record of each construction activity shall consist of the seismograph records identified by instrument number, location of the instrument positively identified, date, time and location of the construction activities, and all other data necessary for the proposed construction. These records, as a formal report, shall be made available to the Engineer as required.

Execution:

1. The Contractor shall make every effort to avoid damages to all structures and existing utilities in the area of the proposed construction. The Contractor is responsible for vibration damages to any structures and existing utilities.

2. Pre-Construction Survey

   a. Data must be obtained by the Contractor during the pre-construction survey to establish a base for determining effects of construction, excavating, and other construction activities on adjacent to underground utilities.

   b. All structural and cosmetic defects shall be thoroughly documented in writing, with annotated photographs and videos.

   c. At least 30 days prior to any excavation or drilled shaft installation, the general plan for the seismic monitoring during construction of the pre-construction survey shall be submitted to the Engineer for review and approval.

   d. Prior to starting, the Contractor shall retain the services of a qualified Professional Engineer licensed in the State of Delaware with experience in pre-construction condition surveys to make

a detailed inspection of all utilities within 100-ft of all construction or within a horizontal distance equal to twice the depth of any planned excavation.

e. The inspection report shall include notes, sketch measurements, photographs, video and a DVD (with audio sound track) of all utilities and structures prior to the start of construction. The audio description of the inspection shall include the date, time, weather conditions, address/stationing/location, brief description of the facility and description of physical conditions encountered. The inspection should also include documentation of existing damage and other factors (both inside and outside) which could be affected by construction activity. Photographs shall be 8" x 10" in size and in color. The report shall also recommend any adjustments to the PPV contained in this Special Provision.

f. The Contractor shall conduct a pre-condition survey for utilities as described in Paragraph E. This survey must include video of any storm drain or gravity sewer or any other utilities accessible to video camera. A survey must be completed under the supervision of a Delaware Registered Professional Surveyor or their representative to establish the elevations of all manholes, valves, pipe invert elevations or any other locations that provides direct access to the utility.

3. Seismic Monitoring

a. Seismic monitoring is required for all construction operations with a distance of 100-feet of existing structures that have the potential to produce vibrations at damaging levels or as directed by the Engineer. These operations include, but are not limited to, pile driving, jack hammering, excavation, compaction, and utility installation.

b. The Contractor shall submit the qualifications of the individual or subcontractor responsible for the seismic monitoring to the Engineer for approval. The individual or subcontractor responsible for the vibration monitoring shall also be present during the pre-construction survey of all structures within the influence area of the project.

c. Qualifications: The supervisor of the seismic monitoring work shall be either a professional geologist or professional engineer with a minimum of 5 years experience of similar scope, size, and complexity. The supervisor of the seismic work shall submit a resumes with a minimum of five projects of similar scope, size, and complexity for the Engineers review and approval at least 30 days prior to start of the work. The field technician for the seismic monitoring shall have experience with at least three projects of similar scope, size, and complexity in addition to having a BS in Engineering or Geology. The field technician's resumes shall be submitted for review and approval of the Engineer.

d. The Contractor shall monitor construction activities adjacent to freshly placed concrete utilizing one of the two seismic monitoring options listed below. Construction activities to be limited during this period include, but not limited to, drilled shaft installation and use of any type of construction equipment.

i. Option 1:
Where vibration monitoring around freshly poured concrete is performed the following Peak Particle Velocity (PPV) limits and distances shall be maintained:

Peak Particle Velocities for Concrete at Different Ages.

Age of concrete at which vibration occurs	**Permitted peak particle velocity, (in/sec)**
0-10 hrs	0.2
10-24 hrs	0.4
More than 24-hrs	2.0

Clear Distance between construction operations and freshly poured concrete at different ages.

Age of concrete	Clear Distance (ft)
0-2 days	50
2-14 days	20

The vibration shall be monitored continuously with a real time data acquisition system with an alarm system to notify the Contractor if vibration exceeds the limiting values.

ii. Option 2:
Where vibration is not monitored the following limits shall be maintained:

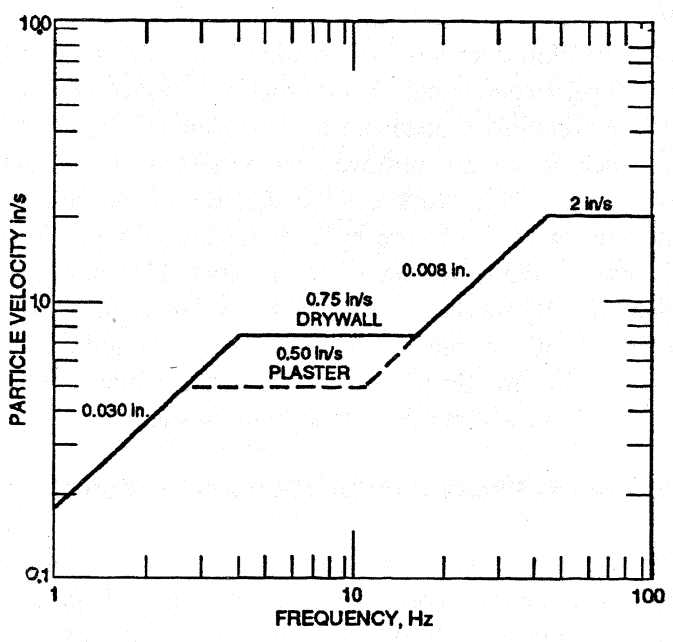
Clear distance between construction operations and freshly poured concrete at different ages

Age of concrete	Clear Distance (ft)
0-2 days	100
2-14 days	20

e. Peak particle velocity (PPV) at existing adjacent structures or utilities shall not exceed that shown in the OSM Method 3 Figure below. PPV allowed for bridge abutments shall be 2.0 in/sec at all frequencies. Peak particle velocity is defined as the vector sum of the three velocity components in three velocity components in three mutually perpendicular directions, measured at any point by an instrument approved by the Engineer. The criteria for drywall shall be used for all structures and utilities except those that actually are constructed of plaster and otherwise noted above. These limits may be adjusted by the Engineer based on any evidence of damage to structure.

All data submitted by the Contractor shall be presented in tabular and graphical form. The record for each instrument shall consist of the seismograph records identified by instrument number, location of the instrument positively identified, date and time.

All construction operations should be monitored in accordance with the Office of Surface Mining (OSM) Method 3 and the following figure.



Method of Measurement:

The vibration monitoring program including all material, labor, equipment, expendables, all readings, data reduction and reports, and necessary incidentals will not be measured and shall be paid for at the Contract lump sum price.

Basis of Payment:

The payment shall be full compensation for all materials, labor, equipment, expendables, all readings, data reduction and reports, and necessary incidentals to complete the Work in conformance with the Plans and specifications.

8/30/16

618562 - DRILLED SHAFT IN SOIL, 36"
618563 - DRILLED SHAFT IN SOIL, 48"
618564 - DRILLED SHAFT IN ROCK, 48"
618565 - DRILLED SHAFT IN SOIL, 72"
618566 - DRILLED SHAFT IN ROCK, 72"
618567 - LOAD TESTING OF DRILLED SHAFTS
618568 - CROSSHOLE SONIC LOGGING TESTING
618569 - PERMANENT CASING FOR DRILLED SHAFT, 72"
619511 - EXPLORATORY DRILLING

618.01 Description.

A. Furnish all materials, labor, tools, Equipment, services and incidentals necessary to construct the drilled shafts in accordance with the Contract Documents and this specification.

B. Site Information

A Final Foundation Report was prepared for the project. This report was prepared to help develop the substructure design only and is not considered part of the Contract Documents or a warranty of subsurface conditions. Data on subsurface conditions are not intended as representations or warranties of continuity of such conditions. The data are made available for the convenience of the Contractor, and it is expressly understood that the Department will not be responsible for interpretations or conclusions drawn there from by the Contractor.

618.02 Materials.

A. Provide Materials as specified in the following:

Reinforcing Steel	Section 824.02
Portland Cement Concrete, Class A or B	Section 812.02

B. Steel Casings

All permanent structural casing must be of steel conforming to ASTM A 36 or ASTM A 252 grade 2 unless specified otherwise in the Contract Documents. Splice permanent structural casing in accordance with Section 6.13.6 of the AASHTO LRFD Bridge Design Specifications, 2014 Edition.

The diameter of permanent casing will be as shown in the Contract Documents, unless a larger diameter casing is approved by the Engineer. When a larger size permanent casing is approved by the Engineer, no additional payment will be made for the increased weight of casing steel, or the increased quantity of drilled shaft excavation and concrete.

All permanent casing must be of ample strength to resist damage and deformation from transportation and handling, installation stresses, and all pressures and forces acting on the casing. For permanent nonstructural casing, corrugated casing may be used.

Where the minimum thickness of the casing is specified in the Contract Documents, it is specified to satisfy structural design requirements only. Increase the casing thickness from the minimum specified thickness, as necessary, to satisfy the construction installation requirements.

All temporary casing must be a smooth wall structure steel, except where corrugated metal pipe is shown in the Plans as an acceptable alternative material. All temporary casing must be of ample strength to resist damage and deformation from transportation and handling, installation and extraction stresses, and all pressures and forces acting on the casing. The casing must be capable of being removed without deforming and causing damage to the completed shaft, and without disturbing the surrounding soil.

The outside diameter of temporary casing may not be less than the specified diameter of the shaft.

All casing must be watertight and clean prior to concrete placement in the excavation.

Completely remove temporary casing, unless otherwise shown on the Plans or approved by the Engineer

C. Access Tubes for Crosshole Sonic Log Testing

Access tubes for crosshole sonic log testing must be steel pipe of 0.145 inches minimum wall thickness and at least 1-1/2 inch inside diameter. Galvanized steel access tubes are not allowed unless otherwise approved by the Engineer.

The access tubes must have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of 1.3 inch maximum diameter source and receiver probes used for the crosshole sonic log tests. The access tubes must be watertight, free from corrosion, and with clean internal and external faces to ensure good bond between the concrete and the access tubes. Fit the access tubes with watertight threaded caps on the bottom and the top.

D. Slurry

1. Mineral Slurry

Use mineral slurry in conformance with the Drilled Shaft Installation Plan as specified in Section 618.03.1.B. Mineral slurry must conform to the following requirements:

Table - 1 Mineral Slurry Requirements

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API RP 13B-1, Section 1	64.3* to 72*
Viscosity (seconds/quart)	Marsh Funnel and Cup API RP 13B-1, Section 2.2	28 to 50
pH	Glass Electrode, pH Meter (ASTM E70), or pH Paper	8 to 11
Sand Content (percent) immediately prior to placing concrete	API RP 13B-1, Section 5	4.0 max

* When approved by the Engineer, slurry may be used in salt water, and the allowable densities may be increased up to 2 pounds per cubic foot. Slurry temperature must be at least 40 degrees Fahrenheit when tested.

2. Polymer Slurry

Use polymer slurries, either natural or synthetic, in conformance with the manufacturer's recommendations, and conform to the Drilled Shaft Installation Plan as specified in Section 618.03.1.B.

The polymer slurry must conform to the following requirements:

Table - 2 Polymer Slurry Requirements

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API RP 13B-1, Section 1	64 * pcf max.
Viscosity (seconds/quart)	Marsh Funnel and Cup API RP 13B-1, Section 2.2	32 to 135
pH	Glass Electrode, pH Meter (ASTM E70), or pH Paper	8 to 11.5
Sand Content (percent) immediately prior to placing concrete	API RP 13B-1, Section 5	1.0 max**

* When approved by the Engineer, polymer slurry may be used in salt water, and the allowable densities may be increased up to 2 pounds per cubic foot.

** The sand content of polymer slurry prior to final cleaning and immediately prior to placing concrete must be less than or equal to 1.0 percent, in accordance with American Petroleum Institute API RP 13B-1, Section 5.

Slurry temperature must be at least 40 degrees Fahrenheit when tested.

3. Water Slurry

Water may be used as slurry when casing is used for the entire length of the drilled hole, provided that the method of drilled shaft installation maintains stability at the bottom of the shaft excavation.

Water slurry must conform to the following requirements:

Property	Test	Requirement
Density (pcf)	Mud Weight (Density) API RP 13B-1, Section 1	64 pcf max.
Sand Content (percent)	API RP 13B-1, Section 5	1.0 max

E. Grout for filling the access tube at the completion of the crosshole sonic log tests shall be a neat cement grout with a minimum water/cement ratio of 0.45.

618.03 Construction.

618.03.1 Submittals, **Approvals, and Meetings**. At the time of bid, submit the qualifications of the Contractor (i.e., the drilled shaft specialty contractor) to verify the successful completion by the Contractor of at least three separate foundation Projects within the last five years with drilled shafts of similar size (diameter and depth) and similar subsurface geotechnical conditions to those shown in the Contract Documents. Include a brief description of each Project and the owner's contact person's name and current phone number for each project listed.

A. Experience and Personnel. At least two weeks prior to the start of drilled shaft construction, submit a list identifying the on-site supervisors and drill rig operators assigned to the Project, to the Engineer for approval. In the list, include a detailed summary of each individual's experience in drilled shaft excavation operations, and placement of assembled reinforcing cages and concrete in drilled shafts.

1. On-site supervisors must have a minimum of two years' experience in supervising construction of drilled shaft foundations of similar size (diameter and depth) and difficulty to those shown in the Contract Documents, and similar geotechnical conditions to those described in the geotechnical report. The work experience must be direct supervisory responsibility for the on-site drilled shaft construction operations. Project management level positions indirectly supervising on-site drilled shaft construction operations are not acceptable for this experience requirement.
2. Drill rig operators must have a minimum one year experience in construction of drilled shaft foundations.

The Engineer will approve or reject the Contractor's qualifications and field personnel within ten Working Days after receipt of the submission. Do not start Work on any drilled shaft until the Contractor's qualifications and field personnel are approved by the Engineer. The Engineer may suspend the drilled shaft construction if the Contractor substitutes field personnel without prior approval by the Engineer. The Contractor is fully liable for the additional costs resulting from the suspension of Work, and no Adjustments in Contract Time resulting from such suspension of Work, will be allowed.

B. Drilled Shaft Installation Plan. At least four weeks prior to the start of drilled shaft construction, submit a Drilled Shaft Installation Plan narrative for acceptance by the Engineer. In preparing the narrative, reference the available subsurface geotechnical data provided in the Contract boring logs and any geotechnical report(s) prepared for this Project. In this narrative, provide at a minimum the following information:

1. Description of overall construction operation sequence and the sequence of drilled shaft construction when in groups or lines.

2. A list, description, and capacities of proposed Equipment, including, but not limited to, cranes, drills, augers, bailing buckets, final cleaning Equipment, and drilling unit. As appropriate, describe why the Equipment was selected, and describe Equipment suitability to the anticipated site and subsurface conditions. Include a Project history of the drilling Equipment demonstrating the successful use of the Equipment on shafts of equal or greater size in similar subsurface geotechnical conditions.

3. Details of drilled shaft excavation methods, including proposed drilling methods, methods for cleanout of the bottom of the excavation hole, and a disposal plan for excavated material, sediment laden water, and drilling slurry (if applicable). If appropriate, include a review of method suitability to the anticipated site and subsurface geotechnical conditions including boulders and obstruction removal techniques if such are indicated in the Contract subsurface geotechnical information or Contract Documents.

4. Details of the method(s) to be used to ensure drilled shaft hole stability (i.e., prevention of caving, bottom heave, etc. using temporary casing, slurry, or other means) during excavation and concrete placement. Include a review of method suitability to the anticipated site and subsurface geotechnical conditions.

5. Provide detailed procedures for mixing, using, maintaining, storing, and disposing of the slurry. Also provide a detailed mix design (including all additives and their specific purpose in the slurry mix) and a discussion of its suitability to the anticipated subsurface geotechnical conditions for the proposed slurry.

   In the submittal, include a detailed plan for quality control of the selected slurry, including tests to be performed, test methods to be used, and minimum and/or maximum property requirements that must be met to ensure that the slurry functions as intended, considering the anticipated subsurface conditions and shaft construction methods, in accordance with the slurry manufacturer's recommendations and these Specifications. As a minimum, include the following tests in the slurry quality control plan:

Property	Test Method
Density	Mud Weight (Density), API RP 13B-1, Section 1
Viscosity	Marsh Funnel and Cup, API RP 13B-1, Section 2.2
pH	Glass Electrode, pH Meter (ASTM E70), or pH Paper
Sand Content	Sand, API RP 13B-1, Section 5

6. Reinforcing steel Working Drawings, details of reinforcement placement including type and location of all splices, reinforcement cage support and centralization methods, type and location of all spacers, crosshole sonic logging tubes and other instrumentation, and procedures for lifting and setting the reinforcement cage.
7. When casings are proposed or required, provide the following:
   a. Casing dimensions and detailed procedures for permanent casing installation.
   b. Temporary casing installation and removal.
   c. Methods of advancing the casing, along with the means to be utilized for excavating the drilled shaft hole in accordance with Section 618.03.4. of this Specification.
8. When using temporary casing, details of the method to extract the temporary casing and maintaining shaft reinforcement in proper alignment and location, and maintaining the concrete slump to keep concrete workable during casing extraction.
9. Details of concrete placement, including proposed Equipment and procedures for delivering concrete to the drilled shaft, placement of the concrete into the shaft including initial placement and the raising of the tremie or pump line during placement, size of tremie and pump lines, operational procedures for pumping, and a sample uniform yield form to be used by the Contractor for plotting the volume of concrete placed versus the depth of shaft for all shaft concrete placement. Define time limits for concrete placement with references cited used in determination.
10. The method to be used to form a horizontal construction joint during concrete placement.
11. When applicable, include a description of the Material to be used to temporarily backfill a drilled shaft excavation hole during a stoppage of the excavation operation, as well as the method used to place and remove the Material.
12. Details of procedures to prevent loss of slurry or concrete into waterways, sewers and other areas to be protected.
13. Describe the method and materials that will be used to fill or eliminate all voids below the top of shaft between the plan shaft diameter and excavated shaft diameter, or between the shaft casing and surrounding soil, if permanent casing is specified.
14. Details of any required load tests including Equipment, instrumentation, procedures, calibration data for test Equipment, calculations, and Drawings.
15. Details and procedures for protecting existing Structures, utilities, roadways, and other facilities during drilled shaft installation.
16. Other information required by the Contract Documents or specified herein.

The Engineer will evaluate the Drilled Shaft Installation Plan for conformance with the Contract Documents within ten Working Days after receipt of the submission. At the option of the Department, a Shaft Installation Plan Submittal Meeting may be scheduled following review of the Contractor's initial submittal of the Plan. Those attending the Shaft Installation Plan Submittal Meeting, if held, must include the following:

a. The Superintendent, on-site supervisors, and other Contractor personnel involved in the preparation and execution of the Drilled Shaft Installation Plan.

b. The Project Engineer and Department's personnel involved with the structural, geotechnical, and construction review of the Drilled Shaft Installation Plan, together with Department's personnel who will provide inspection and oversight during the drilled shaft construction phase of Project.

Submit any significant updates or modifications to the Drilled Shaft Installation

Plan whenever such updates or modifications are proposed to the Engineer. The Engineer will evaluate the new information for conformance with the Contract Documents within ten Working Days after receipt of the submission.

C. Slurry Technical Assistance. If slurry is used to construct the drilled shafts, provide, or arrange for, technical assistance from the slurry manufacturer as specified in Section 618.03.4.D.1. of this Specification. Submit the following to the Engineer:

1. The name and current phone number of the slurry manufacturer's technical representative assigned to the Project.
2. The name(s) of the Contractor's personnel assigned to the project and trained by the slurry manufacturer's technical representative in the proper use of the slurry. In the submittal, include a signed training certification letter from the slurry manufacturer for each individual, including the date of the training.

D. Approvals. Do not begin Work until all the required submittals have been accepted in writing by the Engineer. All procedural acceptances given by the Engineer will be subject to trial in the field and will not relieve the Contractor of the responsibility to satisfactorily complete the Work.

E. Drilled Shaft Preconstruction Conference. Hold a drilled shaft preconstruction conference at least five Working Days prior to the Contractor beginning any shaft construction Work at the site to discuss investigative boring information, construction procedures, personnel, and Equipment to be used, and other elements of the accepted Shaft Installation Plan as specified in Section 618.03.1.B. of this Specification. If slurry is used to construct the shafts, the frequency of scheduled site visits to the project site by the slurry manufacturer's representative will be discussed. Those attending must include:

1. The Superintendent, on-site supervisors, and other key personnel identified by the Contractor as being in charge of excavating the shaft, placing the casing and slurry as applicable, placing the steel reinforcing bars, and placing the concrete. If slurry is used to construct the shafts, the slurry manufacturer's representative and a Contractor's employee trained in the use of the slurry, as identified to the Engineer in accordance with Section 618.03.4.D.1. of this Specification, must also attend.
2. The Project Engineer, key inspection personnel, and appropriate representatives of the Department.

If the Contractor's key personnel change, or if the Contractor proposes a significant revision of the approved Drilled Shaft Installation Plan, an additional conference may be held at the request of the Engineer before any additional shaft construction operations are performed.

F. Logs of Shaft Construction. Prepare inspection logs documenting each shaft construction activity, including casing installation, excavation, shaft bottom inspection, reinforcement installation and concrete placement. Fully document the work performed with frequent reference to the date, time and casing/excavation elevation in the logs. In addition, prepare and submit the logs documenting any subsurface investigation borings or rock core holes performed for the Contract at drilled shaft foundation locations.

In the records for temporary and permanent casings, include at least the following information:

1. Identification number and location of the shaft.
2. Diameter and wall thickness of the casing.
3. Dimensions of any casing reinforcement.
4. Top and bottom elevations of the casing.
5. Method and Equipment used for casing installation.
6. Any problems encountered during casing installation.
7. Name of the Inspector.

In the shaft excavation log, include at least the following information:

1. Identification number, location and surface elevation of the shaft.
2. Description and approximate top and bottom elevation of each soil or rock material encountered.
3. Seepage or groundwater conditions.
4. Type and dimensions of tools and Equipment used, and any changes to the tools and Equipment.
5. Type of drilling fluid used, if any, and the results of slurry tests.
6. Any problems encountered.
7. Elevation of any changes in the shaft diameter.
8. Method used for bottom cleaning.
9. Final bottom elevation of the shaft.
10. Name of the Inspector and the date, time and name of any changes in the Inspector.

In the concrete placement records, include at least the following information:

1. Concrete mix used.
2. Time of start and end of concrete placement.
3. Volume and start/end time for each truck load placed.
4. Concrete test results.
5. Concrete surface elevation and corresponding tremie tip elevation periodically during concrete placement.
6. Concrete yield curve (volume versus concrete elevation, actual and theoretical).
7. Name of the Inspector.

Submit the logs for each shaft construction activity to the Engineer within 24 hours of the completion of that activity. Submit a full set of shaft inspection logs for an individual drilled shaft to the Engineer within 48 hours of the completion of concrete placement at the shaft.

618.03.2 Drilled Shaft Excavation.

A. When designated in the contract documents, the Contractor shall perform excavation under shaft section in soil and shaft section in rock.

1. Shaft Section in Soil

Shaft section in soil is excavation accomplished with conventional rotary tools such as single or double flight augers fitted with either soil or rock teeth, drilling buckets and overreaming buckets attached to drilling equipment of the size, power, torque, and down thrust (crowd) approved for use by the Engineer.

2. Shaft Section in Rock

Shaft section in rock is excavation extending through rock which cannot be drilled with conventional earth augers and/or underreaming tools and requires the use of special rock augers, core barrels, air tools, and/or other methods of hand excavation. Rock is defined as geomaterial having an unconfined compressive strength equal to or greater than 250-psi.

B. Excavate the drilled shafts to the required depth as shown in the Contract Documents or as directed by the Engineer. Once the excavation operation has been started, conduct the excavation in a continuous operation until the excavation of the shaft is completed, except for pauses and stops as noted, using approved Equipment capable of excavating through the type of material expected. Provide temporary casing at the site in sufficient quantities to meet the needs of the anticipated construction method.

Pauses, defined as interruptions of the excavation operation, will be allowed only for casing splicing and removal of obstructions. Drilled shaft excavation operation interruptions not conforming to this definition are considered as stops.

If the drilled shaft excavation is not complete at the end of the shift or series of continuous shifts, the drilled shaft excavation operation may be stopped, provided the Contractor, before the end of the Work Day, protects the shaft as indicated in Section 618.03.3. of this Specification.

If slurry is present in the shaft excavation, conform to the requirements of Section 618.03.4.D.2. of this Specification regarding the maintenance of the minimum level of drilling slurry throughout the stoppage of the shaft excavation operation, and recondition the slurry to the required slurry properties in accordance with Section 618.02 of this Specification prior to recommencing shaft excavation operations.

Ensure the excavation and drilling Equipment have adequate capacity, including power, torque and down thrust to excavate a hole of both the maximum diameter and to a depth of 20 feet, or 20 percent, beyond the maximum shaft length shown in the Contract Documents, whichever is greater.

Blasting will only be permitted if specifically stated in the Contract Documents or authorized in writing by the Engineer.

Perform sidewall overreaming when the time for shaft excavation exceeds 36 hours or as directed by the Engineer (measured from the beginning of excavation below the casing when casing is used) before the start of concrete placement. Also perform sidewall overreaming when the sidewall of the hole is determined by the Engineer to have softened due to the excavation methods, swelled due to delays in the start of concrete placement, or degraded because of slurry cake buildup. Overreaming thickness must be a minimum of 1/2 inch and a maximum of 3 inches. Overreaming may be accomplished with a grooving tool, overreaming bucket, or other Equipment approved by the Engineer. If overreaming is required as a result of the excavation time exceeding the time limit specified herein, or as a result of excavation methods not in compliance with the approved Drilled

Shaft Installation Plan, the Contractor will solely bear the costs associated with both sidewall overreaming and additional drilled shaft concrete related to overreaming.

Complete excavation to the foundation cap elevation before drilled shaft construction begins, unless otherwise noted in the Contract Documents or approved by the Engineer. Any disturbance to the foundation cap area caused by shaft installation will be repaired by the Contractor prior to placing the cap concrete.

When drilled shafts are to be installed in conjunction with Embankment construction, construct drilled shafts after placement of the Embankment fill unless otherwise shown in the Contract Documents or approved by the Engineer. Do not cap the drilled shafts installed prior to the completion of the Embankment fill until the fill has been placed to the bottom of cap level.

618.03.3 Drilled Shaft Excavation Protection. Do not leave drilled shaft excavations open overnight unless cased full depth or otherwise protected against sidewall instability. An open excavation is defined as a drilled shaft that has not been filled with concrete, or temporarily backfilled with a Material approved by the Engineer in accordance with Section 618.03.1.B of this Specification or protected in accordance with Section 618.03.4. The use of slurry to protect a drilled shaft during a drilling stoppage or overnight shutdown may be approved by the Engineer.

Casing of drilled shafts in stable rock formations during stoppages is not required, unless shown in the Contract Documents or specified herein.

618.03.4 Drilled Shaft Excavation Protection Methods. The Contractor bears full responsibility for selection and execution of the method(s) of stabilizing and maintaining the drilled shaft excavation. Protect the walls and bottom of the drilled shaft excavation so that side wall caving and bottom heave is prevented from occurring, and so that the soil adjacent to the drilled shaft is not disturbed. The Contractor may excavate the drilled shaft without excavation protection provided the Contractor can demonstrate that the soil/rock is stable and above the water table and zones of seepage. Acceptable protection methods include the use of casing, drilling slurry, or both.

A. *Temporary Casing Construction Method*. In stable soils, conduct casing installation and removal operations and drilled shaft excavation operations such that the adjacent soil outside the casing and drilled shaft excavation for the full height of the drilled shaft is not disturbed. Disturbed soil is defined as soil whose geotechnical properties have been changed from those of the original in-situ soil, and whose altered condition adversely affects the performance of the drilled shaft foundation.

If utilizing casing that is adequately sealed into competent soils such that water cannot enter the excavation, the Contractor may, with the Engineer's approval, continue excavation in soils below the water table provided the water level within the casing does not rise or exhibit flow.

As the temporary casing is withdrawn, a sufficient head of fluid concrete must be maintained to ensure that water or slurry outside the temporary casing will not breach the column of freshly placed concrete.

Extract the casing at a slow, uniform rate with the pull in line with the shaft axis. Avoid excessive rotation of the casing to limit deformation of the reinforcing steel cage.

Remove all temporary casings from the excavation as concrete placement is completed, unless permission has been received from the Engineer to leave specified temporary casings in place.

B. *Permanent Casing Construction Method.* When permanent casing is specified, excavation will conform to the specified outside diameter of the drilled shaft. After the casing has been filled with concrete, fill all void space occurring between the casing and drilled shaft excavation with a Material that approximates the geotechnical properties of the in-situ soils, in accordance with the Drilled Shaft Installation Plan specified in Section 618.03.1.B of this Specification, and as approved by the Engineer.

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 is specified. Strip the removable casing from the shaft in a manner that will not damage the concrete. Casings can be removed when the concrete has attained sufficient strength provided:

1. Curing of the concrete is continued for a 72-hour period.
2. The shaft concrete is not exposed to salt water or moving water for 7 Days.
3. The concrete reaches a compressive strength of at least 2500 pounds per square inch, as determined from concrete cylinder breaks.

Use of removable casing is permitted only if specified in the Contract Documents or approved by the Engineer. Use removable casing in accordance with the Equipment and procedures shown in the approved Drilled Shaft Installation Plan, and comply with all other requirements specified herein.

C. *Alternative Casing Methods*. When approved by the Engineer, installation of casing using rotating, oscillating, or vibrating methods will be permitted. Use this alternative casing method in accordance with the Equipment and procedures shown in the approved Drilled Shaft Installation Plan, and comply with all other requirements specified herein.

Equip drilled shaft casing with cutting teeth or a cutting shoe and install by rotating, oscillating, or vibrating the casing.

D. *Slurry.* Use slurry in accordance with Section 618.02 of this Specification to maintain a stable excavation during excavation and concrete placement operations once water begins to enter the drilled shaft excavation and remains present.

Use slurry to maintain stability during drilled shaft excavation and concrete placement operations in the event that water begins to enter the drilled shaft excavation at a rate of greater than twelve inches per hour, or if the Contactor is not able to restrict the amount of water in the drilled shaft to less than three inches prior to concrete placement, or to equilibrate water pressure on the sides and base of the drilled shaft excavation when groundwater is encountered or anticipated based on the available subsurface data.

1. *Slurry Technical Assistance.* If slurry is used, the manufacturer's representative, as identified to the Engineer in accordance with Section 618.03.1.C. of this Specification, must:
   a. Provide technical assistance for the use of the slurry.
   b. Be present at the site prior to introduction of the slurry into a drilled hole.
   c. Remain at the site during the construction and completion of a minimum of one drilled shaft to adjust the slurry mix to the specific site conditions.

After the manufacturer's representative is no longer present at the site, the Contractor's employee trained in the use of the slurry, as identified to the Engineer in accordance with

Section 618.03.1.C. of this Specification, must be present at the site throughout the remainder of shaft slurry operations for this project to perform the duties specified above.

2. *Minimum Level of Slurry in the Excavation.* When slurry is used to maintain a stable excavation, maintain the slurry level in the excavation to obtain hydrostatic equilibrium throughout the construction operation at a height required to provide and maintain a stable hole, but not less than 5 feet above the water table or surface of surrounding water body if at an offshore location.

   Provide casing, or other means, as necessary to meet these requirements.

   Maintain the slurry level above all unstable zones a sufficient distance to prevent bottom heave, caving, or sloughing of those zones.

   Throughout all stops in drilled shaft excavation operations, monitor and maintain the slurry level in the excavation the greater of the following elevations:

   a. No lower than the water level elevation outside the drilled shaft.
   b. Elevation as required to provide and maintain a stable hole.

3. Cleaning Slurry. Clean, re-circulate, de-sand, or replace the slurry, as needed, in order to maintain the required slurry properties. Sand content will only be required to be within specified limits immediately prior to concrete placement.

618.03.5 Obstructions. When obstructions are encountered, notify the Engineer promptly. An obstruction is defined as a specific object (including, but not limited to, boulders, logs, and man-made objects) encountered during the drilled shaft excavation operation that prevents or hinders the advance of the drilled shaft excavation. When efforts to advance past the obstruction to the design drilled shaft tip elevation result in the rate of advance of the drilled shaft drilling Equipment being significantly reduced relative to the rate of advance for the portion of the drilled shaft excavation in the geological unit that contains the obstruction, then remove, bypass or break up the obstruction under force account. Blasting will not be permitted unless approved in writing by the Engineer.

Drilling tools that are lost in the excavation will not be considered obstructions, and will be promptly removed by the Contractor. All costs due to lost tool removal will be borne solely by the Contractor including, but not limited to, costs associated with the repair of hole degradation due to removal operations or an excessive time that the hole remains open.

618.03.6 Protection of Existing Structures. Control operations to prevent damage to existing Structures, utilities, roadways, and other facilities. Include preventive measures, which include, but are not limited to, selecting construction methods and procedures that will prevent excessive caving of the drilled shaft excavation and monitoring and controlling the vibrations from the driving of casing or sheeting, drilling of the shaft, or from blasting, if permitted by the Engineer.

618.03.7 Slurry Sampling and Testing. Mix and thoroughly hydrate mineral slurry and polymer slurry in slurry tanks, lined ponds, or storage areas. Draw sample sets from the slurry storage facility and test the samples for conformance with the appropriate specified Material properties before beginning slurry placement in the drilled hole. Ensure that the slurry conforms to the quality control plan included in the Drilled Shaft Installation Plan in accordance with Section 618.03.1.B. of this Specification and as approved by the Engineer. A sample set must be composed of samples taken at mid-height and within two feet of the bottom of the storage area.

Sample and test all slurry in the presence of the Engineer, unless otherwise approved by the Engineer. Record the date, time, names of the persons sampling and testing the slurry, and the results of the tests. Submit a copy of the recorded slurry test results to the Engineer at the completion of each drilled shaft, and during construction of each drilled shaft when requested by the Engineer.

Take and test sample sets of all slurry, composed of samples taken at mid-height and within two feet of the bottom of the drilled shaft, during drilling as necessary to verify the control of the properties of the slurry. As a minimum, take and test the sample sets of polymer slurry at least once every four hours after beginning its use during each shift.

Take and test sample sets of all slurry, as specified, immediately prior to placing concrete.

Demonstrate to the satisfaction of the Engineer that stable conditions are being maintained. If the Engineer determines that stable conditions are not being maintained, immediately take action to stabilize the shaft. Submit a revised Drilled Shaft Installation Plan that addresses the problem and prevents future instability. Do not continue with drilled shaft construction until the damage that has already occurred is repaired in accordance with the Specifications, and until receiving the Engineer's approval of the revised Drilled Shaft Installation Plan.

618.03.8 Drilled Shaft Excavation Inspection. Use appropriate means, such as a cleanout bucket, air lift, or hydraulic pump, to clean the bottom of the excavation of all drilled shafts. The base of the drilled shaft excavation cannot be covered with more than three inches of sediment or loose or disturbed material just prior to placing concrete in soil shafts or more than one-half inch for 50 percent of the shaft area in rock sockets.

The excavated drilled shaft will be inspected and approved by the Engineer prior to proceeding with construction. Sound the bottom of the excavated drilled shaft with an airlift pipe, a tape with a heavy weight attached to the end of the tape, a borehole camera with visual sediment depth measurement gauge, or other means acceptable to the Engineer, to determine that the drilled shaft bottom meets the requirements in the Contract Documents.

618.03.9 Assembly and Placement of Reinforcing Steel. Prior to and during fabrication of the steel reinforcing cage, support the reinforcing bars off the ground surface, and protect the reinforcing bars from contamination with mud and other deleterious materials.

Rigidly brace the reinforcing cage to retain its configuration during handling and construction. Individual or loose bars will not be permitted. Tie all (100 percent) intersections of vertical and horizontal bars.

Show bracing and any extra reinforcing steel required for fabrication of the cage on the Working Drawings.

Carefully position and securely fasten the reinforcement to provide the minimum clearances specified or shown in the Contract Documents, and to ensure that no displacement of the reinforcing steel cage occurs during placement of the concrete.

Splicing of the reinforcement cage during placement of the cage in the shaft excavation will not be permitted unless otherwise shown in the Contract Documents or approved by the Engineer.

Bundle vertical bars when necessary to maximize clear space between vertical reinforcement bars. Use rolled hoops or bundled spirals when necessary to maximize clear space between horizontal reinforcement.

If the reinforcing cage is spliced during placement of the cage into the drilled shaft excavation, the splice details and location of the splices must be in accordance with the Contract Documents and the approved Drilled Shaft Installation Plan. In addition, perform the Work within the time limits specified in Section 618.03.2.

Securely hold the steel reinforcing cage in position throughout the concrete placement operation. Tie and support the reinforcing steel in the drilled shaft so that the location of the reinforcing steel will remain within allowable tolerance. Use concrete spacers or other approved non-corrosive spacing devices at sufficient intervals (near the bottom, the top and at intervals not exceeding 10 feet vertically) to ensure concentric spacing for the entire cage length. The number of spacers required at each level will be one spacer for each foot of excavation diameter, with a minimum of four spacers at each level. The spacers must be of adequate dimension to ensure an annular space between the outside of the reinforcing cage and the side of the excavation along the entire length of the drilled shaft as shown in the Contract Documents. Provide acceptable feet made of plastic, or concrete (bottom supports) to ensure that the bottom of the cage is maintained at the proper distance above the base of the excavation unless the cage is suspended from a fixed base during the concrete pour.

Remove bracing steel that constricts the interior of the reinforcing cage after lifting the cage if freefall concrete or wet tremie methods of concrete placement are to be used.

Check the elevation of the top of the steel cage before and after the concrete is placed. If the upward displacement of the rebar cage exceeds 2 inches, or if the downward displacement exceeds 6 inches, the drilled shaft will be considered defective. Make corrections to the satisfaction of the Engineer. Do not construct additional drilled shafts until the rebar cage support has been modified in a manner satisfactory to the Engineer.

618.03.10 Concrete Placement, Curing and Protection. Commence the concrete placement as soon as possible after completion of drilled shaft excavation by the Contractor and inspection by the Engineer. Continue the concrete placement in one operation to the top of the drilled shaft, or as shown in the Contract Documents.

If water is not present (a dry shaft), deposit the concrete through the center of the reinforcement cage by a method that prevents segregation of aggregates. Place the concrete such that the free-fall is vertical down the center of the drilled shaft without hitting the sides, the steel reinforcing bars, or the steel reinforcing bar cage bracing. Concrete may be placed in dry shafts less than 5 feet in diameter by allowing the concrete to free fall up to 60 feet into the excavation, and the free fall distance may be increased to 100 feet in dry shafts at least 5 feet in diameter. Drop chutes shall be used to direct concrete to the base during free fall placement.

If water exists in amounts greater than three inches in depth or enters at a rate of more than twelve inches per hour, then fill the drilled shaft excavation with slurry to at least the level specified in Section 618.03.4.D.2. and with concrete placed by tremie methods.

Do not exceed the time limit for concrete placement as defined in the approved Drilled Shaft Installation Plan. Commence the concrete placement time at the mixing of the concrete and extend through to the completion of placement of the concrete in the drilled shaft excavation, including removal of any temporary casing. For wet placement methods, the placement time starts at the batching of the initial load of concrete to be placed in the shaft. At least two weeks prior to concrete placement, the Contractor shall provide test results of both a trial mix and a slump loss test conducted by an approved independent testing laboratory using approved methods to demonstrate that the concrete meets this defined placement time limit. Maintain the concrete mix with a slump of 4 inches or greater over the defined placement time limit as demonstrated by trial mix and slump loss tests. Conduct the trial mix and slump loss tests at ambient temperatures appropriate for site conditions. Ambient air temperature at the time of concrete placement is not permitted to be greater than the ambient temperature at the time of the concrete trial tests and slump loss tests.

Do not use admixtures such as water reducers, plasticizers, and retarders in the concrete mix unless permitted in the Contract Documents and detailed in the approved Drilled Shaft Installation Plan. Adjust all admixtures, when approved for use, for the conditions encountered on the job so the concrete remains in a workable plastic state throughout placement.

Throughout the underwater concrete placement operation, the discharge end of the tube must remain immersed in the concrete and the tube must always contain enough concrete to prevent water from entering. The concrete placement must be continuous until the work is completed, resulting in a seamless, uniform shaft. If the concrete placement operation is interrupted, the Engineer may require the Contractor to prove by core drilling or other tests that the drilled shaft contains no voids or horizontal joints. If testing reveals voids or joints, repair them or replace the drilled shaft at no expense to the Department. Responsibility for coring and testing costs, and calculation of time extension, will be in accordance with Section 618.03.13. of this Specification.

Before placing any fresh concrete against concrete deposited in water or slurry (construction joint), remove all scum, laitance, loose gravel and sediment on the surface of the concrete deposited in water or slurry, and chip off any high spots on the surface of the existing concrete that would prevent any steel reinforcing bar cage from being placed in the position required by the Contract Documents.

Complete a concrete yield plot for each wet shaft poured by tremie methods. Submit yield plot to the Department within twenty four (24) hours of completion of the concrete pour.

Do not perform casing installation or drilled shaft excavation operations within a clear distance of three diameters of a newly poured drilled shaft within twenty (24) hours of the placement of concrete and only when the concrete has reached a minimum compressive strength of 1800 pounds per square inch.

618.03.11 Tremies. When placing concrete underwater, use a concrete pump or gravity tremie. A tremie must have a hopper at the top that empties into a watertight tube at least eight inches in diameter. If a pump is used, a watertight tube must be used with a minimum diameter of four inches. The discharge end of the tube on the tremie or concrete pump line must include a device to seal out water while the tube is first filled with concrete. In lieu of a seal at the discharge end of the pipe, the Contractor may opt to place a "Pig" or "Rabbit" in the hopper prior to concrete placement which moves through the tremie when pushed by the concrete, forcing water or slurry from the tremie pipe. Do not use hopper and tubes that contain aluminum parts that will have contact with the concrete. The inside and outside surfaces of the tubes must be clean and smooth to allow both flow of concrete and the unimpeded withdrawal of the tube during concrete placement.

618.03.12 Drilled Shaft Construction Tolerances. Construct the drilled shafts so that the center of the poured shaft at the top of the drilled shaft or mudline, whichever is lower, is within the following horizontal tolerances:

Drilled Shaft Diameter	Tolerance
Greater than 24 inches and less than 60 inches	4 inches
60 inches or larger	6 inches

Drilled shafts in soil must be within 1.5 percent of plumb. Drilled shafts in rock must be within 2.0 percent of plumb. Plumbness will be measured from the top of poured drilled shaft elevation or mudline, whichever is lower.

During drilling or excavation of the drilled shaft, make frequent checks on the plumbness, alignment, and dimensions of the drilled shaft. Submit procedure for correction of any deviations exceeding the allowable tolerances, for approval. Correct any deviations in accordance with the approved procedure.

Do not allow the drilled shaft steel reinforcing bars to be higher than six inches above or three inches below the elevation shown in the Contract Documents.

The reinforcing cage must be concentric with the drilled shaft excavation within a tolerance of 1-1/2 inches.

The top elevation of the completed drilled shaft shall be within a tolerance of plus one inch or minus three inches.

Do not allow the diameter of the drilled shaft to be less than the diameter shown in the Contract Documents.

Ensure that tolerances for casings are in accordance with American Petroleum Institute (API) tolerances applicable to regular steel pipe.

Drilled shaft excavations and completed drilled shafts not constructed within the required tolerances will be considered defective. The Contractor is responsible for correcting all defective drilled shafts to the satisfaction of the Engineer. Submit redesign drawings and computations, signed by a registered Professional Engineer licensed in the State of Delaware. Materials and Work necessary, including engineering analysis and redesign, to complete corrections for out-of-tolerance drilled shafts will be furnished without cost to the Department and without an extension of the Completion date of the Project.

618.03.13 Integrity Testing. Crosshole sonic log (CSL) testing must be performed on all drilled shafts in accordance with ASTM D6760. Accommodate the crosshole sonic log testing by furnishing and installing access tubes.

Install access tubes for crosshole sonic log testing in all drilled shafts, except as otherwise noted herein, to permit access for the crosshole sonic log test probes. If, in the opinion of the Engineer, the condition of the drilled shaft excavation permits drilled shaft construction in the dry, the Engineer may specify that the testing be omitted.

Securely attach the access tubes to the interior of the reinforcement cage of the drilled shaft. Furnish and install one access tube for each foot of drilled shaft diameter, rounded to the nearest whole number, unless otherwise shown in the Contract Documents. A minimum of three tubes will be required. Place the access tubes around the drilled shaft, inside the spiral or hoop reinforcement and three inches clear of the vertical reinforcement, at a uniform spacing measured along the circle passing through the centers of the access tubes. If these minimums cannot be met due to close spacing of the vertical reinforcement, then bundle the access tubes with the vertical reinforcement.

If trimming the cage is required and access tubes for crosshole sonic log testing are attached to the cage, either shift the access tubes up the cage, or cut the access tubes provided that the cut tube ends are adapted to receive the watertight cap as specified.

Install the access tubes in straight alignment and as near to parallel to the vertical axis of the reinforcement cage as possible. Extend the access tubes from the bottom of the drilled shaft to at least two feet above the top of the drilled shaft. Splice joints in the access tubes, if required to achieve full-length access tubes, must be watertight. Clear the access tubes of all debris and extraneous materials before installing the access tubes. Care must be taken to prevent damaging the access tubes during reinforcement cage installation and concrete placement operations in the drilled shaft excavation.

Fill the access tubes with potable water before concrete placement, and reinstall the top watertight, threaded caps.

Prior to performing any crosshole sonic log testing operations specified in this subsection, remove the concrete at the top of the drilled shaft down to sound concrete.

The Contractor will perform crosshole sonic log testing and analysis on all completed drilled shafts designated for testing by the Engineer. The Department will require advance notice from the Contractor to schedule all crosshole sonic log testing. Provide at least forty eight (48) hours' notice to the Engineer of the time the concrete in each drilled shaft is to be sufficiently cured to allow for crosshole sonic log testing.

Perform the testing after the drilled shaft concrete has cured at least ninety six (96) hours. Additional curing time prior to testing may be required if the drilled shaft concrete contains admixtures, such as a set retarding admixture or a water-reducing admixture. The additional curing time prior to testing required under these circumstances will not serve as grounds for additional compensation or extension of time to the Contractor. Do not perform any subsequent construction on the completed drilled shaft until the CSL tests are approved and the drilled shaft is accepted by the Engineer.

After placing the drilled shaft concrete and before beginning the crosshole sonic log testing of a drilled shaft, inspect the access tubes. Replace each access tube that the test probe cannot pass through, at no cost to the Department, with a two inch diameter hole cored through the concrete for the entire length of the drilled shaft. Unless directed otherwise by the Engineer, locate the cored holes approximately six inches inside the reinforcement and do not damage the drilled shaft reinforcement. Log descriptions of inclusions and voids in cored holes and submit a copy of the log to the Engineer. Findings from cored holes must be preserved, identified as to location, and made available for inspection by the Engineer.

The Engineer will determine final acceptance of each drilled shaft, based on the crosshole sonic log test results and analysis for the tested shafts and a review of the visual inspection reports for the subject drilled shaft, and will provide a response to the Contractor within three Working Days after receiving the test results and analysis submittal.

The Engineer may approve continuing with drilled shaft construction prior to approval and acceptance of the first shaft if the Engineer's observations of the construction of the first shaft are satisfactory, including, but not limited to, conformance to the Drilled Shaft Installation Plan as approved by the Engineer, and the Engineer's review of Contractor's daily reports and Inspector's daily logs concerning excavation, steel reinforcing bar placement, and concrete placement.

If the Engineer determines that the concrete placed under slurry for a given drilled shaft is structurally inadequate, that drilled shaft will be rejected. The placement of concrete under slurry will be suspended until the Contractor submits to the Engineer written changes to the methods of drilled shaft construction needed to prevent future structurally inadequate drilled shafts, and receives the Engineer's written approval of the submittal.

If the Engineer determines that additional investigation is necessary, or if the Contractor requests, the Engineer may direct that additional testing be performed at a drilled shaft. At the Engineer's request, drill a corehole in any questionable quality drilled shaft (as determined from crosshole sonic log testing and analysis or by

observation of the Engineer) to explore the drilled shaft condition. The number, locations, diameter and depth of the core holes and lengths of individual core runs will be determined by the Engineer. Coring procedures must minimize abrasion and erosion of the core samples, and must avoid damage to the steel reinforcement. Log descriptions of inclusions and voids in cored holes and submit a copy of the log to the Engineer. Preserve the recovered core in suitably labeled wood core boxes, identified as to location and depth, and make available for inspection by the Engineer. The Engineer may direct water-pressure testing in the core holes, and/or unconfined compression testing and other laboratory testing on selected samples from the concrete core.

If subsequent testing at a drilled shaft indicates the presence of a defect(s) in the drilled shaft, the testing costs and the delay costs resulting from the additional testing will be borne solely by the Contractor. If this additional testing indicates that the drilled shaft has no defect, the testing costs and the delay costs resulting from the additional testing will be paid by the Department, and, if the drilled shaft construction is on the critical path of the Contractor's Schedule, a time extension equal to the delay created by the additional testing will be granted.

For all drilled shafts determined to be unacceptable, submit a plan for further investigation or remedial action to the Engineer for approval. All modifications to the dimensions of the drilled shafts, as shown in the Contract Documents, required by the investigation and remedial action plan, must be supported by calculations and Working Drawings. All investigation and remedial correction procedures and designs must be prepared by a registered Professional Engineer licensed in the State of Delaware, and submitted to the Engineer for approval. Do not begin repair operations until receiving the Engineer's written approval of the investigation and remedial action plan.

Prior to beginning coring, submit the method and Equipment to be used to drill and remove cores from drilled shaft concrete to the Engineer, and do not begin coring until the Engineer's written approval has been received. Recover the complete core and minimize abrasion and erosion of the core.

Dewater all access tubes and cored holes and fill with grout after tests are completed and the drilled shaft is accepted. Fill the access tubes and cored holes using grout tubes that extend to the bottom of the tube or hole or into the grout already placed. Alternative non-destructive tests such as Gamma-Gamma, Sonic Echo/Impulse Response (ASTM D5882), or Thermal Integrity Profiling (ASTM D7949) may be specified in the Contract Documents or directed by the Engineer to use alongside, or in lieu of, CSL testing. Comply with all requirements for the alternate test methods in accordance with the Contract Documents.

618.03.14 Drilled Shaft Load Tests. Install test shafts at the locations shown in the Contract Documents unless otherwise directed or approved by the Engineer.

Install test shafts to the same dimensions, details, and elevations shown in the Contract Documents, and install using the same Equipment and installation procedures proposed for installation of the foundation drilled shafts.

If the Equipment or procedures are changed following the completion of load testing, install additional load test shafts, and conduct additional load tests as directed by the Engineer at no additional cost to the Department.

Complete all load testing and have the results evaluated by the Engineer before installing any production drilled shafts, unless otherwise authorized by the Engineer.

A. *Static Load Tests.* Perform static load tests in accordance with the procedures specified in ASTM D 1143.

B. *Force Pulse (Rapid) Load Tests.* Perform force pulse (rapid) load tests in accordance with the procedures specified in ASTM D 7383.

C. *Bi-Directional Load Cell Testing.* Install load cells and load test instrumentation in accordance with the bi-directional load cell supplier recommendations, instructions, and procedure manual(s), as approved by the Engineer.

The bi-directional load cells must be capable of expanding to not less than 6 inches while maintaining the applied test load.

Coordinate with the load cell supplier to determine and/or verify all required Equipment, Materials, quantities, procedures, and all other applicable items necessary to complete the load testing shown in the Contract Documents.

Furnish an acceptable pressurized gas source, a hydraulic pump, hydraulic lines, calibrated hydraulic gauge and other Equipment and Material necessary to perform the load tests. Furnish fresh, potable water from an approved source to form the hydraulic fluid used to pressurize the bi-directional load cells.

Furnish, install, and monitor vibrating wire strain gauges as shown in the Contract Documents and as directed by the Engineer. Place the strain gauges in pairs on opposite sides of the reinforcing cage at the elevations shown in the Contract Documents, unless otherwise directed by the Engineer.

Attach two Linear Variable Differential Transformer (LVDT) vibrating wire displacement gauges to each load cell to monitor the expansion and contraction of the load cell. In addition, mount two LVDT gauges on an independent reference beam and set on opposite sides of the top of the test shaft to monitor axial shaft displacement.

Set two telltale rods on the top of each load cell to monitor the displacement of the top of the load cell. The telltale must consist of a 3/8 inch diameter stainless steel rod, greased for reducing friction and corrosion, and placed inside a constant 3/4-inch diameter pipe. Individual sections of telltales must be joint-coupled flush so that each rod is of uniform diameter throughout its length.

Furnish a portable computer and electronic logging Equipment to simultaneously monitor all instrumentation at time intervals designated by the Engineer.

Assemble the load cells, piping, and other attachments in preparation for installation in accordance with the requirements of the bi-directional load cell supplier, unless otherwise specified herein or directed by the Engineer. The following guidelines must be followed.

A. Weld steel top and bottom bearing plates to the load cells. Provide holes through the bearing plates, as appropriate, to facilitate placement of tremie concrete.
B. Coat the upper surface of the bottom steel bearing plate with grease prior to installation into the shaft, to prevent concrete bonding with the bottom plate.
C. Attach the load cells and plate assembly to the reinforcement cage. Securely fasten all hydraulic hoses, telltale casing, slip joints, etc. to the rebar cage. Prior to installation into the drilled shaft excavation, protect the top of any piping to keep dirt, concrete, or other deleterious materials from entering the piping.
D. Limit the deflection of the cage to a maximum of 2 feet between pick points while lifting the cage from the horizontal position to vertical. Provide additional support, bracing, strong backs, etc. to maintain the deflection within the specified tolerance.

For each load test, place the load on the drilled shaft in increments of five percent of the estimated maximum test load shown in the Contract Documents, or until the nominal resistance load (as indicated by the instruments) is approached, or to the maximum capacity of the load cell, whichever occurs first. Unless the maximum capacity of the load cell has been reached, apply increments of 2.5 percent of the estimated maximum test load until the limiting load is attained, or the drilled shaft top displacement reaches 2 inches, or to the maximum extension of the load cell. When the load cell will be used for a subsequent loading stage, the Engineer may interrupt the loading sequence at a load cell opening of approximately 3 inches, or less. Maintain each load increment for a minimum period of 5 minutes, with complete sets of readings obtained and recorded from all gauges and instruments at 1, 2 and 5 minutes after application of the load increment. Apply each increment of load within the minimum length of time practical and take the instrument system readings immediately. It is intended that the addition of a load increment and the completion of the instrument system readings be completed within 5 to 15 minutes. The Engineer may elect to hold the maximum applied load for up to one hour.

Remove the load in decrements of approximately 10 percent of the maximum test load. Remove each decrement of load within the minimum length of time practical and take the instrument system readings immediately. It is intended that the removal of a load decrement and the completion of the instrument system readings be completed within 5 to 15 minutes. The Engineer may also require a reloading cycle with ten loading increments and five unloading decrements. Record the final recovery of the drilled shaft for a period up to one hour after the last unload interval.

Submit a preliminary test report containing the load displacement curves and other test data to the Engineer within three Days of completing each load test. Submit the final report on the load tests to the Engineer within ten Days after completion of each load test. Include at least the following items in the test report:

A. Test shaft identification number and location.
B. Date(s) of testing.
C. Description of the test shaft details, instrumentation, and test procedures.
D. Tables presenting all instrumentation data.
E. Plots of load versus displacement (up and down) for each load cell level, for each stage of the test.
F. Plots of load along the length of the drilled shaft determined from the strain gauge data for at least ten applied load increments.
G. Summary of unit side resistance along the length of the drilled shaft and end bearing resistance.
H. Plots of creep displacement for each load increment.
I. Plot of equivalent top-of-shaft displacement for the test shaft, developed from the load test data.

After completion of the load test to the satisfaction of the Engineer, and when authorized in writing by the Engineer, flush all hydraulic fluid from the bi-directional load cells and hydraulic lines, and replace with cement grout in accordance with the approved Drilled Shaft Installation Plan. Grout any voids remaining outside the load cells after completion of the load test.

606.04 Method of Measurement.

A. The Engineer will measure Drilled Shafts in Soil by the length in linear feet from the plan top of shaft elevation to the final authorized and accepted bottom of shaft elevation and will be paid for at the contract unit price per linear foot of the diameter shown on the plans, exclusive of the linear feet of authorized Drilled Shaft in Rock. The Engineer will not separately measure excavation, temporary casing, blasting, slurry, reinforcing steel, concrete, grout, integrity testing tubes, or non-destructive testing.

B. Drilled shaft in rock will be measured in linear feet after an elevation is authorized for Drilled Shaft in Rock and will be paid for at the contract unit price per linear foot of the diameter shown on the plans. Earth seams rock fragments and voids in the excavation less than 3-ft in total length will be considered Drilled Shaft in Rock. If the material excavated is discontinuous, payment will revert to Drilled Shaft in Soil at the elevation where Drilled Shaft in Rock is no longer encountered or, if continuous; will continue to the bottom of the shaft elevation. The Engineer will not separately measure excavation, temporary casing, blasting, slurry, reinforcing steel, concrete, grout, integrity testing tubes, or non-destructive testing. Drilled Shaft in Rock will be deducted from Drilled Shaft in Soil elevations for measurement and payment. .

C. The Engineer will measure permanent casing by the length in linear feet of each size casing used, as 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.

D. The Engineer will measure load tests by the number of load tests completed according to the specified loading procedures and to the designated maximum load shown in the Contract Documents. The engineer will not separately measure the equipment and instrumentation required to complete the load tests.

E. The Engineer will measure exploratory drilling by the length in linear feet from the ground elevation where the drilling begins to the bottom of the exploration hole.

606.05 Basis of Payment.

A. The Engineer will pay for accepted quantities at the Contract Unit Price as follows:

ITEM	DESCRIPTION	UNIT
618562	DRILLED SHAFT IN SOIL, 36"	LF
618563	DRILLED SHAFT IN SOIL, 48"	LF
618564	DRILLED SHAFT IN ROCK, 48"	LF
618565	DRILLED SHAFT IN SOIL, 72"	LF
618566	DRILLED SHAFT IN ROCK, 72"	LF
618567	LOAD TESTING OF DRILLED SHAFTS	EACH
618568	CROSSHOLE SONIC LOGGING TESTING	EACH
618569	PERMANENT CASING FOR DRILLED SHAFT, 72"	LF
619511	EXPLORATORY DRILLING	LF

B. Such payment is full compensation for furnishing all Materials, Equipment, labor, and incidentals to complete the Work as specified.

C. Load Testing of Drilled Shafts. Payment also includes all costs related to the performance of the load test and for the reporting of procedures and results.

623543 - POST-TENSIONING

Description:

This work shall consist of fabricating, furnishing, storing, installing, stressing, and grouting post-tensioning system, including and/or replacement of damaged components (if necessary), in accordance with the Contract Documents, these Special Provisions, and the AASHTO LRFD Bridge Construction Specifications, 3rd edition including all interims.

This includes, but is not limited to preparation of working drawings, testing of post-tensioning material and appurtenances, furnishing and installing ducts, local zone reinforcement, post-tensioning steel and appurtenances, clearing of all ducts prior to grouting, air pressure testing of all ducts prior to grouting, stressing and grouting strand or bar tendons, site visits by grout manufacturer representative, inspection of grouting and reporting on tendon stressing and grouting operations, install and protection at end anchorages.

Furnish all components of a post-tensioning system from a single supplier. Prestressing steel and local zone reinforcing can be obtained from any supplier.

Materials:

a) **Post-Tensioning Strands.** Unless otherwise noted on the plans, strand shall be low relaxation, Grade 270, uncoated seven-wire strand conforming to the requirements of AASHTO M 203 (ASTM A 416).

b) **Bars.** Unless otherwise noted on the plans, uncoated Grade 150, high strength coarse thread bar meeting the requirements of ASTM A 722, Type II.

c) **Ducts.** Ducts shall be high corrugated polypropylene conforming to the requirements of ASTM D 4101 with a cell classification range of PP0340B14541 to PP0340B67884. Resin shall contain antioxidants with a minimum Oxidation Induction Time (OIT) according to ASTM D 3895 of not less than 20 minutes.

The duct material shall not react with concrete or enhance corrosion of the post-tensioning tendons and shall be free of water soluble chloride. The corrugated duct shall be either corrugated with a spiral having a pitch not less than 1/10 of the radius of the duct or concentrically corrugated. Material thickness shall be such that wearing through the wall by the strand during stressing is avoided. Corrugated duct shall be designed so that a force equal to 40 percent of the ultimate tensile strength of the tendon will be transferred through the duct into the surrounding concrete in a length not exceeding 45 duct diameters. Twelve static pull out tests shall be conducted to determine compliance of a duct with a force transfer requirement. If ten of these tests exceed the specified force transfer, the duct is acceptable. The Contractor shall provide to the Engineer certified test reports verifying that the duct meets specification requirements in regard to force transfer for review and approval.

The minimum radius for corrugated duct shall be 30 feet. Duct curvature with radii less than 30 feet may be approved by the Engineer based on review of test data

The confinement reinforcement for curved ducts shall be proportioned in accordance with Section 5.10.4.3 of the 2012 AASHTO LRFD Bridge Design Specifications, including interim revisions.

All duct material shall be sufficiently rigid to withstand loads imposed during placing of concrete and internal pressure during grouting while maintaining its shape, remaining in proper alignment and remaining watertight.

Duct installed and cast into concrete prior to post-tensioning tendon installation, must be capable to withstand at least 10 feet of concrete fluid pressure. Also, such duct shall not dent more than 1/8-inch under 100 lbs. concentrated forces applied between corrugations. The concentrated force shall be applied by a No. 4 reinforcing bar.

Duct for use with preinstalled post-tensioning strands, prior to concreting, shall be capable of withstanding the equivalent of 5 feet of concrete fluid pressure. Resistance to denting is not applicable.

Duct shall have adequate longitudinal bending stiffness for smooth, wobble free placement:

(1) Duct shall, under its own weight, not deflect more than 3 inches, when a 20-foot duct segment is supported at its ends.

(2) Where duct must be bent in a tight radius, more flexible duct is permitted.

(d) **Duct Fittings.** Couplings and reducers for duct connections to anchorages shall provide a non-corrosive, impermeable layer between the concrete and the grout, and shall be watertight and of sufficient strength to prevent distortion or displacement of the ducts during concrete placement. Details of duct fittings including means of waterproofing shall be submitted to the Engineer for approval.

(e) **Couplers.** Strand couplers are not permitted.

(f) **Anchorages.** All post-tensioning steel shall be secured at the ends by means of permanent type anchoring devices meeting the approval of the Engineer. Post-tension anchorages other than special anchorage devices shall be epoxy coated and be designed to develop at least 96 percent of the actual ultimate strength of the post-tensioning steel. Testing of anchorage devices shall be performed using samples representing the type of post-tensioning tendon and concrete strength to be used on the project. The test specimen shall be assembled in an unbonded state and, in testing; the anticipated anchor set shall not be exceeded. Certified copies of test results for the anchorage system shall be supplied to the Engineer. The anchorage system shall be so arranged that the post-tensioning force in the tendon may be verified prior to the removal of the stressing equipment.

Post-tension anchorage devices shall effectively distribute post-tensioning loads to the concrete and shall conform to the requirements of Section 5.10.9 of the 2012 AASHTO LRFD Bridge Design Specifications, including interim revisions. All tendon anchorage devices shall be tested by an independent testing laboratory acceptable to the Engineer in accordance with Section 10.3.2.3 of the AASHTO LRFD Bridge Construction Specifications 3rd Edition, including all interims. Acceptance criteria specified in Section 10.3.2.3.10 shall be as stated for moderately aggressive environments.

(g) **Grout.** Grout to fill the voids between post-tensioning steel and their conduits shall conform to this Specification. The ingredients intended for use in bonded, post-tensioning work can include Portland cement, mineral additives, admixtures, aggregates, and water. Grout shall be prebagged in plastic lined or coated bags. Grout bags shall be stamped with the date of manufacture, lot number, and mixing instructions. Any change of materials or material sources requires the retesting and certification of the conformance of the grout with the physical properties requirements. A copy of the Quality Control

Data Sheet for each lot and shipment shall be submitted to the Engineer. Materials with an age from date manufacturer in excess of 180 days shall be retested and certified before use or removed and replaced.

(1) **Portland Cement and Blended Hydraulic Cement.** Refer to Section 801 of the Standard Specifications. Blended cements, if used, shall be compatible with other ingredients of the grout.

(2) **Concrete Admixtures.** Refer to Section 812 of the Standard Specifications. Compatibility with the cement, mineral additives, and other admixtures being considered shall be established during the grout trial mixes.

(3) **Pozzolans.** Pozzolans shall be limited to percentages by weight given in Section 822 of the Standard Specifications.

(4) **High Range Water Reducing Admixtures.** High Range Water Reducing Admixtures shall not be used in excess of 45 oz. per 100 lb. of Portland cement.

(5) **Anti-Bleeding Admixtures.** Anti-bleed admixtures may be used in grout if the requirements of testing outlined in this section are satisfied. The anti-bleed admixture's performance in post-tensioning grouts shall conform to the acceptable criteria for the bleed tests using both the modified C940 test and the Pressure Bleed Test using a Gelman filter funnel with a test pressure of 50 psi (refer to Appendix C of Post-Tensioning Institute's Specification for Grouting of Post-Tensioned Structures, 2003).

(6) **Expansion Causing Admixtures.** Pre-hardening expansive admixtures based on gas information that are potentially harmful to the grout or the prestressing steel shall not be used. For inert gas forming materials, the level of vertical height change shall be no greater than 2.0 percent for up to 3 hours when measured in conformance with C940.

(7) **Aggregates.** Aggregates, if used, shall have a maximum size passing a No. 50 sieve (300 micron) and shall conform to C33 except for gradation.

(8) **Water.** Refer to Section 803 of the Standard Specifications.

(9) **Testing Requirements.** Grout manufacturer shall submit certified test reports from an audited and independent Cement Concrete Research Laboratory (CCRL) that shows the material conforms to the requirements specified herein. The tests shall be performed on each lot and shipment provided to the project. The test reports, detailing the types and number of tests performed, test procedures, results, and comparison of results with specified values, shall be submitted to the Engineer for approval at least eight weeks prior to the scheduled start of production grouting. Any change in the type, brand or manufacturing source throughout the duration of the grouting will require submittal of certified test results at least eight weeks prior to use of the new materials.

(10) **Physical Property Requirements.** The grout shall not contain aluminum or other components which produce hydrogen, carbon dioxide or oxygen gas. Grout shall achieve a non-bleed characteristic and shall conform to the following physical properties. Grout shall be tested at the temperature and humidity conditions expected on-site, but at temperatures not to exceed 90 degrees F or less than 40 degrees F. Grout shall be used only within the range of conditions tested successfully.

Property	Test Value	Test Method
Total Chloride Ions by Weight of Cementitious Material, Maximum	0.08%	ASTM C1152
Fine Aggregate (if utilized)	99% passing the No. 50 Sieve (300 micron)	ASTM C136 (1)
Wet Density – Laboratory	Report maximum and minimum obtained test value lb/ft^3	ASTM C138
Wet Density – Field	Report maximum and minimum obtained test value lb/ft^3	ASTM C138
Water/Cementitious Materials Ratio, Maximum	0.45	
Volume Change @ 24 Hours and 28 Days	0.0% to +0.2%	ASTM C1090(2)
Expansion, Up to 3 Hours	2.0%	ASTM C940
Compressive Strength, Average of 3 Cubes, at 28 Days, Minimum	7,000 psi	ASTM C942
Initial Set of Grout	Minimum - 3 hours Maximum – 12 hours	ASTM C953
Fluidity Test(3) Efflux Time from Flow Cone Immediately After Mixing	Minimum - 20 seconds Maximum - 30 seconds or Minimum - 9 seconds Maximum - 20 seconds	ASTM C939 ASTM C939(3)
Fluidity Test(3) Efflux Time from Flow Cone Immediately After Mixing	Maximum - 30 seconds or Maximum - 30 seconds	ASTM C939 ASTM C939(4)
Bleeding @ 3 Hours	Maximum-0.0 percent	ASTM C940(5)
Permeability @ 28 Days	Maximum 2500 coulombs at 30 V for 6 hours	ASTM C1202

(1) Use ASTM C117 procedure modified to use a #50 sieve. Determine the percent passing the #50 sieve after washing the sieve.

(2) Modify C1090 to include verification at both 24 hours and 28 days.

(3) Adjustments to flow rates shall be achieved by strict compliance with the manufacturer's recommendations.

(4) Grout fluidity shall conform to the standard C939 flow cone test for non-thixotropic grouts or the modified test described herein for thixotropic grouts. Modify the C939 test by filling the cone to the top instead of to the standard level. The efflux time is the time to fill a 1 liter container placed directly under the flow cone.

(5) Modify C940 to conform with the wick induced bleed test specified in the C940 Modifications herein.

C 940 Modifications:

(a) Condition dry ingredients, mixing water, prestressing strand and test apparatus overnight at 70 to 76 degrees F (21 to 25 degrees C).

(b) Insert 800 ml of mixed conditioned grout with conditioned water into the 1000 ml graduated cylinder. Mark the level of the top of the grout.

(c) Wrap the strand with 2-inch wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut.

(d) Degrease with acetone or hexane solvent and wire brush to remove any surface rust on the strand before temperature conditioning. Completely insert a 20-inch length of conditioned, cleaned, A416 7-wire strand 0.5-inch diameter into the 1000 ml graduated cylinder. Using a centralizer or other means, center and fasten the strand so it remains essentially parallel to the vertical axis of the cylinder. Mark the level of the top of the grout.

(e) Store the mixed grout at the temperature range listed above in (a).

(f) Measure the level of the bleed water every 15 minutes for the first hour and hourly afterward for 2 hours.

(g) Calculate the bleed water, if any, at the end of the 3 hour test period and the resulting expansion per the procedures outlined in C940, with the quantity of bleed water expressed as a percent of the initial grout volume. Note if the bleed water remains above or below the top of the grout.

(11) **Accelerated Corrosion Test Method (ACTM).** Perform the ACTM as outlined in Appendix B of the "Specification for Grouting of Post-Tensioning Structures" published by the Post-Tensioning Institute. Report the time to corrosion for both the grout being tested and the control sample using a 0.45 water-cement ratio neat grout. A grout that shows a longer average time to corrosion in the ACTM than the control sample and the time to corrosion exceed 1,000 hours is considered satisfactory.

(h) **Corrosion Preventative Coating.** The corrosion inhibitor used in packaging post-tensioning steel for shipment shall be a vapor phase inhibitor (VPI) conforming to Federal Specification MIL-P-3420 or as approved by the Engineer.

(i) **Grouting Attachments.** All grouting accessories shall be capable of withstanding at least a 200 psi pressure. All connections to ducts shall be made with metallic or plastic structural fasteners. Waterproof tape shall also be used at all connections including vent and grouting pipes, except where otherwise specified herein. Vents shall be mortar tight, taped as necessary and shall provide means for injection of grout through the vents and for sealing the vents by mechanical shut off valves.

All anchorage end caps (i.e., grout caps) shall be made of plastic and shall remain in place after grouting unless otherwise directed by the Engineer.

Plastic components, if selected and approved, shall not react with the concrete or enhance corrosion of the post-tensioning steel, and shall be free of water-soluble chlorides.

(j) **Grout Vents, Injection, and Ejection Pipes.** Vents shall be 1/2-inch minimum diameter plastic pipe. Plastic components shall not react with the concrete or enhance corrosion of the post-tensioning steel. Plastic components shall be free of water soluble chlorides. Grout injection pipes shall be fitted with positive mechanical-shut-off valves. Vents and ejection pipes shall be fitted with valves or other devices capable of withstanding the grout pumping pressures.

All grout inlets and outlets shall be permanently sealed to prevent water infiltration to the grouted tendon. Sealing details are to be submitted to the Engineer for approval.

Sampling and Testing.

All testing shall be done by the Contractor, his subcontractor, or his supplier in accordance with the appropriate ASTM Specifications. Records of all tests required herein shall be submitted to the Engineer for approval.

The Contractor at his expense shall furnish the following samples of materials and devices selected as designated by the Engineer.

- Three samples of 5-foot long post-tensioning strand for each size from each heat number or production lot.

- Three samples of 5-foot long duct for each size that will be used on this project from each heat number or production lot.

- Three samples of duct couplers for each size that will be used on this project.

- Three samples of duct inlet/outlet tubes with shut-off valves that will be used on this project.

- Three samples of strand wedges that will be used on this project from each heat number or production lot.

- One sample of each size of post-tensioning tendon anchorage that will be used on this project. This shall include both the anchor body and wedge plate for the tendons.

Samples shall be furnished well in advance of the time they are to be incorporated into the work.

The Engineer reserves the right to reject for use at any time any material or device which is obviously defective or was damaged subsequent to testing.

(a) **Manufacturer Lots.** The manufacturer of post-tensioning strands and post-tension anchorages shall assign an individual number to each lot of strand or devices at the time of manufacture. Each reel, coil, bundle, or package shipped to the project shall be identified by tag or other acceptable means as to a manufacturer lot number. The Contractor shall be responsible for establishing and maintaining a procedure by which all post-tensioning materials and devices can be continuously identified with the manufacturer's lot number. Items which at any time cannot be positively identified as to a lot number shall not be incorporated into the work.

Low relaxation strand shall be clearly identified as required by ASTM A 416. Any strand not so identified will not be acceptable.

The Contractor shall furnish manufacturer certified reports covering the tests required by this Special Provision. A certified test report stating the breaking strength, yield strength, elongation and modulus of elasticity shall be furnished for each lot of post-tensioning steel. When requested, typical stress-strain curves for post-tensioning steel shall be furnished. A certified test report stating strength when tested using the type post-tensioning strand to be used in the work shall be furnished for each lot of post-tension anchorage devices.

(b) **Grout.** Refer to Materials (g)(10) and (g)(11) of this Special Provision.

A technical representative of the grout manufacturer shall be present on-site during the first grouting operations and up to three other times at the request of the Engineer.

Construction Methods:

The post-tensioning steel and ducts shall be installed, stressed, and grouted as noted on the Plans and in accordance with these Special Provisions.

(a) **Submittals.** Shop drawings and calculations shall be prepared by or under the supervision of a qualified Professional Engineer registered in the State of Delaware and experienced in providing engineering services of the kind indicated. Drawings shall be 22 by 34 inches in size. Smaller size drawings will not be accepted.

The Contractor shall submit to the Engineer for approval not less than 45 days prior to precasting or erection of any portion of the structure detailed shop drawings. These drawings shall include, but are not necessarily limited to, the following:

(1) A complete description of, and details covering, the post-tensioning system to be used. This shall include:

(a) Designation of the specific post-tensioning steel, anchorage devices, duct material, and accessory items.

(b) Properties of each of the components of the post-tensioning system.

(c) Equipment to be used in the post-tensioning sequence.

(d) Procedure and sequence of operations for post-tensioning and securing tendons.

(e) Parameters to be used to calculate the typical tendon force such as: expected friction coefficients, anchor set and post-tensioning steel relaxation curves.

(f) Details covering assembly of each type of post-tensioning tendon.

(g) Complete details of the Contractor proposed method for preventing water and debris from entering the post-tensioning ducts. Methods shall address the protection from the time the ducts are installed until the tendons are grouted.

(2) A table detailing the post-tensioning jacking sequence, jacking forces, and initial elongations of each tendon.

(3) Complete details of the anchorage system for post-tensioning including certified copies of the reports covering tests performed on post-tension anchorage devices and details for any additional reinforcing steel needed due to stresses imposed in the concrete by anchorage plates. Certified tests shall include the concrete being used and reinforcing steel.

(4) For the operation of grouting post-tensioning tendons, the materials and proportions for grout, details of equipment for mixing and placing grout and methods of mixing and placing grout.

(5) Calculations to substantiate the post-tensioning system and procedures to be used including stress-strain curves typical of the post-tensioning steel to be furnished, required jacking forces, and elongation of tendons during tensioning. These calculations shall show a typical tendon force after applying the expected friction coefficient and anticipated losses. Elongation calculations shall be revised when necessary to properly reflect the modulus of elasticity of the tendon material as determined from in place friction tests.

(6) Complete horizontal and vertical geometric layouts for each post-tensioning duct and tendon. Integrated shop drawings shall not be submitted until the Engineer has approved these layouts. This drawing shall show all air vents and water/fluid drains in the ducts for approval of the Engineer. Duct and tendon layout shall be accomplished so as to cause no curvature within the longitudinal limits of the trumpet component of a tendon anchorage device.

(7) Fully integrated drawings showing concrete dimensions, reinforcing steel, post-tensioning duct, post-tensioning hardware, inserts, and any other items to be embedded in a segment. Details of mild steel reinforcing shall be clearly shown as to size, spacing, and location including any anchorage reinforcing not shown in the Plans, which may be required by the post-tensioning anchorage system selected by the Contractor. Details of post-tensioning ducts shall clearly indicate the size, type, horizontal and vertical profiles, duct supports, grout pipes, and concrete covers. Any drawing not showing all items to be embedded in the concrete will be returned to the Contractor for resubmittal as a part of an integrated drawing. Prior to submittal, the Contractor shall review these drawings to determine the absence of reinforcement and tendon or embedment conflicts. Any unresolved conflicts shall be called to the attention of the Engineer at the time of submittal. The Contractor shall be solely responsible for any and all effects of conflicts found during fabrication.

(8) Duct supports, grout tubes, vents and drains shall be clearly designed and detailed on the shop drawings, including the size, type, and locations.

(9) Calculations prepared under the direction of, and signed and sealed by, a Delaware Registered Professional Engineer which show that the loads imposed on the permanent structure by the equipment will not adversely affect the structural adequacy of the permanent structure, nor exceed allowable stresses during the construction process.

(b) **Execution.** The post-tensioning duct and tendons shall be installed, capped, tensioned and grouted in accordance with these Special Provisions, 2012 AASHTO LRFD Bridge Design Specifications, including interim revisions, Post-Tensioning Institute (PTI) Acceptance Standards for Post-Tensioning Systems, 6th edition of PTI Post-Tensioning Manual, and Specification for Grouting of Post-Tensioned Structures. If there are any conflicts between these requirements, the more stringent requirement will control.

(c) **Protection of Post-Tensioning Steel.**

(1) **During Shipping, Handling, and Storage.** All post-tensioning steel shall be protected against physical damage and corrosion at all times from manufacture to final grouting. Post-

tensioning steel that has sustained physical damage at any time shall be rejected. Any reel that is found to contain broken wires shall be rejected and the reel replaced.

Post-tensioning steel shall be packaged in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor which prevents rust or other results of corrosion shall be placed in the package or form, or shall be incorporated in a corrosion inhibitor carrier type packaging material, or when permitted by the Engineer, may be applied directly to the steel. (See Grouting Operations). The corrosion inhibitor shall have no deleterious effect on the steel or the concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specification MIL-P-3420. Packaging or forms damaged from any cause shall be immediately replaced or restored to the original condition.

The shipping package or form shall be clearly marked with a statement that the package contains high-strength post-tensioning steel, the care to be used in handling, and the type, kind, and amount of corrosion inhibitor used, including the date when placed, safety orders and instructions for use.

The post-tensioning steel shall be stored in a manner which will at all times prevent the packing material from becoming saturated with water and allow a free flow of air around the packages. If the useful life of the corrosion inhibitor in the package expires, it shall immediately be rejuvenated or replaced.

(2) **During Installation in the Structure.** At the time the post-tensioning steel is installed in the work, it shall be free from loose rust, loose mill scale, dirt, paint, oil, grease, or other deleterious material. Removal of tightly adhering rust or mill scale will not be required. Post-tensioning steel, which has experienced rusting to the extent that it exhibits pits visible to the naked eye, shall not be used in the work.

(d) **Cutting of Post-Tensioning Steel.** Post-tensioning steel shall be cut by an abrasive saw within ¾ to 1½ inches away from the anchoring device. Flame cutting of post-tensioning steel is not allowed. If tendons are not capped within 4 hours of stressing, the tails and anchorages shall be adequately protected from precipitation and runoff.

(e) **Stressing Operations.** The post-tensioning operation shall be so conducted that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times. The Contractor shall keep a record of the following post-tensioning operations for each tendon installed. Any other relevant information shall also be recorded. The Contractor shall provide the Engineer with a complete copy of all stressing and grouting operations, such as:

(1) Project name and number.

(2) Contractor and/or subcontractor name.

(3) Tendon location, size, and type.

(4) Date tendon was first installed in ducts.

(5) Heat number for bar and strands.

(6) Assumed and actual cross-sectional area.

(7) Assumed and actual modulus of elasticity.

(8) Date stressed.

(9) Jack and gauge numbers per end of tendon.

(10) Required jacking force.

(11) Gauge pressures.

(12) Elongations (anticipated and actual).

(13) Anchor sets (anticipated).

(14) Stressing sequence (i.e., tendons before and after this).

(15) Stressing mode (one end/two ends/simultaneous).

(16) Witnesses to stressing operation (Contractor and inspector).

(17) Date grouted, days from stressing to grouting, and grouting pressure applied at injection end.

Elongations shall be measured to the nearest 1/16-inch. For the required tendon force, the observed elongation shall agree within 7 percent of the theoretical elongation or the entire operation shall be checked and the source of error determined and remedied to the satisfaction of the Engineer before proceeding further. The tendon shall not be overstressed to achieve the theoretical elongation. In the event that agreement between the observed and theoretical elongations at the required force falls outside the acceptable tolerances, the Engineer may, at his discretion and without additional compensation to the Contractor, require additional tests for tendon Modulus of Elasticity and/or in-Place Friction. The post-tensioning operation shall be so conducted that the forces being applied to the tendon and the elongation of the post-tensioning tendon can be measured at all times. The tendon force may be verified by performing a lift-off test at the non-stressing end (dead end) of the tendon. A lift-off test at the stressing end will not be acceptable procedure to determine the tendon force.

Friction. The Contract Plans were prepared based on the assumed friction and wobble coefficients and anchor set noted on the Plans. The Contractor shall submit calculations and show a typical tendon force diagram, after friction, wobble, and anchor set losses, on the shop drawings based upon the expected actual coefficients and values for the post-tensioning system to be used. These coefficients and values shall be given on the shop drawings.

If, in the opinion of the Engineer, the actual friction significantly varies from the expected friction, the Contractor shall revise the post-tensioning operation such that the final tendon force is in agreement with the Plans.

When friction must be reduced, water soluble oil or graphite may be used as a lubricant subject to the approval of the Engineer. Lubricants shall be flushed from the duct as soon as possible after stressing is completed by use of water pressure. These ducts shall be flushed again just prior to the grouting operations. Each time ducts are flushed, they shall be immediately blown dry with oil-free air.

Installing Tendons. Post-tensioning tendons may be pushed or pulled through the ducts to make up a tendon. Pushing shall be done with care so as to avoid snagging on any lips or joints in the ducts. The Contractor shall take precautions by rounding off the end of the bars or fitting it with a smooth protective cap for this purpose. Cutting shall be done with an abrasive saw or similar. Flame cutting shall not be allowed. Installation of tendons in ducts prior to concrete placement shall not be allowed. No permanent tendons shall be installed

prior to the completion of testing as required by these Specifications or in the Plans, except for the in Place Friction Test where only the tendon to be tested shall be installed prior to successful completion of the test.

Cleaning Tendons and Ducts. Immediately prior to grouting operations, the inside of the tendon duct shall be blown out with compressed oil-free air to the extent necessary to remove any water or debris, and to dry the post-tensioning steel and inside surfaces of the pipe.

Fabrication.

General. All post-tensioning anchorages, ducts, vent pipes, miscellaneous hardware, reinforcing bars, and other embedments shall be accurately and securely fastened at the locations shown on the Plans or on the approved shop drawings or as otherwise approved by the Engineer.

Post-Tensioning Ducts.

(1) **Ducts:** Duct shall be accurately aligned and positioned at the locations shown on the Plans or according to the approved shop drawings or as otherwise approved by the Engineer. All internal ducts shall be securely fastened in position at regular intervals not exceeding 2'-0" to prevent movement, displacement or damage from concrete placement and consolidation operations. Ducts shall be attached to supporting chairs or reinforcement in such a way that the duct is not damaged. The method and spacing of duct supports shall be shown on appropriate shop drawings. All alignments of ducts, including curved and straight portions, splices, joints, and connections to anchorages shall be watertight, smooth and continuous with no lips, kinks, or dents. All splices, joints, and connections to anchorages shall be watertight and of sufficient strength to prevent distortion or displacement of the ducts during concrete placement. In the event duct alignment cannot be maintained during concrete placement, mandrels shall be used to stiffen the duct along its entire length. All ducts shall be carefully checked and repaired as necessary before the placing of any concrete commences. After installation in the forms, all ends of ducts, connections to anchorages, splices, vents, and the like shall at all times be sealed to prevent the entry of water and debris. The Contractor at no expense to the Department shall supply additional mild reinforcing required to support post-tensioning ducts. The tolerance on the location of the tendons shall be plus or minus 1/4-inch at any point in respect to the vertical, linear, and transverse position as shown on the Plans. After installation in the forms, the ends of ducts shall, at all times, be sealed to prevent entry of water and debris.

Minimum bend radius of ducts shall be not less than 30 feet. The ducts shall be bent so as to accurately conform to the geometry shown on the Plans and shall be sized to ensure that post-tensioning forces exerted by the steel enclosed in the pipe are within tolerable limits of the concrete surrounding the pipe.

The duct system, including splices and joints shall effectively prevent entrance of cement paste or water into the system and shall effectively contain pressurized grout during grouting of the tendon. The duct system shall also be capable of withstanding water pressure during flushing of a duct in the event the grouting operation is aborted.

The interior diameter of ducts made up of multiple strands shall be large enough to cause the duct to have an interior area not less than 2.5 times the post-tensioning steel area.

(2) **Grout Vents, Injection, and Ejection Pipes.** All ducts or anchorage assemblies for permanent post-tensioning shall be provided with pipes or other suitable connections at each end for the injection of grout after post-tensioning. As a minimum, ducts shall be vented at the high points of the tendon profile when there is more than a 6-inch variation in the vertical position of the duct. The Contractor may use additional injection and vent pipes when shown on the shop drawings. All connections to ducts shall be made with plastic structural fasteners. Waterproof tape or other method approved by

the Engineer shall be used at all connections to include vent and grouting pipes. Vents shall be mortar tight, taped as necessary, and shall provide means for injection of grout through the vents and for sealing the vents.

(j) Placing Concrete.

(1) Precautions. The Contractor shall exercise great care when placing and consolidating concrete so as not to displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement or other embedments.

(2) Proving of Post-Tensioning Ducts. Upon completion of concrete placement, the Contractor shall prove that the post-tensioning ducts are free and clear of any obstructions or damage and will be able to accept the intended post-tensioning tendons by passing a torpedo through the ducts. The torpedo shall have the same cross-sectional shape as the duct, and shall be 1/4-inch smaller all around than the clear, nominal inside dimensions of the duct. No deductions to the torpedo section dimensions shall be made for tolerances allowed in the manufacture or fixing of the ducts. The length of the torpedo shall be determined by the Contractor such that when both ends touch the outermost wall of the duct, the torpedo is 1/4-inch clear of the innermost wall. If the torpedo will not travel completely through the duct, the member shall be rejected, unless a workable repair can be made to clear the duct, to the satisfaction of the Engineer. The torpedo shall be passed through the duct easily, by hand, without resorting to excessive effort or mechanical assistance.

(3) Problems and Remedies. If the ducts or any part of the work is found to be deficient, it will be rejected. No remedial or repair work will be permitted without the approval of the Engineer.

(k) Post-Tensioning Operations.

(1) General. All post-tensioning stressing operations shall be conducted under supervision of a person experienced in bridge construction post-tensioning techniques. The Contractor shall identify the experienced person and shall provide documentation showing previous experience for at least two similar projects totaling not less than two years duration. Post-tensioning forces shall not be applied until the concrete has attained the minimum compressive strength as specified on the contract Plans, determined by cylinder tests.

(2) Stressing Tendons. All post-tensioning steel shall be tensioned by means of hydraulic jacks so that the post-tensioning force shall not be less than that required by the Plans or approved shop drawings, or as otherwise approved by the Engineer. The maximum temporary stress (jacking stress) in the post-tensioning steel shall not exceed the percent of its specified minimum ultimate tensile strength specified in the Plans. Tendons shall not be overstressed to achieve the expected elongation. The post-tensioning steel shall be anchored at initial stresses that will result in the long term retention of permanent stresses or forces of not less than those shown on the Plans or the approved shop drawings. Unless otherwise approved by the Engineer, the initial stress at the anchorage after anchor set shall not exceed the percent of the specified ultimate tensile strength of the post-tensioning steel specified in the Plans. Permanent stress and permanent force are the stress and force remaining in the post-tensioning steel after all losses, including long-term creep and shrinkage of concrete, elastic shortening of concrete, relaxation of steel, losses in the post-tensioning steel from the sequence of stressing, friction and unintentional wobble of the ducts, anchor set, friction in the anchorages, and all other losses particular to the post-tensioning system. In the event that more than two percent of individual strand wires in a tendon break during the tensioning operation, the tendon shall be removed and replaced. Previously tensioned strands shall not

be allowed. Immediately after post-tensioning, all grout vents of each tendon shall be temporarily sealed with plugs to prevent entrance of air or water and left in place until just prior to tendon grouting.

(3) **Stressing Sequence.** All tendons shall be stressed from both ends.

(4) **Stressing Equipment.** Equipment for tensioning the tendons shall be furnished by the manufacturer of the post-tensioning system (tendons, hardware, anchorages, etc.). Each jack used to stress tendons shall be equipped with a pressure gauge for determining the jacking pressure. The pressure gauge shall have an accurate reading dial at least 6 inches in diameter. The pressure gauge shall be installed at the stressing ram. Prior to use for stressing on the project, each jack and its gauge shall be calibrated as a unit by a testing laboratory approved by the Engineer.

(5) **Calibration of Jacks and Gauges.** Calibration shall be performed within six months of use, with the cylinder extension in the approximate position it will be in when applying the final jacking force. Calibration shall be done when the jack is connected to the equipment (pumps and gauges) in the identical configuration as it will be used on the job site (e.g., with the same length hydraulic lines). Initial calibration of the jacks and gauges shall be performed by an independent testing laboratory using a proven load cell. For each jack and gauge unit used on the project, certified calibration calculations and charts shall be furnished to the Engineer from the independent laboratory prior to stressing the first tendon. Any repair of the jacks, such as replacing seals or changing the length of the hydraulic lines, is cause for recalibration of the jacks using a load cell. No extra compensation shall be allowed for the initial or subsequent calibrations or for the use and required calibrations of the master gauge.

(l) **Grouting Operations.**

Within fifteen (15) calendar days after installation of the post-tensioning steel strands, ducts shall be grouted in accordance with these Specifications. If grouting operations exceed fifteen calendar days, then the Contractor shall distress, remove and replace the tendons in the presence of the Engineer. In lieu of this, the Contractor shall submit a written corrosion protection Plan for approval by the Engineer. The Plan shall include field testing of the proposed Plan. The approved corrosion protection Plan shall limit the duration to a maximum of forty-five (45) calendar days between strand installation and grouting. Within forty-five (45) calendar days after installation of the post-tensioning steel bars (epoxy coated), ducts shall be grouted in accordance with these Specifications. If grouting operations exceed forty-five (45) calendar days, then the Contractor shall distress, remove and replace the bar tendons in the presence of the Engineer. After stressing and prior to grouting, bar tendons shall be protected against corrosion or harmful effects of debris, by temporarily plugging or sealing all openings and vents until the bar tendons are grouted. When stressing has been completed and the stressed bar tendons have been accepted by the Engineer, the annular space between the bar tendons and the duct shall be grouted.

The Contractor shall determine the exact kinds of admixtures and proportions of materials to be used to meet the requirements set under Materials, and which, from prior documented experience with similar materials, equipment and placing conditions, will result in grout which does not bleed and can be effectively placed. The quantity of water in the grout shall be as low as possible, consistent with the fluidity needed for placing.

After post-tensioning and anchoring of a tendon has been completed and accepted, the annular space between the post-tensioning steel and the duct shall be grouted. The grouting for any tendon shall be completed a minimum of 4 hours prior to placing live loads on the spans.

(1) **Written Grouting Procedures.** At least four weeks prior to the start of construction of post-tensioned elements, written procedures for grouting operations shall be submitted to the Engineer for approval. The grouting procedures shall be devised to ensure that the ducts will be properly filled by grout and shall cover in detail the following:

(a) type, quantity, and brand of materials used in grouting including all certification required;

(b) type of equipment needed, including capacity in relation to demand and working condition, as well as provisions for back-up equipment and spare parts;

(c) types and locations of inlets and outlets;

(d) types and sizes of grout hoses and connections;

(e) duct cleaning methods and air pressure testing methods prior to grouting;

(f) mixing and pumping procedures;

(g) direction of grouting;

(h) sequence of use of the inlets and outlets;

(i) procedures for handling blockages, including flushing of ducts;

(j) procedures for possible regrouting;

(k) procedures for post-grouting operations and inspections; and

(l) the names of the persons in charge and the other personnel who will perform the grouting operation, including their relevant experience and skill.

(2) **Mixing and Pumping Procedures.** The mixing and pumping procedures required in Item (1) (f) above shall include:

(a) inspection to ensure that all materials are of the specified type and quantity;

(b) inspection to ensure that all equipment is in satisfactory condition;

(c) detailed Plan for production testing of grout;

(d) inspection of ducts to ensure that they are free of water, debris, and other obstructions.

(e) inspection of ducts to ensure that there will be no grout leakage between adjacent ducts in joint areas (i.e., air pressure testing);

(f) temperature measurement of air, water, cement, grout, and concrete elements to ensure that they are within the acceptable limits as specified in Post-Tensioning Grout;

(g) procedures for cold and hot weather grouting; and

(h) inspection of all cement or grout mixture packages for evidence of age and dampness, such as lumps and hardened pieces.

Grouting operations shall commence only after Engineer has approved the grouting procedures.

(3) **Records of Grouting Operations.** The Contractor shall record the progress of grouting operations for each duct and submit a written report to the Engineer within 72 hours after grouting.

Information to be noted in the records shall include but shall not necessarily be limited to the following:

(a) identification of tendons grouted, injection end and maximum applied grouting pressure;

(b) date grouted;

(c) number of days from stressing to grouting;

(d) type of grout mix used and lot number of prebagged grout;

(e) volume of grout pumped into the duct compared to the volume of the duct adjusted for the grout displaced by the post-tensioning stand; and

(f) summary of any problems encountered and corrective action taken.

(4) **Grouting Personnel.** All grouting operations shall be carried out by experienced superintendents, foremen, and workers. Grouting shall be performed under the immediate control of a person skilled in all aspects of grouting and has received certification as an American Segmental Bridge Institute Certified Grouting Technician. The person shall provide close observation and control of all grouting operations, as necessary for full compliance with specified requirements. This person shall be named and shall furnish proof of at least three years experience as approved by the Engineer.

(5) **Ducts.** Care shall be taken to ensure that all ducts, anchorages, block-outs, openings, inlets, and vents are kept clean and free of water, debris, fuel, oils, other contaminants and trash at all times prior to and after installing tendons. Temporary plugs, seals and covers shall be used as needed. Minor damage to ducts shall be satisfactorily and effectively repaired and sealed or by removing the locally damaged duct and splicing duct or couplers onto the damaged section prior to placing any concrete. Major damage shall require the removal and replacement of duct.

Prior to grouting, the ducts shall be blown with oil free compressed air to remove water and debris. Ducts shall be dried with compressed air to remove standing water. Each tendon duct shall be air pressure tested to locate potential grout leaks. All blockages, and leaks shall be repaired to the satisfaction of the Engineer.

(6) **Supplies.** Before grouting operations begin, an adequate supply of water and compressed air shall be available for clearing the ducts, mixing, and pumping the grout, and flushing out grouted ducts in the event of breakdowns or incomplete operations. All necessary materials shall be checked and made conveniently available for mixing.

(7) **Production Testing.** Testing equipment for flow-cone testing, and temperature measurements shall be available on-site during grouting operations. Fluidity of the grout shall be strictly maintained within the limits established by the grout manufacturer. In addition to the fluidity tests required for each tendon (see routing Operations , one fluidity test (flow cone) in accordance with C939 or C939 Modified shall be performed every two hours of grouting operations. One test shall be taken at the

mixer and one at the duct outlet. The efflux times shall be within 5 seconds of the values established during laboratory testing. No grout which tests outside the allowable flow rate shall be used. In addition to the flow-cone tests described above, field trial tests and production tests shall be performed in accordance with Section 4.7 of the PTI Guide Specification for Grouting of Post-Tensioned Structures. The flow cone test described in Section 4.7.3(d) of the PTI Guide Specification is not required.

(8) **Storage of Materials.** Grout shall be delivered in prepackaged bags and stored in a building or other location that is weatherproof. Storage in the open may be permitted by the Engineer, if a raised platform and adequate waterproof covering are provided. Care should be taken with the storage of dry grout mixtures in temperatures below 32 degrees F or as recommended by the manufacturer, whichever is more stringent.

(9) **Equipment.** Grouting equipment consists of measuring devices for water, a high speed shear colloidal mixer, a storage hopper (holding reservoir) and a pump with all the necessary connecting hoses, valves, and pressure gauges. Provide air compressor and hoses with sufficient output to perform the required functions.

Provide equipment with sufficient capacity to ensure that the post-tensioning ducts to be grouted can be filled and vented without interruption at the required rate of injection. Under normal conditions, the grout equipment shall be capable of continuously grouting the longest tendon on the project in not more than 20 minutes.

(a) **Mixer, Storage, Hopper and Screen.** Provide a two-speed high shear (colloidal) mixer capable of continuous mechanical mixing. The mixer will produce a homogeneous and stable grout free of lumps and undispersed cement and will be able to deliver a continuous supply of grout to the pumping equipment.

The colloidal grout machinery will have charging and agitating tanks. One unit is a blender and the other a holding tank. The blending tank shall be equipped with a two-speed high shear (colloidal) mixer.

The storage hopper must be kept agitated and at least partially full at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.

Add water to the mix by use of a flow meter or calibrated water reservoir with measuring accuracy of at least 0.1 gallon.

The grouting equipment shall contain a screen having clear openings of 1/8-inch maximum size to screen the grout prior to introduction into the pump. If the grout is thixotropic, a maximum screen opening of 3/16-inch is satisfactory. The screen shall be inspected periodically during grouting operations. If lumps of cement remain on the screen, the mixture is not suitable for grouting.

Grout shall be gravity fed from hopper into pump inlet.

(b) **Grout Pumping Equipment.** Provide pumping equipment capable of continuous operation which will include a system for recirculating the grout when actual grouting is not in progress.

The equipment will be capable of maintaining pressure on completely grouted ducts and will be fitted with a valve that can be closed off without loss of pressure in the duct.

Grout pumps will be positive displacement type, will provide a continuous flow of grout and will be able to maintain an outlet pressure of at least 150 psi.

Pumps will be so constructed and have seals adequate to prevent oil, air or other foreign substances from entering the grout and to prevent loss of grout or water. The capacity will be such that an optimal rate of grouting can be achieved.

A pressure gauge having a full-scale reading of no more than 300 psi will be placed at some point in the grout line between the pump outlet and the duct inlet. If hoses longer than 100 feet are used, two gauges shall be used, one for at the pump and one at the inlet.

The diameter and rated pressure capacity of the grout hoses must be compatible with the pump output. Grout hoses will be firmly connected to pump outlets and the duct inlets.

(c) **Stand-by Equipment.** During grouting operations, provide a high pressure water pump rated at 250 psi for adequate flushing to facilitate complete removal of the grout in the event of a breakdown of the grouting equipment or other disruption before the grouting operation has been completed. At the request of the Engineer, the Contractor shall demonstrate that this equipment is in full working order. Where water is not supplied through the public water supply system, a water storage tank of sufficient capacity is required.

As well, a backup grout mixer/hopper and pump shall be available on-site during all grouting operations to allow continuous grouting in the case of failure of the primary pump or mixer and to have the capability to run two independent grouting operations, if needed.

(10) **Grouting Operations.** Grout tendons in accordance with the procedures outlined in the approved grouting procedures when the ambient temperature is at or above 40 degrees F. If temperatures fall below 40 degrees F within 24 hours of completion of grouting operations, the Contractor shall provide means of and maintain the temperature of grouted ducts above 40 degrees F until a strength of 2500 psi is achieved.

Maximum grout temperature will not exceed 90 degrees F to avoid flash set and rapid stiffening in the duct. Use chilled water and/or pre-cooling of the bagged material to maintain mixed grout temperature below the maximum allowed temperature. Grouting operations are prohibited, if freezing temperatures are forecast. If grout manufacturer temperature restrictions are more stringent than those above, they shall be followed.

Mix the grout with the metered amount of water. The materials shall be mixed to produce a homogeneous grout. Continuously agitate the grout until it is pumped. Check the fluidity of the grout in accordance with C939 or C939 Modified.

Open all grout outlets before starting the grouting operation. Unless otherwise approved by the Engineer, grout the tendons from the lowest inlet. Pump grout from the lowest inlet location of the tendon in an uphill direction. Use the grout within 30 minutes of mixing to ensure the flowability of the grout.

Maintain a continuous one-way flow of grout.

Unless approved by the Engineer, pump grout at a rate of between 15 linear feet and 30 linear feet of duct per minute.

The approved method of pumping grout will ensure complete filling of the ducts and complete encasement of the steel. Grout shall flow from the first and subsequent outlets until any residual flushing water or entrapped air has been removed then expel an additional 2 gallons of grout prior to closing the outlet.

Close all outlets in a similar manner one after another in the direction of the flow except at intermediate crests. Outlets placed a short distance downstream of the crest will be closed before their associated crest outlet pipe.

Pump grout through the duct and continuously discharge it at the anchorage and grout cap outlets until all free water and air are discharged and the consistency of the grout is equivalent to that of the grout being pumped at the inlet. In addition, discharge a minimum of 2 gallons of grout into a clean receptacle to perform a fluidity test. Close the anchorage outlet.

For each tendon, immediately after discharge, perform a fluidity test using the flow cone on the grout discharged from the anchorage outlet. Acceptable measured grout efflux time will not be less than the efflux time measured at the pump nor the minimum acceptable efflux time as established in the Post-Tensioning Grout special provision. If the grout efflux time is not acceptable, discharge additional grout from the anchorage outlet. Test grout efflux time. Continue this cycle until acceptable grout fluidity is achieved. Discard grout used for fluidity testing. Conduct normal grouting operations at a pressure range of 10 psi to 50 psi measured at the grout inlet. Do not exceed the maximum pumping pressure of 150 psi at the grout inlet.

After all outlets have been bled and sealed, terminate grouting by the following procedure. Elevate the grout pressure to 75 psi and maintain for 1 minute. If leaks are present, fix the leaks. If no leaks are present, lower the pressure to 50 psi and seal the inlet valve.

If the actual grouting pressure exceeds the maximum allowed, the inlet will be closed and the grout will be pumped at the next outlet that has just been or is ready to be closed as long as a one-way flow is maintained. Grout shall not be pumped into a succeeding outlet from which grout has not yet flowed. If this procedure is used, the outlet/inlet that is to be used for pumping shall be fitted with a positive means of shut-off.

When one-way flow of grout cannot be maintained or when grouting is interrupted, immediately flush the grout from the duct with potable water.

(11) **Post-Grouting Operations and Inspection.** Fully grouted tendons will not be subjected to vibration within 4 hours of grouting.

Valves, caps, and pipes at the inlets and outlets will not be removed or opened until the grout has cured for 4 to 8 hours. After the grout has cured for 4 to 8 hours, remove the ends of plastic inlets and outlets 1 inch below the surface of the concrete and fill the hole with freshly mixed post-tensioning grout or epoxy grout.

At all anchorages and, where possible, high points, drill into the grout vent to expose the duct contents within 7-days of grouting. Care shall be exercised to avoid drilling into post-tensioning steel. Jointly with the Engineer visually inspect for voids in the grout using a videoscope probe (supplied by the Contractor). If no voids are found, immediately fill the drill hole with freshly mixed post-tensioning grout or epoxy grout. If voids are detected, seal the hole until a repair procedure can be implemented. Repair procedures shall utilize the vacuum grouting method, unless otherwise approved by the Engineer. Contractor shall prepare a repair procedure and submit to the Engineer for approval. Repairs shall be implemented at no additional cost to the Department. A written report on all inspections and repairs shall be submitted to the Engineer.

If problems with grout bleed or voids in grouted ducts are discovered, the Contractor shall immediately stop all grout operations, determine the cause of the problem and submit a revised grouting procedure for approval by the Engineer. The revised procedure shall identify the causes of the problems and how the revised procedures will correct these problems.

References.

(a) American Association of State Highway and Transportation Officials (AASHTO)
- **(1)** LRFD Bridge Design Specifications, 6th Edition.
- **(2)** LRFD Bridge Construction Specifications, 3nd Edition.

(b) American Society for Testing and Materials (ASTM)

(c) Post-Tensioning Institute (PTI)
- **(1)** Acceptance Standard for Post-Tensioning Systems
- **(2)** 6th edition of PTI Post-Tensioning Manual
- **(3)** Specification for Grouting of Post-Tensioned Structures

(d) American Segmental Bridge Institute (ASBI)

(e) FIB Technical Report, Bulletin 7

Quality Assurance.

(a) **Installer Qualifications.** Engage an experienced installer who has completed post-tension concrete work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance.

(b) **Fabricator Qualifications.** Engage a firm experienced in producing post-tension hardware similar to those indicated for this project and with a record of successful in-service performance, as well as sufficient production capacity to supply hardware without delaying the work.

(c) **Professional Engineer Qualifications.** A Professional Engineer registered in the State of Delaware and experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for design and installation of post-tensioning for concrete spliced girders that are similar to that indicated for this project in material, design, and extent.

Method of Measurement and Basis of Payment:

The preparation, testing, furnishing, installing, stressing, grouting and anchorage protection of the post-tensioning system in the various concrete units will be paid for at the contract lump sum price for the Post-Tensioning item. The payment will be full compensation for all tendons, anchorages, ducts, grout as well as all material, labor, equipment, tools, and incidentals necessary to complete the work.

8/30/16

623544 - POST-TENSIONED PRESTRESSED REINFORCED CONCRETE MEMBERS, BULB TBEAM

Description:

This work consists of furnishing and erecting prestressed, precast, reinforced concrete members and accessories, on substructure units.

This work also includes furnishing and installing bearing pads and materials, dowels, tie rods, nuts, plates, joints and joint materials, scuppers, and all other parts and materials required to complete the work.

Prestressed concrete members consist of members that are stressed by either the pretensioning method or the post-tensioning method, or a combination of both methods. In the pretensioning method steel components are stressed and anchored, the concrete for the member is then cast and cured, and finally the stress in the steel components is released from the anchorages to the concrete through bond, after the concrete has attained its specified release strength. In the post-tensioning method, prestressing steel, which may be strands, wires or bars, is installed through embedded ducts in the concrete, stressed up to a predetermined load and anchored directly against the hardened concrete, initially imparting stresses through end bearing. Grout is then injected into the ducts to completely fill all remaining voids and to seal the permanently stressed tendons.

Post-tensioning prestressed concrete members consists of the furnishing, installing, stressing and grouting of prestressing tendons. This also includes furnishing and installing all the hardware and any other appurtenant items necessary for the particular prestressing system used, including but not limited to ducts, anchorage assemblies, supplementary steel reinforcing bars and grout used for pressure grouting ducts and all associated operations.

a) Definitions.

(1) Segment: An individual prestressed concrete girder member.

(2) Pier Segment: Girder segment that is directly supported by one of the bridge piers in its final position.

(3) Drop-In Segment: Girder segment that, during erection, is supported at each end by one of the Pier Segments.

(4) End Segment: Girder segment that, during erection, is supported at one end by a Pier Segment and at the other end by an abutment.

(5) Girder: An entire group of segments after they are made continuous by post-tensioning.

(6) Sand Jack: A sand-filled containment device that temporarily supports concrete bridge girder segments prior to post-tensioning. The girder segments bear directly on a plunger, which in turn is supported on the sand bed. After girder assembly is complete, the sand is removed, causing the plunger to drop, thereby removing support from beneath the finished girder.

(7) Strong Back: A temporary steel beam that is attached to the Drop-In Segment or End Segment, which enables it to be supported by the adjacent Pier Segment during girder erection.

Materials:

a) **Strand**. Strands shall be as shown on the Plans.

b) **Wire.** Wire shall be as shown on the Plans. The Contractor may propose the use of superior materials to the Department for approval.

c) **Bar Reinforcement.** Bar reinforcement shall conform to the requirements of Section 824.

d) **Portland Cement Concrete.** Portland cement concrete shall conform to the requirements of Section 812. The Contractor shall submit a mix design for the concrete to be used in prestressed members to the Department for approval. In addition, the total chloride content of the concrete mixture shall not exceed 0.06% by weight of cement. The mix design shall follow ACI design procedures and shall include the following:

Cement:	Type I, II, or III, 7 bags/yd³ (9.2 bags/m³)
Air Content:	5 ± 2%
Admixtures:	AASHTO M 194
Required Strength, *f* cr:	Sufficient to ensure a minimum 28-day design strength of 9,000 psi (62 MPa) (ACI 214 evaluation)

The required test cylinder strength of the concrete at the time of transfer of the tensioning load from strand to concrete (release of prestress) shall be not less than 6,800 psi (47 MPa).

Cylinders shall be initially cured under the same curing conditions as the members. A total of six test cylinders shall be cast for each member and tested as follows:

a. Two cylinders (release cylinders) shall be tested to determine when transfer of the tensioning load may be permitted.

b. Three cylinders shall be tested at 28 days.

c. One cylinder shall be held in reserve or tested at the time of shipping, if necessary.

After the release cylinders have been tested, the remainder of the test cylinders shall be moist cured.

e) **Bearing Materials.** Elastomeric bearings shall include plain bearings, consisting of elastomer only, and laminated bearings consisting of layers of elastomer restrained at their interfaces by bonded laminates, each type being of the size indicated on the Plans.

The elastomer portion of the elastomeric compound shall be 100% virgin natural polyisoprene(natural rubber) conforming to the requirements of Table 623-A, or 100% virgin chloroprene (neoprene) conforming to the requirements of Table 623-B, as specified in the Contract. Compounds of nominal hardness between the values shown in the tables may be used and the test requirements interpolated. If test specimens are cut from the finished product, a 10% variation in "Physical Properties" will be allowed.

Laminates shall be rolled mild steel sheets conforming to AASHTO M 183/M 183M unlessotherwise specified by the Engineer.

Bearings shall be manufactured according to the following requirements. Plain bearings may bemolded individually, cut from previously molded strips or slabs, or extruded and cut to length. Cut edges shall be at least as smooth as specified for an ANSI 250 (6.3 µm) finish. Unless otherwise shown on the Plans, all components of a laminated bearing shall be molded together into an integral unit, and all edges of the nonelastic laminations shall be covered by a minimum of 1/8" (3 mm) of elastomer, except at laminate restraining devices and around holes that will be entirely closed on the finished structure.

Bearing tolerances shall conform to the following requirements. Flash tolerance, finish and appearance shall meet the requirements of the latest edition of the Rubber Handbook as published by the Rubber Manufacturers Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings. For both plain and laminated bearings, the permissible variation from the dimensions and configuration required by the Plans and this Section shall be as follows:

(1) Overall Vertical Dimensions:
Average Total Thickness 1¼" (32 mm) or less . . . . . -0, +1/8" (-0, +3 mm)
Average Total Thickness over 1¼" (32 mm) . . . . . -0, +1/4" (-0, +6 mm)

(2) Overall Horizontal Dimension:
36" (900 mm) and less . . . . . -0, +¼" (-0, +6 mm)
over 36" (900 mm) . . . . . -0, +½" (-0, +13 mm)

(3) Thickness of Individual Layers of Elastomer
(laminated bearing only) . . . . . ±1/8" (±3 mm)

(4) Variation from a plane parallel to the theoretical surface (as determined by measurements at the edges of the bearings):
Top . . . . . 1/8" (3 mm)
Sides . . . . . 1/4" (6 mm)
Individual Non-Elastic Laminates . . . . 1/8" (3 mm)

(5) Position of Exposed Connection Members . . . . . 1/8" (3 mm)

(6) Edge Cover of Embedded Laminates or
Connection Members . . . . . .-0, +1/8" (-0, +3 mm)

(7) Size of Holes, Slots, or Inserts . . . . . ±1/8" (±3 mm)

(8) Position of Holes, Slots, or Inserts . . . . . ±1/8" (±3 mm)

Whenever practical, the mechanical properties of the finished bearing shall be verified by laboratory test.

The following values shall be met under laboratory testing conditions of full size bearings:

(1) Compressive strain of any layer of an elastomeric bearing shall not exceed 7% at 800 psi (5.5 MPa) average unit pressure or at the design dead load plus live load pressure if so indicated on the Plans.

(2) The shear resistance of the bearing shall not exceed: 30 psi (205 kPa) for 50 durometer, 40 psi (275 kPa) for 60 durometer, or 50 psi (345 kPa) for 70 durometer Table 623-A compounds; and shall not exceed 50 psi (345 kPa) for 50 durometer, 75 psi (515 kPa) for 60 durometer, or 110 psi (760 kPa) for 70 durometer Table 623-B compounds at 25% strain of the total effective rubber thickness after an extended four-day ambient temperature of -20 °F (-29 °C).

Table 623-A

ASTM Standard	*Physical Properties*	*50 Durometer*	*60 Durometer*	*70 Durometer*
D 2240 D 412	Hardness Tensile Strength, minimum psi (MPa) Ultimate elongation, minimum %	50 ± 5 2500 (17) 450	60 ± 5 2500 (17) 400	70 ± 5 2500 (17) 300
	Heat Resistance			
D 573 70 hours at 158 °F (70 °C)	Change in durometer hardness, maximum points Change in tensile strength, maximum % Change in ultimate elongation, maximum %	+10 -25 -25	+10 -25 -25	+10 -25 -25
	Compression Set			
D 395 Method B	22 hours at 158 °F (70 °C), maximum %	25	25	25
	Ozone			
D 1149	25 pphm ozone in air by volume, 20% strain, 100±2 °F (38 ± 1 °C), 48 hours mounting procedure D 518, Procedure A	No Cracks	No Cracks	No Cracks
	Adhesion			
D 429 B	Bond made during vulcanization, lb/in (kN/m)	40 (7.0)	40 (7.0)	40 (7.0)
	Low Temperature Test			
D 746 Procedure B	Brittleness at -40 °F (-40 °C)	No Failure	No Failure	No Failure

Table 623-B

ASTM Standard	*Physical Properties*	*50 Durometer*	*60 Durometer*	*70 Durometer*
D 2240 D 412	Hardness Tensile Strength, minimum psi (MPa) Ultimate elongation, minimum %	50 ± 5 2500 (17) 450	60 ± 5 2500 (17) 350	70 ± 5 2500 (17) 300
	Heat Resistance			
D 573 70 hours at 212 °F (100 °C)	Change in durometer hardness, maximum points Change in tensile strength, maximum % Change in ultimate elongation, maximum %	+15 -15 -40	+15 -15 -40	+15 -15 -40
	Compression Set			
D 395 Method B	22 hours at 212 °F (100 °C), maximum %	35	35	35
	Ozone			
D 1149	100 pphm ozone in air by volume, 20% strain, 100 ± 2 °F (38 ± 1 °C), 100 hours mounting procedure D 518, Procedure A	No Cracks	No Cracks	No Cracks
	Adhesion			
D 429 B	Bond made during vulcanization, lb/in (kN/m)	40 (7.0)	40 (7.0)	40 (7.0)
	Low Temperature Test			
D 746 Procedure B	Brittleness at -40 °F (-40 °C)	No Failure	No Failure	No Failure

f) **Non-Shrink Grout.** Non-shrink grout shall conform to ASTM C1107, Grade C with one modification. The minimum 24-hour strength shall be increased to 5.0 KSI. The sampling and testing procedures of ASTM C1107 need not be changed.

g) **Structural Steel.** Structural steel shall conform to the requirements of Section 605, as applicable.

h) **Protective Coating.** The Contractor shall apply an epoxy coal-tar protection coating system to the surfaces indicated on the Plans. The epoxy coal-tar application shall consist of grinding and preparing the bridge deck surfaces, applying the epoxy coal-tar resin to the prepared surfaces, and coating the epoxy with sand as described herein or as directed by the Engineer.

DESIGN AND MANUFACTURE OF PRESTRESSED MEMBERS:

i) **Plans and Alternate Designs.** The Plans show general details and information, pertaining to the prestressed, precast, concrete members, that serve as an indication of the type of construction acceptable. If the Contractor proposes an alternate design, a complete set of detailed shop drawings, with supporting design computations for the prestressed members to be furnished, shall be submitted in accordance with Subsection 105.04 for approval prior to any work.

The manufacture of prestressed members shall not proceed until the final shop drawings have been approved.

Prepare shop drawings to address all requirements stated in the plans and the requirements stated herein. Shop drawings for post-tensioned concrete segments will not be approved until all of the required submittals for the post-tensioning and for the falsework and erection procedures have been approved, as described in Section p) and special provision "Post-tensioning System", respectively.

j) **Design Criteria.** The design of the prestressed, precast, reinforced concrete members shall meet the requirements of the AASHTO LRFD Specifications for Highway Bridges.

The design load shall be HL 93.
For compressive strength of concrete at 28 days, *f'c* shall be 9,000 psi (62 MPa) minimum.
For compressive strength of concrete at time of initial prestress, *f'c* shall be 6,800 psi (47 MPa) minimum.

k) **General Manufacturing Requirements.** All plants manufacturing prestressed reinforced concrete members for work under this Contract shall be inspected and approved before manufacture of the members may be started. Only PCI certified plants, or plants which have been inspected and approved by the Department, will be permitted to manufacture prestressed primary load carrying members.

All materials, equipment, processes of manufacture, and the finished members, including handling, storage, and transportation, shall be subject to inspection and approval. Any defective construction, which may adversely affect the strength of a member or its performance in the bridge deck, shall be cause for rejection.

Permissible construction tolerances shall be in accordance with those recommended in the PCI Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products. Tolerances for reinforcing bar cover shall be from -1/4 to 1/2" (-6 to +13 mm).

l) **Forms.** Forms and centering shall be made and maintained, during their use, true to the shapes and dimensions shown on the approved drawings.

Unless otherwise provided, only metal forms shall be used. The forms shall be well constructed, carefully aligned, substantial, firm, and securely braced and fastened together. The forms shall be sufficiently tight to prevent leakage of mortar and strong enough to withstand the action of mechanical vibrators.

Form ties shall be either the threaded type or the snap-off type. No form wires or metal pieces shall be left at the surface of the finished concrete. Corners and angles shall be mitered or rounded.

Joints between panel forms shall be made smooth and tight.

m) **Reinforcement, Pretensioning Strands and other components.** Bar reinforcement and pretensioning strands shall be free of frost, dirt, oil, paint, mill scale, corrosion, or any foreign material that may prevent a bond between the steel and concrete. If an antibonding agent is used on the forms, every precaution shall be taken to protect the reinforcement and the pretensioning strands from being coated by the antibonding agent.

Pretensioning strands, post-tensioning anchorages, ducts, vent pipes, miscellaneous hardware, reinforcement, and other embedded fixtures shall be accurately placed as indicated on the drawings and shall be maintained in their correct position during the manufacture of the members.

Ducts shall be accurately aligned and positioned at the locations shown on the Plans or according to the approved Shop or Working Drawings or as otherwise approved by the Engineer. All internal ducts shall be securely fastened in position at regular intervals as specified in special provision "Post-

tensioning System" to prevent movement, displacement or damage from concrete placement and consolidation operations. The method and spacing of duct supports shall be shown on appropriate Shop Drawings.

n) **Pretensioning.** The amount of stress to be given each cable or strand shall be shown on the approved working drawings.

All cables or strands to be prestressed in a group shall be brought to a uniform initial tension prior to being given their full pretensioning. This uniform initial tension shall be approximately 500 lb (2.2 kN) per strand and shall be measured by a dynomometer or other approved means so that the initial tension can be used as a check against elongations computed and measured. After this initial tensioning, the group of strands shall be stressed until the required elongation and jacking pressure is attained. The stress induced in the cables or strands shall be measured both by jacking gages and by elongations of the cables or strands. The calculated stress based on the elongation should closely match the gage reading.

All jacks shall be equipped with accurate and calibrated gages for registering jacking pressures. Means shall be provided for measuring the elongation of the prestressing strands to at least the nearest 1/32" (1 mm).

The Contractor shall be required to furnish the Department with satisfactory, accredited proof that all jacking equipment and gages to be used in the manufacture of the prestressed members have been calibrated by a reputable testing laboratory.

The interpretations and analysis of the elongations and jacking pressures shall consider and allow for all possible slippage or relaxation of the anchorage.

If there is a discrepancy of as much as 10% between the stresses determined by the jacking pressure and the elongation measurement, the entire operation shall be carefully checked and the source of error determined, before proceeding.

After the cables or strands are stressed in accordance with the plan requirements and this Subsection, and all other reinforcing is in place, the concrete shall be placed in the form. The temperature of the concrete shall be between 50 and 85 °F (10 and 29 °C). Cable or strand stresses shall be maintained between anchorages until the concrete has reached a minimum compressive strength of 6,800 psi (47 MPa) and the process of transferring the prestress to the member has begun.

Members shall be steam cured under a suitable enclosure to contain the live steam and minimize moisture and heat losses. The initial application of the steam shall be from four to six hours after the final placement of concrete to allow the initial set of the concrete to take place. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. Application of the steam shall not be directly on the concrete. During application of the steam, the ambient air temperature shall increase at a rate not to exceed 40 °F (22 °C) per hour until a maximum temperature of from 140 to 160 °F (60 to 71 °C) is reached. The maximum temperature shall be held until the concrete has reached the desired release strength. In discontinuing the steam, the ambient air temperature shall not decrease at a rate exceeding 40 °F (22 °C) per hour until a temperature has been reached that is about 20 °F (11 °C) above the temperature of the air to which the concrete will be exposed. The concrete shall not be exposed to temperatures below freezing for six days after casting. Recording charts of steam temperature shall be maintained.

The detensioning shall be done immediately following the curing period while the concrete is still warm and moist. If allowed to dry and/or cool prior to detensioning, dimensional changes take place which may cause cracking or undesirable stresses in the concrete.

In all detensioning operations, the prestressing forces must be kept nearly symmetrical about the vertical axis of the member. The detensioning must be applied in a manner that will minimize sudden or shock loading. Maximum eccentricity about the vertical axis shall be limited to one strand.

Forms, ties, inserts, holddowns, or other devices that would restrict longitudinal movement of the members along the bed shall be removed or loosened. Alternate detensioning shall be performed in such manner and sequence that longitudinal movement is precluded.

After completing the release of the prestresses, the strands shall be cut flush with the ends of the member and painted with either an approved bitumastic compound or waterproofing compound.

o) **Production.** The manufacturing process shall provide uniform production of dense, high grade concrete for all parts of the prestressed members under all working and weather conditions. The operations of mixing, placing, finishing, and curing shall be subject to inspection and approval.

The Contractor shall exercise great care when placing and consolidating concrete so as not to displace or damage any of the post-tensioning ducts, anchorage assemblies, splices and connections, reinforcement or other embedments.

Ends of pier segments, drop-in segment, and interior ends of end segments shall be roughened to an amplitude of ¼".

After post-tensioning and pourbacks have been poured and cured, end segments shall be coated with an approved elastomeric coating, as specified in special provision "Post-tensioning System", for a distance of three times the depth of the beam from each abutment.

The Contractor shall submit a numbering system as part of the shop drawings that identifies the location of each segment in the structure. Each segment shall have an identifying mark clearly shown on one end corresponding to its location and orientation.

p) **Handling, Storage, Shipping and Erection.** Prestressed members may be handled immediately after curing and detensioning of the strands or cables. Members shall not be shipped until at least the minimum 28-day compressive strength has been attained but in no case less than three days after the placing of concrete in the forms. Members shall be handled using the pick-up points provided especially for this purpose. The members shall be maintained in a horizontal position (as when formed on the casting bed) at all times during handling, moving, storing, and shipping.

Members damaged by improper storing, handling, transporting, or erecting shall become the property of and be replaced by the Contractor.

Members will be inspected at the Project site for possible shipping damage and for verification that the member meets all dimensional requirements required by the Contract.

The Contractor shall follow the manufacturer's recommended procedures for handling and placing the precast members during the entire process of transporting, unloading, and installing the members.

(1) **Temporary Components.**

Working drawings and design calculations for falsework, temporary support for Pier Segments, strong back, temporary girderbracing and other temporary components, required to temporarily support the segments during erection shall be sealed and signed by a Licensed Engineer in the State of Delaware and submitted for the Engineer's review. However, the lack of exceptions taken by the Engineer during his review or his acquiescence in the work

constructed according to them shall not relieve the Contractor of full responsibility for the structural adequacy and safety of all such temporary construction, even if the conceptual details and sequenceshown on the plans are used. The working drawings shall completely describe all activities and temporary components needed for each step required to erect the girders. All construction loads proposed by the Contractor shall be clearly stated on the workingdrawings.

Temporary components for falsework shall be designed in accordance with AASHTO Guide Design Specifications for Bridge Temporary Works, 1995 and the AASHTO Construction Handbook for Bridge Temporary Works, 1995. Items not covered by this document shall be designed in accordance with AASHTO LRFD Bridge Design Specifications, 6th edition with 2013 interim revisions and 2005 DelDOT Bridge Design Manual.

(2) Temporary Support for Pier Segment.

To facilitate erection of the girders, a temporary support for the Pier Segment is anticipated. The system to produce this support may include the following components: tie-downs, spreader beams, bearings and blocking. The Pier Segments shall be supported on the blocking such that they will conform to the required final slope of the Pier Segments, taking into account the required haunch at the ends of the segments. The temporary support shall remain in place until the post-tensioning has been installed and accepted. Once the temporary support has been removed, the girders shall be lowered onto the permanent bearings. All girders at a given pier shall be lowered onto the permanent bearings simultaneously. After they are no longer needed, the post-tensioning bars, if used, shall be removed a minimum of two inches below the finished surface of the pier cap and the cap shall be repaired at this location with non-shrink grout.

If sand jacks are used for the blocking, a sample sand jack shall be fabricated and assembled in a manner consistent with how it is intended to be used. Prior to its use on the project, the sample sand jack shall be proof tested by an independent testing laboratory for 150% of the expected maximum design loading based on the approved design and erection procedure. In order to determine the amount of settlement that would be expected due to the loading based on the proposed sand jack design and compaction technique, a load-deflection curve with a minimum of ten data points shall be developed. If the maximum settlement of the tested jack exceeds 1/8”, the sand jack design or compaction procedure shall be modified to reduce the settlement unless an acceptable means of accounting for the anticipated settlement is provided. The test must be performed a minimum of two times to demonstrate the consistency of the load-deformation behavior of the sand jack. The results of the testing shall be submitted to the Engineer for approval. The structural components, properties of the sand, and assembly procedures of the sand jacks used in the girder erection shall be consistent with those of the tested and approved sample sand jack.

If conventional jacks are used for the girder erection, they shall be rated for 150% of the expected maximum design loading, based upon the approved erection procedure. Lifting or support settlements produced on the completed girders by the use of sand jacks or conventional jacks shall not exceed ¼” at each support location.

(3) Temporary Girder Bracing.

In order to stabilize the girder segments against wind and accidental loads during erection, temporary bracing shall be provided. The bracing shall be installed immediately after girders are erected on the structure. A minimum of four bracing locations shall be provided for the Drop-In Segment or End Segments, and three locations for the Pier Segments. Additionally,

lateral bracing may be required. The bracing shall be designed to withstand anticipated wind loads consistent with that defined in ASCE 37-02 "Design Loads on Structures During Construction" in conjunction with ASCE 7-02 "Minimum Design Loads for Buildings and Other Structures" and the design criteria mentioned above. The structure shall be stabilized during construction to resist the specified wind loads with full regard to all intermediate stages of construction. At the Contractor's discretion (and risk) the design wind speed may be reduced by appropriate factors depending on the anticipated exposure period, as defined in Section 6.2.1 of ASCE 37-02. However, the Contractor shall include provisions to reinforce the wind bracing system, in the event that a severe coastal storm is predicted. Materials to reinforce the wind bracing shall be on site and shall be able to be installed within a single working day. If necessary, additional inserts shall be provided in the precast concrete segments to connect the temporary bracing members at no additional cost to the owner. The temporary bracing shall remain in place until the permanent diaphragms have been constructed and the concrete has achieved its design strength.

(4) Strong Back for Support of Drop-In Segment.

To facilitate erection of the segment, the use of Strong Backs is anticipated. Strong Backs shall be installed on top of the Drop-In Segment prior to erecting them in order to temporarily support them before the girder splices are constructed. The location of the Strong Backs may require that reinforcement couplers be used for some of the stirrups that protrude above the top of the beam. The girder shop drawings shall indicate any modifications to the reinforcement that are needed to accommodate the Strong Back. The components of the Strong Back system shall be designed to support the full dead load of the Drop-In Segment plus the weight of the temporary bracing and other construction loads.

A shear transfer device that is designed to transmit transverse loads, such as wind, from the Drop-In Segment to the Pier Segments shall also be provided. As a minimum, the transverse design load for the shear transfer device shall be the full design wind load with no reduction for duration. The shear transfer device shall remain in place until the permanent diaphragms at the splices have been constructed and the concrete has achieved its design strength. The Strong Backs shall remain in place until the post-tensioning has been installed and accepted.

During erection of the Drop-In Segment and End Segments, each segment shall be suspended by a crane until it is in its final position. Before the load is removed from the crane, the space between each end of the Drop-In Segment (i.e. at the splices), or between the end of the End Segment and the abutment at each end of the bridge, shall be blocked such that the required gap is provided. The blocking shall be designed to withstand the force noted on the plans. This blocking shall remain in place until all segments have been erected, bracing has been installed, and the load on each side of each pier has been balanced. After all segments have been erected, the tops of the girders shall be surveyed for the purpose of setting the deck haunch forms. It may be necessary to adjust the final position of the segments by adjusting the opening at one or more of the girder splices by jacking the segments apart. Details for blocking and possible jacking shall be shown on the working drawings.

(5) Splicing the Ducts at the Cast-In-Place Concrete Girder Splices.

Segments shall be shimmed as required such that the corresponding ducts are in alignment. Ducts shall be spliced in accordance with special provision "Post-tensioning System". After all duct splices have been constructed, the ducts shall be pressure tested for leaks in accordance with special provision "Post-tensioning System".

(6) Cast-In-Place Concrete Girder Splices.

Only after successfully constructing and testing the duct splices as described in (4) above, the cast-in-place girder splices may be constructed. The girder splices shall be constructed with concrete meeting the requirements of Section 602, with the minimum compressive strength at 28 days of 6,500 psi (45 MPa). After the girder splices have beenconstructed, prove that the post-tensioning ducts are free and clear of any obstructions or damage and are able to accept the intended post-tensioning tendons by passing a torpedo through the ducts in accordance with the requirements of special provision "Post-tensioning System".

(7) Sequence of Erection.

The prestressed girders and piers as detailed on the Plans have been designed for the sequence of segment erection as described on the Plans. If the Contractor selects a sequence or method of erection for the segments different from that described on the Plans, the Contractor may, at the discretion of the Engineer, be required to submit calculations confirming the adequacy of the girders and piers to resist the resulting erection loads. A geometry control plan that defines survey procedures and adjustment for girder erection shall be submitted for approval. No separate payment will be made for any strengthening of the girders or piers that is required as a result of the Contractor's chosen erection scheme. All costs thereof shall be included in the price bid for prestressed concrete girders.

q) Grouting Between Prestressed Members. After the deck members have been placed and fastened together with tie rods and the end anchor dowels have been placed, the longitudinal joints between adjacent members shall be filled with a non-shrink grout.

Immediately prior to filling the joints, the keyways shall be cleaned of all debris, oil, grease, and other material that may prevent effective bonding. After cleaning, the keyways shall be thoroughly soaked with water and tightly caulked with an approved material, below the bottom of the shear key to avoid grout leaks. The caulking material shall not project more than ½" (13 mm) into the shear key area. In cold weather, the concrete against which the grout will be placed must be frost-free.

The grout shall be mixed to a consistency necessary to place the material. Traffic, or other loading, shall not be permitted on the bridge deck for at least 24 hours after the grout has been placed or, preferably, not until the end of the curing period.

The joints shall be covered with wet burlap, kept wet, and cured for three days.

r) Scuppers. The Contractor shall furnish and install scuppers of the material and at the locations shown on the Plans or as directed.

Method of Measurement:

The quantity of post-tensioned, prestressed, precast, reinforced concrete members, Bulb TBeam placed and accepted, will not be measured.

Basis of Payment:

The quantity of post-tensioned prestressed reinforced concrete members, Bulb TBeam placed will be paid for at the Contract lump sum price. Price and payment will constitute full compensation for furnishing and placing all materials, including the removal and replacement of all prestressed members rejected due to defective construction or improper storing, handling, or transporting; and for all equipment, tools, labor, and incidentals required to complete the work.

No separate measurement and payment will be made for anchorage components, local anchorage zone reinforcement supplied as an integral part of a proprietary anchorage system, nor ducts for similar post-tensioning system hardware. Anchorage components, ducts and similar items of post-tensioning system hardware which are embedded within precast components or cast-in-place concrete shall be deemed to be included in the cost of the precast components or cast-in-place concrete.

No separate measurement and payment will be made for falsework, temporary support for Pier Segments, strong back, temporary girder bracing and other temporary components that may be required for erection of the girders. No separate payment shall be made for cast-in-place girder splices. All costs thereof shall be included in the price bid for post-tensioned prestressed concrete girders.

Separate payment will not be made for permanent tensioning strands which are an integral part of individual precast concrete segments or units. All costs thereof shall be included in the price bid for post-tensioned prestressed concrete girders.

4/7/16

705517 - PORTLAND CEMENT CONCRETE SIDEWALK, SPECIAL

Description:

This work consists of furnishing all materials and constructing reinforced P.C.C. sidewalk in accordance with notes and details on the Plans, these Special Provisions and directions from the Engineer.

Materials and Construction Methods:

Materials and construction methods shall conform to the requirements of Section 705, match the existing Riverwalk conditions in all facets and meet the following provisions:

Colored Concrete - Concrete admixture and color, as noted on the plans, shall match the existing Riverwalk. Follow all manufacturers' recommendations for batching, installing, and curing. Finishes as noted on plans. Concrete shall be sealed as per manufacturer's recommendations.

Reinforcement shall be 6 x 6 - W10 x W10 welded wire fabric meeting the requirements of AASHTO M 221 M and M 225 M. The welded wire fabric shall be placed mid depth of sidewalk slab.

Preformed Expansion Joint Material - Preformed Expansion Joint Material shall conform to the requirements of Subsection 808.06 or otherwise as noted on the plans. All expansion joints shall be sealed with a sealant as noted on the plans color to match colored concrete color.

Brick Pavers - Brick header courses noted on the plans shall match the existing brick 4" x 8" x 2 ¼" brick pavers as noted on the plans. Existing bricks shall be carefully salvaged and reused. Any bricks damaged upon removal shall be replaced in kind. Additional bricks shall be required and should be mixed/blended in with replacement of existing bricks.

Steel Rail - The existing steel crane rail shall be removed, cleaned, stored and reinstalled in the lines indicated on the plans. Additional rail sections shall be required and shall be salvaged as directed by the Engineer from a location in close proximity to the project site.

Method of Measurement and Basis of Payment:

Method of measurement and basis of payment will be in accordance with Subsections 705.11 and 705.12 respectively. Cost of furnishing and placing welded wire fabric, removing, cleaning, storing, reshaping and reinstalling steel rails and brick pavers, and all other items noted on the plans is included in the item.

8/30/16

708583 - PERSONNEL GRATE FOR PIPE INLET

Description:

This work consists of furnishing all materials, fabricating, delivering and constructing personnel grates for pipe inlets in accordance with the Standard Details, at locations as shown on the Plans, as directed by the Engineer and as required by these Special Provisions.

Materials:

Materials shall conform to the requirements of Sections 603 and 612 and shall be galvanized in accordance with Subsection 826.07 including all rebar, hardware and fasteners as shown on the Standard Details.

Working drawings shall be submitted in accordance with Subsection 105.04.

Construction Methods:

Personnel grates for pipe inlets shall be constructed based on the Standard Details and at the size and locations shown on the Plans.

Method of Measurement:

The number of inlet grates to be paid for under this item shall be the actual number of inlet grates installed and accepted.

Basis of Payment:

The quantity of personal grate for pipe inlet will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing, hauling and installing materials, including bar reinforcement; lock, for excavating including removal and disposal of existing end sections, backfilling, and compacting; for cribbing, shoring, sheeting, coating, and paving; and for all labor, materials, equipment, tools, and incidentals required to complete the work. Design services for the personnel grate for pipe inlet including the preparation and submittal of working drawings shall be incidental to this item.

6/11/2013

708585 - JUNCTION BOX, 48" X 30"
708586 - JUNCTION BOX, 48" X 48"
708587 - JUNCTION BOX, 66" X 30"
708588 - JUNCTION BOX, 66" X 48"
708589 - JUNCTION BOX, 66" X 66"

Description:

This work consists of furnishing materials and constructing a junction box of the type specified on the Plans, and as directed. It includes excavation, placing of pipe, concrete masonry, reinforcing and forms all in conformity with the Standard Construction Details, the Plans, and these specifications.

Materials:

Materials used in the construction of the junction box shall conform to Subsections 708.02, 708.03, and 708.04 of the Standard Specifications.

Construction Methods:

Construction methods shall conform to Standard Construction Details and applicable requirements of Section 708 of the Standard Specifications.

Method of Measurement:

The quantity of junction boxes will be measured as the actual number of junction boxes constructed in accordance with these special provisions, complete in place and accepted.

Basis of Payment:

The quantity of junction boxes will be paid for at the Contract unit price for each. Price and payment shall constitute full compensation for furnishing and placing all materials, including bar reinforcement; for all excavation and backfilling around the structures, for the disposal of surplus materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

6/27/01

715502 - TEMPORARY DRAINAGE PIPE, 30"
715503 - TEMPORARY DRAINAGE PIPE, 48"
715505 - TEMPORARY DRAINAGE PIPE, 15"
715506 - TEMPORARY DRAINAGE PIPE, 24"
715507 - TEMPORARY DRAINAGE PIPE, 36"
715508 - TEMPORARY DRAINAGE PIPE, 18"
715510 - TEMPORARY DRAINAGE PIPE, 12"
715515 - TEMPORARY DRAINAGE PIPE, 60"

Description:

This work consists of furnishing, installing, and disposing of temporary drainage pipe and end sections in accordance with the locations and elevation shown on the Plans and as directed by the Engineer.

Materials:

Pipe, fittings, and end sections initially furnished under this section shall be as noted on the Plans. If material is not specified on the Plans, the Contractor may use either Corrugated Polyethylene Pipe meeting the requirements of AASHTO M 294 or reinforced concrete pipe meeting the requirements of Section 612 of the Standard Specifications, or corrugated metal pipe meeting the requirements of Sections 614 of the Standard Specifications and as noted on the Plans. End sections and fittings shall be the same material as the pipe.

The pipe provided shall have a connection systems with all necessary gaskets, sealers, clamps, etc. required to produce water tight joints.

Construction Methods:

Temporary pipe is to be placed in accordance with Standard Specification Section 208 except that in order to maintain drainage during embankment construction, it will be necessary to install the temporary pipe prior to placement of the fill.

The temporary pipes shall be installed with leak resistant joints. The Contractor shall be responsible for the repair of leaks and damage caused by such leaks.

Temporary pipe is to be backfilled utilizing suitable excavated material or material being used for construction of the embankment over the pipe.

Required compaction shall be 95% or more of the laboratory maximum density.

The Contractor shall be responsible for placing sufficient embankment over the temporary pipe prior to crossing the area with any substantial loads. Any pipe damaged due to excessive loading must be excavated, replaced and backfilled by the Contractor at his/her expense. In areas of multiple pipes, sufficient separation of the pipes shall be maintained in order that proper compaction around all pipes can be performed.

If pipes are not to be covered with fill, they shall be securely anchored to prevent movement under use.

In order to maintain stream flow at all times, it will be necessary to offset the temporary pipe location from the permanent pipe location. Necessary diversion of ditches to align the flow through the temporary pipe and then back through the permanent pipe shall also be performed under this item.

When pipe is no longer needed it shall be removed and the resulting trench shall be backfilled. Where under final roadway the backfill material shall conform to the requirements of Borrow Type C. When water is present Borrow Type B shall be used for backfill up to 12" (300 mm) above the elevation of the water.

Method of Measurement:

The quantity of temporary drainage pipe will be measured as the actual number of linear feet (linear meters) of pipe installed and accepted, measured end to end including any fittings, end sections, couplings or connecting bands which will not be measured or paid for separately.

Basis of Payment:

The quantity of temporary drainage pipe will be paid for at the Contract unit price per linear foot (linear meter). Price and payment will constitute full compensation for furnishing, hauling, and installing the pipe, fitting, and end sections, for all cribbing, shoring and sheeting, and for all materials including couplings or connecting bands, labor, equipment, tools, and incidentals necessary to complete the work. Also included in this item is the excavation, backfill, and backfilling necessary to install the pipe, remove the pipe, and fill the empty trench.

If pipes are not covered with fill, this item will include all cost for securely anchoring the pipes and all cost for complete removal of such anchoring system.

Following its removal, the temporary pipe, fittings, and end sections will be eligible for reuse at other location(s) of this Contract if approved by the Engineer and desired by the Contractor. The Engineer shall be the sole authority in determining the acceptability of the pipe, fittings, and end sections for reuse. If approved, any reuse of temporary pipe, fittings, and end sections will again be paid as if the pipe was new. All provisions outlined in this specification will apply to both new and reused pipes.

After final use of the pipes, fittings, and end sections, they shall become the Contractor's property and shall be removed from the project. However, the Contractor may use these pipes, fittings, and end sections for similar work on this job at different locations(s) or on different jobs if found to be in good condition as determined by the Engineer.

10/25/01

720512 - P.C.C. SAFETY BARRIER PERMANENT, DOUBLE FACE
720529 - P.C.C. SAFETY BARRIER PERMANENT, SINGLE FACE
720587 - P.C.C. SAFETY BARRIER PERMANENT, DOUBLE FACE, MODIFIED

Description:

This work consists of furnishing all materials and constructing permanent Portland cement white concrete safety barrier in accordance with the locations, details, notes shown on the Plans, and/or as directed by the Engineer.

Materials:

Material shall conform to the requirements listed on the Plans, and as noted herein. Portland cement concrete shall be 4500 psi minimum and shall conform to the material requirements of Class A, Section 812, Portland Cement Concrete of the Standard Specifications with the following modifications:

Portland cement shall be White Cement.

Fine Aggregate shall be white sand from a source approved by the Department.

Bar reinforcement shall be epoxy coated and meet the material requirements of section 824.02 of standard specification manual.

All Portland cement and white sand used for construction of all white concrete barriers on the project shall be from the same supplier for the entirety of the project. No changes or substitutions of suppliers will be allowed once construction of the white concrete on the project commences. The manufacturer of the white concrete for the project shall dedicate a hopper to the manufacture of the white concrete for this project to ensure no cross contamination with regular Portland cement or sand. The white concrete items shall be white Portland cement or 60% non-white Portland cement + 40% slag.

Construction Methods:

Construction shall conform with the applicable subsections of Sections 602 and 603 of the Standard Specifications, and details shown on the Plans.

The Contractor shall have the option of constructing the permanent safety barriers by selecting Cast-In-Place or Slip-form methods. The Contractor shall submit his/her plans for the selected method to the Department's Materials and Research Section for approval. In case of selecting the Slip-form method, the Contractor shall be able to demonstrate his/her ability to successfully accomplish the item by his/her past involvement in doing such work. Slip-form plans shall show the sawing of 3” deep contraction joints at a maximum of 20-ft. intervals. The Contractor shall saw joint to ensure crack-free concrete. Any cracking due to the Contractor’s operations will be repaired at no additional cost to the Department.

Method of Measurement:

The quantity of permanent Portland cement safety barrier will be measured by the linear foot along the toe of the barrier, installed in place and accepted.

Basis of Payment:

The quantity of Portland cement safety barrier will be paid for at the Contract unit price per linear foot for each type of barrier. Price and payment will constitute full compensation for all material, formwork, sawing of joints, reinforcement bars, and concrete all complete in place and accepted, for all labor, equipment, tools and incidentals necessary to complete the work. Payment for excavation and the P.C.C. footer portion of the barrier are included in this item.

6/27/16

720550 - PORTLAND CEMENT CONCRETE BARRIER, MODIFIED

Description:

This work consists of furnishing all materials and constructing the Portland Cement Concrete Safety Barrier, Modified in accordance with the locations, details, and notes shown the Plans, and/or as directed by the Engineer.

Material:

Material shall conform to the requirements listed on the Standard Construction Details, Plans, and as noted herein. Portland Cement Concrete shall be 4500 psi (30 MPa) minimum and shall conform to the material requirements of Class A, Section 812, Portland Cement Concrete of the Standard Specifications.

Bar reinforcement shall meet the requirements of AASHTO M 31M, Grade 400.

Construction Methods:

Construction methods shall conform with the applicable subsections of Sections 602 and 603 of the Standard Specifications, and details shown on the plans.

The Contractor shall have the option of constructing the modified safety barriers by selecting Cast-In-Place, or Pre-Cast methods. The Contractor shall submit his plans for the selected method to the Department's Materials and Research Section for approval.

Method of Measurement:

The quantity of modified Portland Cement Concrete Barrier will be measured in linear feet (linear meters) along the toe of the barrier, installed in place and accepted.

Basis of Payment:

The quantity of modified Portland Cement Concrete Barrier will be paid for at the Contract unit price bid per linear foot (linear meter). Price and payment will constitute full compensation for all material, formwork, sawing of joints, reinforcement bars, and concrete all complete in place and accepted, for all labor, equipment, tools and incidentals necessary to complete the work. Payment for excavation shall be made elsewhere in the contract.

8/8/02

727519 - RELOCATE CHAIN LINK FENCE

Description:

This work consists of furnishing any required new materials and resetting the chain link fence shown on the Plans. The fence shall be reset at locations as directed by the Engineer. Footings shall conform to the detail shown on the Plans.

Materials:

All materials lost or in any way damaged shall be replaced with new material matching the present fences. Concrete for the new post footings for the fences shall conform to Section 812, Class B, Portland Cement Concrete.

Construction Methods:

The fences shall be reset true to line and grade. The elevation of the top of the fences shall be uniform. Necessary grading to accomplish these requirements shall be performed by the Contractor as part of the Contract.

Method of Measurement:

The quantity of relocated chain link fence will be measured the actual number of linear feet (meters) of fence relocated and accepted, measured in place along the line of the fence in the area of relocation only.

Basis of Payment:

The quantity of relocated chain link fence will be paid for at the Contract price per linear feet (meter). Price and payment will constitute full compensation for resetting the present fence, connecting to existing fence, all fittings, hardware, corner supports, and braces; clearing the line of the fence, grading the area to conform to the contours of the adjacent area, furnishing and placing concrete for posts and for any backfill required, furnishing and placing all materials required to make any repairs to the existing fences and in resetting the fence, and for all labor, equipment, tools, and incidentals necessary to complete the item.

8/30/16

727538 - RELOCATE GATE

Description:

The item shall consist of removing and resetting the gate and gate posts in accordance with the notes and at the location listed below, and/or as directed by the Engineer.

Materials:

Any material for relocate gate shall conform to the requirements of the following Section and Subsections:

Portland Cement Concrete, Class B, (812)

Construction Methods:

The Contractor shall carefully remove the gate from the existing location and reset at the location designated on the Plans, exercising every precaution to avoid and/or minimize damage to the gate. The Contractor shall safely store the gate, if necessary, until it can be reset. If, in the opinion of the Engineer, damage to the gate was caused due to the negligence of the Contractor, the Contractor shall make the repairs to the gate at his own expense to the satisfaction of the Engineer.

The gate posts shall be cleaned of any existing debris including existing foundation concrete. If in the opinion of the Engineer the existing posts are not satisfactorily cleaned, the Engineer may request that the Contractor supply new posts, at no additional cost to the project. The size, type and length shall match the existing posts. The posts shall be set plumb, true to the line and grade shown on the plans. Each gate post shall be embedded in a concrete footing with the minimum dimensions as specified in Section 727.07 - Concrete Footings.

Method of Measurement:

The quantity of Relocate Gate will be measured as the actual number of gates relocated and accepted by the Engineer.

Basis of Payment:

The quantity of Relocate Gate will be paid for at the unit price bid for Relocate Gate. The payment will constitute full compensation for all of the work necessary to remove and relocate the gate and gate posts, including, but not limited to connection to existing fence, fittings and hardware, support posts and braces, removing the existing gate and posts, cleaning the posts, supplying new posts when requested by the Engineer, removing the existing post foundations, backfill, backfilling the existing foundation hole, relocating the gate and posts, storing the gate and posts, excavation for the foundation, foundation concrete, placing the concrete, resetting the gate and posts, disposing of surplus materials, backfill, backfilling around the foundation, and for all labor, tools, equipment and incidentals necessary to complete the work.

8/30/16

743526 - GALVANIZED TELESCOPING STEEL SIGN POSTS, 9'x2", COMPLETE W/ BASEPOSTS & HARDWARE
743527 - GALVANIZED TELESCOPING STEEL SIGN POSTS, 10'x2", COMPLETE W/ BASEPOSTS & HARDWARE
743528 - GALVANIZED TELESCOPING STEEL SIGN POSTS, 11'x2", COMPLETE W/ BASEPOSTS & HARDWARE
743529 - GALVANIZED TELESCOPING STEEL SIGN POSTS, 12'x2", COMPLETE W/ BASEPOSTS & HARDWARE
749567 - GALVANIZED STEEL SIGN POST ONLY, 9'x2"
749568 - GALVANIZED STEEL SIGN POST ONLY, 10'x2"
749569 - GALVANIZED STEEL SIGN POST ONLY, 11'x2"
749570 - GALVANIZED STEEL SIGN POST ONLY, 12'x2"
749571 - GALVANIZED BASEPOST SECTION ONLY, 36" X 2.25"
749572 - GALVANIZED BASEPOST SECTION ONLY, 18" X 2.5"
749573 - UNC CORNER BOLT, GRADE 5 .3125", COMPLETE WITH NUT
749575 - GALVANIZED STEEL SIGN POST ONLY, POWDER COATED, 10'x2"
749576 - GALVANIZED STEEL SIGN POST ONLY, POWDER COATED, 11'x2"
749577 - GALVANIZED STEEL SIGN POST ONLY, POWDER COATED, 12'x2"

Description:

This work consists of designing, furnishing all materials, and fabricating telescoping steel sign posts, including any and all bolts, nuts, baseposts, and hardware, in accordance with these special provisions, the locations, notes and details on the Plans and as directed by the Engineer.

The four items referred to as 'Telescoping' are complete units inclusive of one specified length 2" sign post, one 36" x 2.25" basepost, one 18" x 2.5" basepost, one corner bolt and one nut. The remaining items are to be ordered individually to be used as replacement parts.

Materials:

The sign posts shall be square tubes formed from Galvanized Sheet Structure (Physical) Quality, ASTM A 570, Grade A, Coating designation G90, Regular Spangle or formed from Hot Rolled Carbon Sheet Steel Structural (Physical) Quality, ASTM A 570, Grade 50. All square tubes shall be 12 gauge.

Cold rolled steel is to be hot dipped galvanized conforming to the latest revision of ASTM A 653, coating designation G90, Grade 50, Class 1 with regular spangle. The coating shall form an excellent bond with the steel surface so as not to be affected by subsequent forming operations. Exposed edges shall be protected against corrosion by sacrificial action when zinc is present on intimate adjacent areas. Both the interior and exterior of the post shall be galvanized.

Hot rolled steel, after forming, is to be hot dipped galvanized conforming to the latest revision of ASTM A 653 with a minimum coating of 0.90 oz. per square foot (270 gm per square meter) when tested according to ASTM G90. All holes and end openings shall be free of excess amounts of zinc, so as to provide for any other alternate coating system/combination, but is intended to be a hot dipped galvanized zinc coating.

Permissible Tolerances:

(1) Wall thickness shall be 0.1084" ± 0.008" (2.73 mm ± 0.20 mm).
Note: The thickness includes both the base metal and the galvanized coating.

(2) Nominal Outside Dimensions, inches (millimeters):

2 x 2 ± 0.008 (51 x 51 ± 2.2)
2 1/4 x 2 1/4 ± 0.010 (57 x 57 ± 2.5)
2 1/2 x 2 1/2 ± 0.010 (63 x 63 ± 2.5)

Note: Measurements for outside dimensions shall be made at least 2" (50 mm) from end of tube.

(3) Convexity and concavity to be measured in the center of the flat sides, tolerances being ± 0.010" (± 0.25 mm) applied to the specific size determined at the corner.

(4) Permissible variation tolerance in straightness is 1/16" in 3 feet (1.7 mm in 1 meter).

(5) Length tolerance on standard length members with holes shall be no more than 2 1/8" (54 mm) longer.

Nominal Outside Dimension, in (mm)	Twist Permissible in 3 ft, in (1 m, mm)
2 x 2 (51 X 51)	0.062 (1.72)
2 1/4 x 2 1/4 (57 X 57)	0.062 (1.72)
2 1/2 x 2 1/2 (63 X 63)	0.075 (2.08)

Squareness Tolerance, in (mm)
± 0.012 (± 0.30)
± 0.013 (± 0.36)
± 0.015 (± 0.38)

Holes:

All four sides are to have evenly spaced 7/16" (11 mm) diameter holes on 1" (25 mm) centers the entire length of the tube.

Tolerance on hole size is ± 1/64" (± 0.4 mm). Tolerance on hole spacing is ± 1/8" in 20 feet (± 3 mm in 6 m).

Fabrication: The furnished members shall be straight and shall have a smooth uniform finish. It shall be possible to telescope consecutive sizes of tubes freely for 9' (2.7 m), 10' (3 m), 11' (3.3 m), and 12' (3.6 m) with a minimum amount of play. All holes and cut off ends shall be free from burrs.

Corner Radii: Standard corner radius shall be 5/32" ± 1/64" (4 mm @ 0.4 mm).

Weld Flash: Weld flash on corner welded square tubing shall permit 9/64" (3.6 mm) radius gauge to be placed in the corner.

Fasteners: The fasteners to be supplied under this specification shall be 5/16" (8 mm) Grade 5 UNC corner bolts and nut with cadmium or zinc plating.

Basepost: The galvanized basepost section shall be 18" x 2.5" and 36" x 2.25".

Packaging: Posts shall be securely wired or strapped in bundles containing not more than 2000 lb (900 kg) of posts or anchors of the same length and section weight. The posts shall be nested and fastened in such a manner that they will not slip. Care shall be taken in shipping to minimize the rubbing of posts against each other with resulting damage. Excessive damage to the finish of the posts in shipping will be cause for rejection of the damaged posts as determined by the Engineer.

Special Instructions: The vendor must certify that the posts meet the criteria for yielding sign supports as established by the Federal Highway Administration.

Powder Coating: Powder coated posts shall be polyester based powder coated (black) over galvanization to minimum dry thickness of 3.0 mm.

Methods of Measurement:

The quantity of telescoping steel sign post, steel sign post, basepost, corner bolt and nut will be measured as the number of each size which are furnished and accepted.

Basis of Payment:

The quantity of telescoping steel sign post, steel sign post, basepost, corner bolt and nut will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing and delivering all materials, equipment and incidentals necessary to complete the work.

08/21/06

743552 – PEDESTRIAN CHANNELIZING BARRICADE SYSTEM

Description:

Furnish, place, relocate, and maintain a pedestrian channelizing barricade system in accordance with the requirements of the Americans with Disabilities Act (ADA), the Delaware Manual on Uniform Traffic Control Devices (DE MUTCD), these specifications, the plans and details, and as directed by the Engineer.

Materials:

Furnish a pedestrian channelizing barricade system meeting the National Cooperative Highway Research Program (NCHRP) Report 350 or the Manual for Assessing Safety Hardware (MASH) Test Level 2 certification. The approved system must have been tested as a barricade in accordance with the NCHRP 350 and/or MASH testing criteria. Submit a copy of the FHWA certification letter and associated documentation to the Engineer prior to the preconstruction meeting with the Department and prior to installation of the device on the project.

A. *Barricade Rails:*
   1. Manufactured from high density polyethylene (HDPE) with UV inhibitors.
   2. Barricade rails must accommodate a minimum of 7 3/4" (197 mm) wide retroreflective sheeting on both sides of the rails.
      a. Use white prismatic and fluorescent orange retroreflective sheeting where the white and fluorescent orange colors are placed at 45-degree angles.

B. *Barricade supports:*
   1. Manufactured from high density polyethylene (HDPE) with UV inhibitors and internally ballasted.
      a. Use ballast material in accordance with manufacturer recommendations.

Construction Methods:

Construct the barricade with continuous delineation along the designated walkway for use as a channelization device.

A. Assemble the barricade without hardware and in accordance with manufacturer's recommendations.

B. Provide continuous upper and lower rails for hand or cane trailing.
   1. Install upper rail of barricade a minimum 36" (1 m) above the ground, measured from the ground to the top of the upper rail.
   2. Install lower rail of the barricade a minimum of 1 ½" (38 mm) above the ground, measured from the ground to the bottom of the lower rail.

C. No portion of the barrier structure or supports may extend into the walkway more than 3/4" (19 mm) further than the common plane formed by the upper and lower rails.

D. Ensure that barricade joints are smooth and snag-resistant to accommodate safe hand trailing.

E. Provide accommodations for attachment of audible information devices.

F. Pedestrian channelizing barricades cannot be used as road closure barricades or provide positive protection between the temporary walkway and vehicular traffic.

G. Remove pedestrian channelizing when it is no longer needed.
   1. Dispose of all materials in accordance with Subsection 106.09

Method of Measurement:

Pedestrian channelizing barricade will be measured along the linear centerline of the barricade in units of linear feet per day (LF/DY), acceptably installed, maintained, removed and completed as specified

Basis of Payment:

Pedestrian channelizing barricade will be paid for at the contract unit price bid per linear feet per day for the item Pedestrian Channelizing Barricade. Price and payment includes full compensation for providing certification, furnishing, placing, maintaining, and relocating the barricades as required, all labor, equipment, tools, and all incidentals necessary to complete the work. Replace barricades stolen or damaged at no cost to the Department.

8/30/16

743553 – TEMPORARY PEDESTRIAN PATHWAY

Description:

Furnish, place, relocate, and maintain temporary pedestrian pathway in accordance with the requirements of the Americans with Disabilities Act, locations, notes and details in the Plans and as directed by the Engineer.

Surface Materials:

Portland Cement Concrete	Section 812
Hot-mix	Section 823
Cold-Patch	Section 815
Milled Hot-Mix Base Course	Section 821

Construction Methods:

1. Construct a temporary pedestrian pathway having a smooth, continuous hard surface using one of these materials: Portland cement concrete (PCC), hot-mix, cold patch or milled hot-mix base course.
   A. Placement of Portland Cement Concrete in accordance with Section 500
   B. Placement of Hot-Mix in accordance with Section 400
   C. Placement of Milled Hot-Mix Base Course in accordance with Section 300

2. Meet the requirements of the Americans with Disabilities Act for running slope, cross slope, vertical differences and openings.

3. Remove temporary pedestrian pathway when it is no longer needed.
   A. Dispose of all materials in accordance with Subsection 106.09

Method of Measurement:

The quantity of temporary pedestrian pathway will be measured as the number of square yards of surface area acceptably installed, maintained, removed and completed as specified.

Basis of Payment:

The quantity of temporary pedestrian pathway will be paid for at the Contract unit price per square yard acceptably installed, maintained, removed and completed as specified by the Contract. Price and payment will constitute full compensation for preparing, furnishing, placing, finishing and compacting the materials, maintaining the pathway, removal and disposal of the pathway when it is no longer needed, restoring and seeding the area to its original configuration, and for furnishing all labor, equipment, tools and incidentals required to complete the work.

Any necessary seeding will be paid under the respective item.

2/24/12

744500 - CONDUIT JUNCTION WELL, TYPE 6, PRECAST POLYMER CONCRETE
744506 - CONDUIT JUNCTION WELL, TYPE 7, PRECAST POLYMER CONCRETE
744507 - CONDUIT JUNCTION WELL, TYPE 8, PRECAST POLYMER CONCRETE
744508 - CONDUIT JUNCTION WELL, TYPE 9, PRECAST POLYMER CONCRETE
744509 - CONDUIT JUNCTION WELL, TYPE 10, PRECAST POLYMER CONCRETE
744520 - CONDUIT JUNCTION WELL, TYPE 1, PRECAST CONCRETE
744523 - CONDUIT JUNCTION WELL, TYPE 4, PRECAST CONCRETE
744524 - CONDUIT JUNCTION WELL, TYPE 5, PRECAST CONCRETE
744530 - CONDUIT JUNCTION WELL, TYPE 11, PRECAST CONCRETE/POLYMER LID-FRAME
744531 - CONDUIT JUNCTION WELL, TYPE 14, PRECAST CONCRETE/POLYMER LID-FRAME
744532 - CONDUIT JUNCTION WELL, TYPE 15, PRECAST CONCRETE/POLYMER LID-FRAME

Description:

This work consists of supplying, constructing and installing conduit junction wells as shown on the applicable Plan Sheets or Standard Construction details.

Materials:

Concrete shall conform to Section 812, Class B of the Standard Specifications.

Castings shall conform to Section 708.05 of the Standard Specifications.

Frames and lids shall be in accordance with Sections 708 and 744 of the Standard Specifications.

All required hardware and wire for Bonding and Grounding as shown on the Standard Construction or applicable Plan details.

Types 6, 7, 8 and 10 are precast polymer concrete stackable boxes with no base.

Precast polymer concrete is reinforced by heavy-weave fiberglass with a compressive strength of 9,000-15,000 psi, impact energy of 30-72 ft. lbs. and a tensile strength of 800-1,100 psi. Precast polymer concrete should be tested according to the requirements of ASTM Method D-543, Section 7, Procedure 1 for chemical resistance.

All precast polymer concrete covers shall be the heavy-duty type with a design load of 15,000 lbs. over a 10" square. The coefficient of friction should be greater than 0.5. The precast polymer concrete cover logo shall bear the inscription "DelDOT" (Types 6, 8, and 10) or "DelDOT TRAFFIC FIBER OPTICS" (Type 7).

Types 11, 14, and 15 are precast polymer frame and lids installed on a precast concrete base. Precast polymer concrete frame and lids shall be the heavy-duty nonconductive type with a design load of 15,000 lbs. over a 10" square. The coefficient of friction should be greater than 0.5. The precast polymer concrete lid logo shall bear the inscription "DelDOT ELECTRIC"(Types 11, 14, and 15).

Construction Methods:

The conduit junction well shall conform to the dimensions shown on the Standard Construction or applicable Plan Details, or on the manufacturer's specifications and shall be built so as to ensure that the cast iron frame and lid or polymer concrete box and cover are set level with the surrounding surface when constructed within pavement, sidewalks, pedestrian curb ramps, etc., and set above grade and graded to drain away from the junction well when constructed in unpaved areas. More than one conduit may extend into the well and shall conform to the dimensions shown on the applicable plan sheets or Standard Construction Details. A stone base shall be built for all types of junction wells. Grounding and bonding of the units shall be performed as shown on the plans or Standard Construction details.

Method of Measurement:

The quantity of junction wells shall be the actual number of conduit junction wells by type, that are supplied, constructed, complete in place, and accepted, including cast iron frames and lids with grounding lugs, precast polymer concrete frame and covers, or precast polymer concrete covers, stone base, bonding, grounding, and splicing if required. Frames and lids or precast polymer concrete covers must be installed prior to acceptance of this item.

Payment for all conduits extending into the junction well shall be included in the items for conduit installation.

The length of ALL conduits within a junction well shall conform to the Standard Construction or applicable Plan Details or as directed by Engineer. Payment for cutting existing conduit as directed by Engineer, where a junction well is replaced with a larger type of junction well is included in the bid price. The removal and replacement of cables within the conduits to be shortened shall be handled under other items of this contract.

Basis of Payment:

Payment for conduit junction wells as measured above shall be made at the Contract unit price per each junction well of the type indicated, completely installed and constructed, including excavation, backfilling, and stone base. Price and payment will constitute full compensation for all labor, equipment, tools, and incidentals required to complete the work.

2/29/12

744529 – P.C.C. BARRIER, JUNCTION WELL

Description:

This work consists of furnishing junction wells (located in P.C.C. Barrier sections) of the sizes and types shown on the Plans.

Materials and Construction Methods:

Junction boxes (or pull boxes) shall be rated Nema 4X. The cover shall be of the same material as the box, fastened with stainless steel screws, and rain-tight.

Furnish grounding lugs that are UL listed and approved for copper wire. Use stainless steel for both inside and outside mechanical connections to the junction box.

Conduit knockouts shall be made in the junction box by an approved method. Each conduit entrance shall accommodate the nominal outside diameter of the conduit specified on the plans. All conduits are to be secured to the junction box using washers, locknuts, and bushings. A drain pipe with outlet to free air shall be installed in the junction box as detailed on the Plans.

Method of Measurement:

The quantity of P.C.C. Barrier, Junction Well will be measured as the actual number of junction boxes of the size specified furnished and accepted under the terms of this Contract.

Basis of Payment:

The quantity of P.C.C. Barrier, Junction Well will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for all materials, including box, cover, gasket, drain pipes, cover screws, grounding lugs, necessary fittings and hardware, and all incidentals to the satisfaction of the Engineer.

Installation of P.C.C. Barrier, Junction Well will be incidental to the pertinent concrete or barrier wall item.

9/7/06

745601 – FURNISH & INSTALL UP TO 3" FLEXIBLE METALLIC-LIQUIDTIGHT CONDUIT
745602 - FURNISH & INSTALL UP TO 4" SCHEDULE 80 HDPE CONDUIT (BORE)
745603 - FURNISH & INSTALL UP TO 4" SCHEDULE 80 PVC CONDUIT (OPEN CUT)
745604 - FURNISH & INSTALL UP TO 4" SCHEDULE 80 PVC CONDUIT (TRENCH)
745605 - FURNISH & INSTALL UP TO 4" SCHEDULE 80 PVC CONDUIT (ON STRUCTURE)
745606 - FURNISH & INSTALL UP TO 4" GALVANIZED STEEL CONDUIT (TRENCH)
745607 - FURNISH & INSTALL UP TO 4" GALVANIZED STEEL CONDUIT (BORE)
745608 - FURNISH & INSTALL UP TO 4" GALVANIZED STEEL CONDUIT (OPEN CUT)
745609 - FURNISH & INSTALL UP TO 4" GALVANIZED STEEL CONDUIT (ON STRUCTURE)
745610 - FURNISH & INSTALL UP TO 4" NONMETALLIC POLE RISER SHIELD

Description:

Furnish and install HDPE, PVC, or Galvanized steel conduits of any size less than or equal to 4 inches in diameter (3 inches or less for Flexible Metallic Liquidtight Conduit) as described below.

Materials:

All conduits shall be UL listed.

HDPE Conduit - 4" or less diameter, high density polyethylene (HDPE) schedule 80, smooth wall conduit with permanently pre-lubricated lining, meeting ASTM D2447, ASTM D3035 and NEMA TC7 specifications.

PVC Conduit - 4" or less diameter, schedule 80 rigid polyvinyl chloride (PVC) conduit, meeting Commercial Standard CS-272-65 (PVC), ASTM D-1785 and U.C. Standard 651 specifications.

Galvanized Steel Conduit - 4" or less diameter, rigid galvanized steel conduit meeting National Electric Code 2002, Article 344.

Nonmetallic Pole Riser Shield – 4" diameter or less nonmetallic pole riser shield with belled ends meeting NEMA TC-19 specifications.

Flexible Metallic-Liquidtight Conduit – meets National Electric Code 2002, Article 350

Weatherhead for galvanized or PVC conduit – material shall match the adjoining conduit

Insulated grounding bushing with knockouts - meet or exceed UL 514 B

Condulets for conduit sizes - material shall match the adjoining conduit

Anchors - A 307, Galvanized per A 153

One hole conduit hangers - Steel City Series 6H or 6H-B, CADDY CD3B Rigid Conduit Hanger, or approved equal

End caps - material shall match the adjoining conduit

LONG sweep sections for conduit sizes - material shall match the adjoining conduit, and shall be manufactured 90 degree sweeping bends.

Construction Methods:

General Installation Requirements - The Department has the right to reject any installation method proposed for a given work site. PVC shall not be installed under existing pavement unless it is on a continuous roll or with the Engineer's written approval.

Conduit installed underground shall be installed in a straight line between terminal points. In straight runs, junction well spacing shall be no more than 600 feet for fiber optic conduit or no more than 300 feet for copper in conduit, or as directed by the Engineer. If bends are required during installation, they must be manufactured sweeping bends. The Engineer will be consulted before any bends are installed to ensure that the proper arc is provided.

Conduit shall have a minimum cover as measured from the finished grade of 24 inches and a maximum cover of 48 inches.

The opening shall be filled half way with the cover material, and tamped down firmly before filling in the remainder of the opening. Additional lifts shall be used as required to install the metallic warning tape at the specified depth. All cover material shall be free of rocks, debris, vegetation or other deleterious material that may damage the conduit. An underground utility warning tape shall be installed as specified in this section and the remainder of the fill shall be added, tamping down the top layer.

Conduit not terminated to a base or in a junction well shall be terminated 2 feet beyond the edge of the pavement unless otherwise directed by the Engineer, and properly capped. Tape is NOT an approved method. Conduit shall not extend more than 3 inches inside a junction well. See Standard Construction Details or applicable Plan Details for typical methods of termination.

All underground conduits shall be marked in the ground with a metallic warning tape. The marking tape shall be buried directly above the conduit run that it identifies, at a depth of approximately 12 inches below final grade. The tape identifying ALL conduits shall be at least 6 inches wide, and have a minimum thickness of 3 mils and 500 percent elongation.

The color of the metallic warning tape identifying fiber optic cable should be bright orange (preferably AULCC orange), and shall read "WARNING - OPTICAL CABLE" or other wording approved by the Engineer that conveys the same message. The color of the tape identifying all other cables shall be bright red, and shall read "WARNING —BURIED ELECTRIC BELOW" or other wording approved by the Engineer that conveys the same message.

Using conduit tools, rigid metallic conduit shall be cut, reamed, and threaded. The thread length shall be as necessary to ensure that the sections of conduits when screwed into a coupling and tightened correctly will butt together and the joint will be watertight. A three-piece threaded union, as approved by the Engineer, shall be used to join two threaded lengths of conduit in the case where a standard coupling will not work. A threaded union shall not be used in a conduit run that is to be driven. At no time is a threadless coupling or a split-bolt coupling to be used for direct buried conduit.

All lengths of HDPE conduit shall be connected with irreversible fusion couplings. Mechanical and removable couplings will not be accepted.

All lengths of PVC conduit shall be connected by one conduit end fitting inside the flared end of the other conduit section. If this is not possible, then a coupling may be used. Regardless of how connection is made, all joints shall be sealed with the appropriate epoxy to ensure that the two conduit pieces bond to one another to form a solid waterproof link. Using conduit tools, the conduit shall be cut and prepared. If approved by the Engineer, a coupler module may be used where conduit segments do not align properly to allow the flared end of one conduit segment to mate with the normal end of the other segment.

Sealed end caps (with knockouts if empty) shall be placed on the ends of all conduits, after compressed air has been used to clear all foreign matter.

If not already pre-installed by the manufacturer, a polyester or polypropylene pulling rope or tape (fish wire) with a minimum rated strength of 1250 pounds shall be installed in each conduit for future use. In instances where the Contractor installs the cable, the fish wire may be eliminated.

All PVC and HDPE conduits shall have a continuous metallic trace wire installed for the entire length of the conduit run for all fiber installations.

Installation Of Conduit Under Existing Pavement, Directional Bore -

Directional bore shall be used for installation of conduits under existing pavement with a conduit diameter not less than 1-1/2". The size of a bore shall not exceed the outside diameter of the conduit by more than 1 inch. If it does, cement grout shall be pumped into the void. **Only HDPE and/or Galvanized Steel conduit may be installed by Directional Bore methods.**

Installation Of Conduit Under Existing Pavement, Open Cut -

Installation by sawcutting the full pavement depth and removing the existing pavement with an excavator or by hand methods, shall be used only for conduits not less than 1-1/2" diameter. The Engineer must first approve all open cutting of roadways. The width and length of open cut and patch restoration materials shall be as shown on the plan details. The Contractor shall be responsible for the removal of all cut pavement and surplus excavation, and for the replacement and correction of any damaged pavement outside the sawcut limits after the conduit(s) are installed. Asphalt pavement, concrete, base course, sawcutting, and/or borrow from an outside source as required to restore the roadway will be paid for separately under their respective bid items.

Installation Of Conduit Under New Pavement, Unpaved Trench -

Trenching or other approved method shall be used for installation of conduit in unpaved trench or under new pavement. Backfill in conduit trenches shall be compacted thoroughly as it is being placed. At the discretion of the Engineer, sod, that must be removed for the placement of conduit, shall be removed either by the use of an approved sod cutter and then replaced, or 6 inches of topsoil shall be placed and the surface seeded in accordance with Section 908 - Seeding. In areas where new pavement is to be placed or in areas where total reconstruction is taking place, sodding or seeding may not be required by the Engineer. Sodding and/or topsoil from an outside source if required will be paid for separately under their respective bid items. Seeding is considered incidental to the conduit item.

Installation Of Conduit On Structure -

Conduit installed on structure shall consist of drilling anchors into concrete, brick, stone, steel or wood and mounting the conduit with the proper clamps or hangers. The conduit shall be attached to the structure by use of one-hole conduit hangers and approved anchors not more than 36 inches apart. Any 90-degree turns in the conduit run shall be accomplished by placing the proper size and type manufactured sweeping bends for the application needed. Install engineer-approved expansion or expansion/deflection fittings where the conduit crosses between fixed bridge elements and bridge elements subject to movement.

Installation Of Conduit In Structure

Install conduit by embedding in concrete. Hold conduit rigidly in place while pouring concrete. Unless specifically provided otherwise, do not leave openings in the structure for subsequent conduit placement.

Install engineer-approved expansion fittings where the conduit crosses an expansion joint in the structure to allow for expansion and contraction of the conduit relative to the structure. The conduits entering and leaving the expansion fitting shall be bonded across the fitting with an accompanying bonding strap sized in accordance with the manufacturer's recommendations.

Installation of Nonmetallic Riser Shield or Flexible Metallic Liquidtight Conduit -

Riser Shield and/or Flexible Metallic Liquidtight Conduit installed on wood poles, metal poles, structures, and/or mast arms shall be installed in a straight line. The conduit, when attached to poles, shall be attached with 2-hole straps spaced not more than 36 inches apart with the top-most strap being 12 inches from the weatherhead and the lower-most being 12 inches from the condulet. A weatherhead matching the diameter of the conduit shall be installed on the upper end of the conduit. A condulet of the same size as the conduit being installed, but not smaller than 2 inches shall be placed 48 inches above finished grade. Install two, 2-hole straps of the proper size, evenly spaced below the condulet. Nonmetallic pole risers (U-guard) shall be installed on poles to allow interduct to be connected directly to messenger cable. The underground conduit shall be as close to the base of the pole as possible. If the nonmetallic pole riser or metallic liquidtight conduit is not the same size as the conduit, an adapter shall be used at no additional cost to the Department. The nonmetallic pole riser or metallic liquidtight conduit shall be attached to the pole with 1/4" x 1-1/2" galvanized lag bolts with washers. Lag bolts will be used every 36 inches on BOTH sides of the nonmetallic pole riser or liquidtight conduit, and in the top most and bottom most set of slots. Flexible metallic liquidtight conduit shown on the plans to be installed on mast arms or on metal structure shall also include stainless steel banding placed at a maximum of 5 feet intervals.

Method of Measurement:

The quantity of conduit or riser shield installed as specified, shall be measured as the number of linear feet of each conduit or riser shield installed as specified, complete in place, and accepted.

The length of each conduit installed under existing pavement by a directional bore or by open cutting the pavement shall be measured along the path of the bore or open cut, from the point that cannot be trenched to the point that trenching can resume.

The length of any conduit that is reduced or divided (with a junction well or conduit body) shall be measured as part of the larger conduit.

Basis of Payment:

The quantity of conduit or riser shield will be paid for at the Contract unit price per linear foot. Price and payment shall include full compensation for furnishing all conduit and/or riser shield materials, equipment, labor, and incidentals necessary to complete the item.

For conduit installed by Directional Bore, the linear foot payment also includes excavation and backfilling for Bore Equipment, placing the conduit, caps if required, and all other requirements and incidentals listed in the body of this specification.

For conduit installed by Open Cutting existing pavement, the linear foot payment also includes excavating, backfilling, placing the conduit, disposal of excess materials, and all other requirements and incidentals listed in the body of this specification.

For conduit installed in an Unpaved Trench, the linear foot payment also includes excavating, removal of sod if required, backfilling, placing the conduit, disposal of excess materials, replacing excavated on-site sod if required, seeding if required, and all other requirements and incidentals listed in the body of this specification. Sod and/or topsoil furnished from an outside source, will be paid for separately.

For conduit installed on a structure, the linear foot payment also includes furnishing and installing anchors and hangers, expansion fittings, expansion/deflection fittings, removal of excess materials, and all other requirements and incidentals listed in the body of this specification

For riser shield or flexible metallic conduit installed on poles, mast arms, or structures the linear foot payment also includes furnishing and installing straps, weatherhead, condulet, lag bolts and washers, any other required mounting hardware, and all other requirements and incidentals listed in the body of this specification.

For conduit installed in concrete barrier walls or in structural elements, payment shall be incidental to the cost of the barrier wall or appropriate structure item and shall include expansion fittings, expansion/deflection fittings, and all other requirements and incidentals listed in the body of this specification.

5/5/16

746515 - FURNISH & INSTALL 1-CONDUCTOR #6 AWG STRANDED INSULATED COPPER GROUND WIRE
746577 - FURNISH & INSTALL 1-CONDUCTOR #8 AWG STRANDED INSULATED COPPER GROUND WIRE
746598 - FURNISH & INSTALL 1-CONDUCTOR #2 AWG STRANDED INSULATED COPPER GROUND WIRE
746605 - FURNISH & INSTALL 1-CONDUCTOR #10 AWG STRANDED INSULATED COPPER GROUND WIRE
746904 - FURNISH & INSTALL 1-CONDUCTOR #4/0 AWG STRANDED INSULATED COPPER GROUND WIRE
746906 - FURNISH & INSTALL 4-CONDUCTOR #18 AWG SHIELDED OPTICOM CABLE
746907 - FURNISH & INSTALL 1-CONDUCTOR #2 AWG STRANDED COPPER
746908 - FURNISH & INSTALL 1-CONDUCTOR #4 AWG STRANDED COPPER
746909 - FURNISH & INSTALL 1-CONDUCTOR #6 AWG STRANDED COPPER
746910 - FURNISH & INSTALL 1-CONDUCTOR #8 AWG STRANDED COPPER
746911 - FURNISH & INSTALL 1-CONDUCTOR #10 AWG STRANDED COPPER
746912 - FURNISH & INSTALL 1-CONDUCTOR #14 AWG STRANDED COPPER
746913 - FURNISH & INSTALL 2-CONDUCTOR #14 AWG ALUMINUM SHIELDED CABLE
746914 - FURNISH & INSTALL #6 BARE STRANDED COPPER GROUND
746915 - FURNISH & INSTALL #8/2 WIRE UF W/GROUND
746916 - FURNISH & INSTALL #8/3 WIRE UF W/GROUND
746918 - FURNISH & INSTALL #2/0 AWG THWN STRANDED COPPER
746919 - FURNISH & INSTALL #4/0 AWG THWN STRANDED COPPER
746920 - FURNISH & INSTALL #14/4 TRAFFIC CONTROL CABLE
746921 - FURNISH & INSTALL #14/9 TRAFFIC CONTROL CABLE
746922 - FURNISH & INSTALL #14/16 TRAFFIC CONTROL CABLE

Description:

The pay items listed above include furnishing, installing, and splicing if approved, the various types and sizes of cable in conduit, or overhead and lashed to a span wire. All conduit installation will be paid for under their respective items.

Materials:

Cable -All electrical cables shall be manufactured in conformance with the National Electrical Code, 600-Volt, UL approved.

1. Stranded or solid, single conductor copper cables shall be XLP Insulated; USE or RHW rated

2. Type UF cable shall include ground and the number and size of conductors as shown on the plans. Use cable conforming to ANSI/UL 493.

3. 14/4, 14/9, 14/16 #14 AWG Solid copper conductor Traffic Signal cable shall conform to IMSA Specification Number 19-1. Provide wire size and number of conductors as shown on the plans or as directed by the Engineer. Additional material requirements for Traffic Signal Cables are as follow:
   a. If requested, the Contractor shall provide independent test results to verify specification compliance. Costs of testing are incidental to the Cable item being supplied.
   b. All cables shall be supplied on reels with each reel containing one continuous length of cable.

c. Color code to be used as established by IMSA Specifications. In addition to IMSA, DelDOT requires that individual tracers contrast with the base color to allow easy identification between each base color and the same base color plus tracer.

To test for sufficient color contrast, remove the sheath for a length of 6 inches. All filler material and tapes shall be removed for the same length. All conductors of the same base color will be placed side by side and all other conductors will be hidden. The conductors will be held against a white or ivory surface and viewed from a distance of 6 feet. The base color, tracer, and tracer color must be identified within a period of three seconds after being placed in position. The same test for contrast will also be made for base colors. If either the base color or tracer color test fails, the material will be rejected.

d. The tracer line width shall not exceed 3/20 inch when measured perpendicular to the edge of the line. Also, the total width of tracer lines on a conductor may not be equal to or greater than one-half the total circumference of the conductor.

4. Aluminum Shielded Cable shall be shielded two conductor controlled capacitance cable enclosed in an aluminized polyester shield within a polyethylene jacket, rated to 600 volts. The two conductors are AWG # 14 stranded copper. Cable shall meet IMSA 50-2. Referred to as "Home-run Cable".

5. Opticom Cable – must meet the manufacturer's recommended specifications

Splicing Materials -

1. Insulating (rubber) tape shall be of the self-bonding type and shall be 3M Company, Inc. (Cat. No. 130C, 2228); Plymouth Rubber (Cat. No. 2212); Permacel (Cat. No. 253, P280), or an approved equal.

2. Jacket (plastic) Tape shall be of the waterproof type and shall be 3M Company, Inc. (Cat. No. 33); Plymouth Rubber (Cat. No. 3117); Permacel (Cat. No. P29), or an approved equal.

3. For overhead traffic control cable splices:
   a. Wire Nuts: Ideal 74B or 76B, 3M Highland H-33, or approved equal

4. For Lighting Cable Splicing:
   a. H-Tap, C-Tap and Butt Splice Compression Connectors in junction wells or transformer bases:
      i. Fabricated from high strength copper alloy.
      ii. Plated connectors fabricated from metals other than copper are prohibited.
      iii. Use bolted type connectors for splicing bare ground conductors.
   b. Submersible, breakaway connector kits in lighting transformer bases:
      i. Unfused, quick disconnect inline connector kit containing:
         1. A copper pin crimpable to a conductor
         2. A receptacle having a centrally located, recessed locking socket constructed so that it is filled and retained by its housing and a disposable assembly pin.
         3. A plug housing for retention of the copper pin.
         4. A receptacle housing with disposable protective sleeve.
      ii. Fused, quick disconnect inline connector kit containing:
         1. A pair of spring loaded copper fuse contacts suitable for gripping the specified cartridge fuse.
         2. A fuse of specified amp rating, rated 600V, 100 000 amps AIC.
      iii. Fused, quick disconnect Y connector kit containing:

1. A pair of spring loaded copper fuse contacts suitable for gripping the specified cartridge fuse. One contact shall be crimpable on a conductor and after insertion into its proper position within the load side plug housing, be capable of being securely retained therein. The other contact shall be preassembled for retention within a Y insert body.
2. A line side Y housing with two water seal cable ports.
3. Two terminal lugs, each having a mounting hole.
4. A bolt and a self-locking nut.
5. A Y insert body with preassembled line side fuse contact and a ring tongue terminal.
6. A load side plug housing permanently marked "Load Side".
7. A disposable assembly pin.
8. A fuse of specified amp rating, rated 600V, 100 000 amps AIC.

iv. Unfused, quick disconnect Y connector kit containing:

1. A copper pin crimpable to a conductor and suitable for retention in the load side receptacle housing.
2. A Y insert body with preassembled load side copper socket and ring tongue terminal.
3. A line side Y housing with two water seal cable ports.
4. Two terminal lugs, each having a mounting hole.
5. A bolt and self-locking nut.
6. A load side receptacle housing.

v. Each kit contains sufficient silicone compound to lubricate metal parts and the housing for each assembly along with complete installation instructions.

vi. All housings are made of water resistant synthetic rubber suitable for burial in the ground or exposure to sunlight.

vii. Each housing forms a watertight seal around the cable at the point of disconnection and between the insert body and enveloping Y housing.

viii. All copper pins, sockets, and fuse contacts have a minimum conductivity of 90 percent.

ix. The crimpable portion is fully annealed while the rest of the device is maintained in its original state.

x. Plastic sleeves shall be rigid, molded insulating plastic material of sufficient outside diameter to form a watertight fit with its related housing.

xi. One contact is crimpable on a conductor and after insertion into its proper position within the load side plug housing, and is capable of being securely retained therein.

xii. The other contact is preassembled for retention within the line side of the connector body.

Cable Installation

<u>Installation in Conduit</u>:

This work consists of installing various types, sizes, and number of communications or electrical cable(s) in existing conduits, which may or may not contain an existing communications or electrical cable(s) or wire(s). Conduits may be located underground, within mast arms, on wood poles, or on metal poles.

The number of cables to be pulled through each conduit will be as shown on the plans or as directed by the Engineer.

Construction Methods:

All cable must be transported by and unreeled from a cable trailer(s). The laying of reels on the ground and subsequent removal of wire or cable from this position is prohibited. Avoid damaging cable insulation when removing cable from drums or reels, or during installation of the cable.

Hand pulling methods are required for conduit sizes of 1-1/2" or less and are **preferred** for all other sizes. Dynamometer is recommended for use when pulling other than by hand.

Prior to installation, **written approval by the Engineer is required** for the use of any power-assisted methods of pulling communications or electrical cable(s) or wire(s) into conduit. A short piece of material that will part if the strain exceeds the amount specified below shall be used between the pulling grip and the pulling medium, unless industry standards require less:

150 lbs. for all pulls up through 12 pair communications cable; and
300 lbs. for all larger cables

Any and all cable(s) pulled into any conduit without the use of an acceptable pulling grip, Kellems or equal, and without the use of a strain release element or by using methods which may have or did result in pulling forces in excess of strain release material, or using methods which may have or did result in pulling forces in excess of those set forth herein or prescribed by industry standards are **unacceptable.**

Any and all unacceptable cable(s) shall be removed and replaced with new cable(s) using correct methods at no cost to the Department.

The installation of cable(s) in existing conduits shall be accomplished by pulling the cable(s) through the conduits. If required, pulling lubricant of the type recommended by the cable manufacturer will be used. The cable(s) shall be prepared for pulling by reeling them from their respective reels as they enter the conduit or by taking sufficient length from the reel(s) to comprise the set to be pulled. Care shall be taken to avoid damaging insulation and to eliminate any twists or kinks and to marry the cables in a straight lay. Care shall also be taken to prevent entry of moisture into the cable at all times during installation. Cable ends will be sealed using rubber tape and painted with a sealing type of waterproof compound until final splices are made.

The cable(s) shall be hand fed into the conduit. When, in the opinion of the Engineer, additional radius is required to prevent damage to the cable(s) a sleeve shall be used. There shall be no additional payment made for sleeves or their use.

Underground cable runs shall be started at one terminal point and shall be continuous without splices to the final terminal point except for “Home Run Cable” to “Loop Detector Wire”. Opticom cable shall not be spliced in any application.

Additional cable(s) shall be left and arranged in a neat and orderly manner as noted:

1. When pulled through junction wells, 6 feet of copper cable, supported on cable rack assemblies
2. At the control box and other splice locations, 6 feet of cable, neatly arranged and laced with cable ties

When cable already exists in a conduit, the Contractor shall ensure that the placement of a fish does not damage or entangle the existing wire or cable(s). The lead end of a fish shall contain a blunt terminal. Bending and/or taping the end of the fish shall not be satisfactory nor shall any termination which contains rough edges or any sort of hook that might engage an existing wire or cable when the fish is extracted.

Where two or more wires occupy the same conduit, they shall be drawn in together and kept parallel to each other by means of a pulling head. Phase legs shall be arranged circumferentially and in sequence around the neutral wires.

All conduit ends shall be duct sealed after cable installations.

Installation on Span Wire Overhead:

This work consists of installing electrical cable on an existing span wire.

Construction Methods:

All electrical cable must be transported by and unreeled from a cable trailer(s). The laying of reels on the ground and subsequent removal of wire or cable from this position is prohibited. Avoid damaging cable insulation when removing cable from drums or reels, or during installation of the cable.

The electrical cable will not be spliced at the top of the pole but will continue on to be taped onto the span wire. The electrical cable shall be oriented so water will not run along its length and run into the steel pole. The electrical cable shall be installed on the underside of the span wire with no crossover or wraps around the span wire. The electrical cable shall be pulled tight without any kinks and the jacket (plastic) tape wrapped tight around the span wire and electrical cable at least six wraps every twelve to fourteen inches.

At each signal head location, there will be a loop of signal cable 36 inches long.

Splicing:

Traffic Control Cable and Single Conductor Stranded Wire :

General - Traffic signal cable splicing shall only be made above ground in pole hand-holes, transformer bases or on span wire at the signal head. Underground traffic control cable splices (except between loop detector wire and "home-run" cable) or splices in between conduit runs are prohibited. After cables have been installed and pending permanent splicing, the end of each section of cable in the control box and at all splice locations shall be carefully sealed, using rubber tape, and painted with a sealing type of waterproof compound. The circuit number of all cables and wires shall be identified by color coded tape attached to each of the cables and wires in the control box and at all splice locations. The color coded tape shall be secured to the cable or wire with nylon cable ties. Any splices found to be faulty within 90 days of installation shall be remade at the Contractor's expense. Insulation from each conductor to be spliced shall be removed to expose ½ inch of copper. Use of any tool or method which might nick the conductor is prohibited. Each conductor not being spliced shall be inspected and trimmed so that the conductor does not extend beyond the insulation. After each conductor to be spliced is connected, all conductors both used and not used shall be returned to their original configuration before the insulation was removed and then sealed as specified.

Individual cables shall not extend beyond the splice of the last signal head for each signal phase.

Shielded Opticom cable shall not be spliced.

Shielded Aluminum Cable ("Home-Run cable") may be spliced only with the loop detector wire in a junction well. No splicing of the "home-run cable" outside of this junction well is permitted.

Overhead - Conductors to be electrically connected shall be placed side by side with the exposed copper aligned. The copper shall then be twisted clockwise with pliers until a good mechanical connection shall be effected. A proper size wire nut shall be installed and hand tightened. If necessary to cover all the copper, minor trimming may be done. The copper splice shall be 5/16 inch long when trimmed. Care shall be taken

to ensure that no insulation is caught up in the copper area of the splice. It is essential that the splice be kept dry. Therefore, care must be taken during taping and by placement of the completed splice to prevent water from entering the splice between or around the cables.

1. **Termination of cable (Butt Splice) -** The sheath of each cable shall be removed as necessary. When all conductors to be joined have been completed, the splice shall be prepared for taping. The cables shall be placed in a butt position and all wires and wire nuts shall be positioned to ensure that no shorts exist and that the splice area is reduced to as small a diameter as possible. Taping shall begin with rubber tape two inches over the intact sheath. Taping shall proceed toward the other cable overlapping half of the tape width until a point two inches on the other cable sheath has been reached. Taping shall then be repeated in the other direction starting one tape width wider than the previous wrap. Where necessary to cover all areas of the splice, overlapping shall be increased. Every area of the splice shall have rubber tape at least four layers (two fully overlapped passes) deep. The rubber tape shall be covered with plastic tape applied in the same fashion.

2. **Taps or Tee Splices** - The sheath of the through cable shall be removed for a distance of 8 inches centered on the point of splice. The sheath of the branch cable(s) shall be removed for a distance of 4 inches. The through cable conductors which are to be joined to the conductors of the branch cable(s) are to be separated out from the others and cut. No other conductors shall be cut for any purpose. Depending upon the need, the branch cable(s) may be placed beside one of the through cables and the splicing proceed or the through cable may be doubled back so that the parts of the through cable and the branch cable(s) are placed side by side. When all conductors to be joined have been completed, the splice shall be prepared for taping. The cables shall be placed in approximately their final position and an inspection for shorts shall be made. After all wire nuts and wires are properly positioned, taping shall begin on the through cable 2 inches from the end for the sheath. It shall proceed with 1/2 inch width overlap across the splice area and onto the other through sheath for a distance of 2 inches. The taping shall start at the end point and return back across the splice to the branch cable(s). It shall proceed along the branch cable(s) and onto the sheath for a distance of one inch. A return along the branch back to the main cable shall be made and the remaining part of the splice shall be taped continuing as before. Every area of the splice shall have rubber tape at least four layers (two fully overlapped passes) deep. The cables shall be placed in their final position and taped with two fully overlapped passes of plastic tape. Plastic tape need not cover the interior areas covered by the rubber tape. The splice shall be placed so that the branch cable(s) enters the splice from below to prevent water from flowing along the branch cable(s) into the splice area.

3. **Termination End of Cable** - Dead ended cables shall have 3" of sheath removed. Each individual cable shall be rubber taped then bundled and re-taped with vinyl tape and coated with waterproofing compound.

Lighting Cable and Single Conductor Stranded Wire:

1. H-Tap and C-tap Compression Connectors in junction wells or transformer bases:
   a. Installed in transformer bases for “pass-through” cables; Conductors serving luminaire spliced with breakaway connector kits.
   b. Compression type, applied by means of a compression tool.
   c. Compression connector is wrapped in 2 layers of vinyl tape and 2 layers of rubber tape. Tape is “half-lapped” around connector.

2. Submersible, breakaway connector kits in lighting transformer bases:
   a. Install for splices in light pole base that service the luminaire.
   b. Install connector kits in conformance with the Manufacturer’s recommendations.

Method of Measurement:

The quantity of cable will be measured as the actual number of linear feet of cable furnished and pulled through conduits (underground, in mast arms, or on poles) or installed on a span wire in accordance with these specifications, complete in place, and accepted.

All required cable slack left at termination points or in junction wells shall be measured as part of this item.

Basis of Payment:

The quantity of cable furnished and pulled through all conduit (underground, in mast arms, or on poles) or furnished and installed on a span wire will be paid for at the Contract unit price per linear foot of the applicable pay item. Splice installations and all costs related to the splice shall be incidental to the linear foot payment of the cable being spliced. Price and payment will constitute full compensation for all labor, equipment, tools, materials, material testing, splicing, taping, and incidentals required to complete the work as specified above.

5/5/16

746537 - RELOCATING EXISTING LIGHT STANDARDS

Description:

This work consists of removing, storing, and installing existing light standard(s) at location(s) shown on the Plans and as directed by the Engineer.

Materials and Construction Methods:

Any material required and furnished under this item, shall be in accordance with the notes on the Plans.

The light standard shall be carefully removed from the existing location to avoid any damage. Should any damage occur to the light assembly, and in the opinion of the Engineer adequate precaution was not exercised by the Contractor during the relocation operation, the Contractor shall at his/her expense replace damaged component in kind or equivalent to the satisfaction of the Engineer.

Supply and install new anchor bolts, per the manufacturer's recommendation.

Final acceptance of the light standard shall be made only after its satisfactory operation as determined by the Engineer.

Method of Measurement:

The quantity of light standards relocated will be measured as the actual number of light standards relocated and accepted.

Basis of Payment:

The quantity of light standards relocated will be paid at the Contract for unit price per each. Price and payment will constitute full compensation for removing, storing and installing the entire light standard unit, including but not limited to, pole, luminaire, transformer base, installing new fuse, connectors, access door, hardware, etc., if required by the Engineer, labor, tools, equipments, and all incidentals to complete the work.

8/30/16

746552 - FURNISH AND MAINTAIN TEMPORARY LIGHTING

Description:

This work consists of furnishing, installing, operating and removing temporary pathway lighting. The existing lighting will be impacted during various phases of construction. The temporary lighting shall be used to supplement the existing lighting to illuminate the travel way during these phases of construction. At such time the ultimate lighting system is in place in this area, the temporary lighting can be removed. The temporary lighting assemblies shall become the property of the Contractor after the completion of the project.

Materials and Operation Requirements:

The Contractor shall coordinate the Temporary Lighting Design with the phases of the Maintenance of Traffic Design.

The Contractor must use fixed poles, and the lighting system must be powered by an electrical feed from the local utility company. The Contractor shall submit an Application for Electric Service and coordinate the Electric Service with the local utility company. The Contractor shall meet the Electric Service requirements of the local utility company. The Contractor may use overhead triplex temporary wiring between the light poles.

At least sixty days prior to the installation of the Temporary Lighting the Contractor shall submit a Temporary Lighting Design drawing to DelDOT for their review and approval. The Temporary Lighting Design drawing shall include the following:

1. Layout drawings showing locations of temporary lighting equipment, including both spacing and placement.
2. Description of lighting equipment to be used.
3. Description of electrical power source.
4. Specific technical details including catalog cuts on all lighting fixtures to be provided, including power rating and photometric charts.
5. Details of any hoods, louvers, shields or other means to control glare.
6. Lighting calculations confirming that the illumination requirements will be met by the layout plan.

The layout drawings shall be on sheet size approved by the Engineer and at an appropriate scale to adequately describe the work. Layout drawings must be submitted and approved for all Phases of Construction.

Temporary Lighting design shall be 1.5 – 2.0 average maintained footcandles with an average / minimum uniformity ratio of approximately 4 to 1.

It is the Department's intent to provide a continuously operating light assembly unit whenever the unit is in service. Should an operation problem be reported to the Contractor at any time during use of the unit, the Contractor shall have 30 minutes after receipt of notification to rectify the problem to the Engineer's satisfaction. Failure of the Contractor to make this effort may result in deduction of payment for the day the unit is not satisfactorily operating. To this end, the Contractor shall designate an on-site representative, other than the Project Superintendent, who shall be the Department's contact person on all issues related to the light assemblies. The Contractor shall also designate a Manufacturer's Representative to be on call for technical assistance or as otherwise necessary.

Method of Measurement:

The quantity of temporary lighting assemblies will not be measured.

Basis of Payment:

Payment for this item will be made at the lump sum price bid for the item "Furnish and Maintain Temporary Lighting," which price and payment will constitute full compensation for wire, conduit, service installations, meter installations, meter applications, monthly bills, installation, relocation, maintaining light assemblies, cost for any movement and set up to another location, final removal from project and for all labor, materials, equipment and tools required to complete the work.

3/4/16

746596 - JUNCTION BOX ON STRUCTURE

Description:

The item shall consist of furnishing and installing Junction Box(es) as detailed on the Plans and specified herein.

Materials and Construction Methods:

Unless noted otherwise on the Plans, the junction box shall be cast iron and hot-dipped galvanized. Contractor shall size the box per the NEC to accommodate the number and size of conduits and cables entering the box. Units shall be surface-mounted to structure and held in place by four stainless steel drop-in anchors and bolts. A flat neoprene gasket shall be cemented to cover. The unit shall be U.L. listed and NEMA 4.

Method of Measurement:

The number of junction boxes to be measured under this item shall be the actual number of installed junction boxes in accordance with these specifications.

Basis of Payment:

The number of junction boxes, as determined above, shall be paid for at the contract unit price bid per Each for Item 746596, Junction Boxes on Structure, which price and payment shall constitute full compensation for furnishing and installing of the box, and other related hardware, for all labor, tools, equipment and necessary incidentals to complete the work.

5/5/16

746653 - ELECTRICAL TESTING

Description:

This work consists of furnishing all materials, equipment, tools, and labor necessary to perform electrical testing in accordance with these special provisions, notes and details on the Plans, and as directed by the Engineer.

When this item is required to test a highway lighting system constructed as part of the Contract, the item shall also include a one year warranty of the highway lighting system. The highway lighting system is understood to include all items of work performed under this Contract to provide lighting of roadways, bikepaths, parking lots, signs, etc.

Construction Methods:

Ground Resistance Testing

The ground resistance shall be measured with a three-terminal, fall-of-potential, direct-reading, battery-powered earth tester with a 0.50 to 500 ohm scale or digital read-out. The 25 ohm reading shall be approximately at mid scale.

The test shall be performed according to the manufacturer's instructions and OSHA requirements. The test shall be performed when the soil is dry. The Contractor shall not add any chemical or salt solutions to any portion of the grounding system. All grounding rods and foundation grounds to be tested shall be installed a minimum of ten days prior to testing unless otherwise determined by the Engineer in the field.

Two auxiliary copper clad ground rods shall be driven into the ground at a minimum distance of 3 feet (one meter). The lateral spacing for each test rod shall be given in writing on the test report form and the spacing shall be approved by the Engineer.

Each ground rod or foundation ground shall be isolated with the bond wires disconnected when the test is being performed. The resistance to ground shall be 25 ohms or less.

System Testing

Insulation from ground and roadway lighting circuits shall be tested as follows:

(1) Insulation from Ground. All underground circuits shall be tested for resistance to ground with a megger both before and after the conduit and wiring have been buried and all ground rods have been installed and connected. No circuit shall measure less than 10 megohms to ground. Circuits that fail will be inspected, repaired, and retested.

(2) Roadway Lighting Circuits. The Contractor shall connect field wiring to the load center terminals. The entire lighting system shall be energized for ten consecutive days for ten hours each day at the time directed by the Engineer prior to initial acceptance. Failures occurring during this test period shall be corrected. The Contractor shall repair or replace any equipment, components, or system that fails during this test. A retest shall be performed on the repaired portion at the Engineer's direction.

All tests shall be performed in the presence of the Engineer, and test results shall be written, dated, and given to the Engineer for approval.

Highway Lighting System Warranty:

The Contractor shall secure the manufacturer's warranties and/or guarantees on electrical and/or mechanical equipment. These warranties and/or guarantees shall be submitted to the Department upon final acceptance of the completed highway lighting system. In addition to the manufacturer's warranties and/or guarantees, the Contractor shall warrant to the Department the complete, installed highway lighting system to be free of defects, as hereafter defined, for one calendar year beginning at the initial acceptance of the highway lighting system by the Department. The initial acceptance of the highway lighting system will occur upon the satisfactory correction of all deficiencies noted in the lighting system during the final inspection of the project.

The highway lighting system will be considered defective if any of the following conditions are discovered by visual inspection or by inspection with testing equipment within the warranty period:

1. Defective lamps or ballasts.
2. Failure to operate, in whole or in part.
3. Power wire grounding less than ten mega-ohms.
4. Shifts in pole/foundation alignment.
5. Short circuits or open circuits anywhere within the system.
6. Deterioration of finishes, plating, or paint not normal and customary in the environment in which the equipment is installed.
7. Settlement of trench backfill.
8. Defective fuses.
9. Defective or improperly installed splices.

These conditions listed shall not be considered all inclusive.

The highway lighting system is comprised of all Contract items for lighting, including but not limited to conduits, junction wells, cables, load centers, transformers, cabinet pads, pole bases, poles, high mast poles, light standards with and without davit arms, luminaires, sign lighting, service installations, and reworked/relocated existing lighting facilities.

There will be initial and periodic highway lighting system performance inspections after the Contractor has completed all the work. The initial inspection, to be conducted during the final construction inspection, will be to determine if the initial performance requirements are met. Periodic reviews will be conducted at monthly intervals through the warranty period to determine the sustained ability of the highway lighting system to meet the stated performance requirements. The Department review team will be responsible for evaluating the highway lighting system within the project limits for both day and night acceptability considering all the possible defects listed above. If the highway lighting system is considered defective because of abnormal operation or deterioration (as listed above), the Department will require repair or replacement of the defective portion at its sole option.

All defective areas, which may include all highway lighting systems and components within the project limits, identified by the Department during initial or periodic inspections shall be repaired by the Contractor in accordance with this Section. All highway lighting system repair shall begin immediately following the notice to the Contractor of the lighting system defect unless weather limitations prevent the corrective work. The Department shall be given notification before the Contractor begins corrective work and shall be allowed full inspection of all operations and provided safe access to the areas being repaired.

If at any time during the warranty period, the highway lighting system or any portion thereof is rendered defective as a result of other than a manufacturing design or construction defect, the Department will repair, replace or revise said system at its sole option. The Contractor will not be held responsible for the cost to correct failures due to design defects in the highway lighting system.

Method of Measurement:

The quantity of electrical testing will not be measured.

Basis of Payment:

The quantity of testing will be paid for at the Contract lump sum price. Price and payment will constitute full compensation for furnishing all testing equipment, including ground rods; performing the tests; preparing the reports; and for all labor, equipment, tools, and incidentals required to complete the work. For highway lighting systems, price and payment will also constitute full compensation for providing the warranties.

5/24/02

746659 - DECORATIVE LIGHT STANDARD AND FIXTURE, SINGLE, 12' POLE
746829 - DECORATIVE LIGHT STANDARD AND FIXTURE, SINGLE, 10' POLE

Description:

This work consists of furnishing and installing street lighting fixtures as detailed and at locations shown on the Plans.

Materials:

General.

1. All luminaires shall embody the highest standards of electrical and mechanical design, materials and workmanship, and shall be subject in all respects to the approval of the Engineer.

2. All luminaires shall be installed complete with lamps by the manufacturer specified or an equal approved by the engineer.

3. Manufacturers' packaging shall be marked to include identification by type, quantity of contents, and manufacturer's component designation.

4. Lighting standards shall meet or exceed the requirements of the 2009 edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals".

Warranty.

1. Provide manufacturer's standard form in which manufacture agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship, corrode, fade, stain, or chalk due to the effects of weather or solar radiation within specified warranty period.

2. Warranty period for luminaires: Minimum five years from date of Substantial Completion.

3. Warranty period for lamps: Replace lamps and fuses that fail within 12 months from the date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

Fabrication.

1. Fit and shop assemble components in largest practical sizes for delivery to site.

2. Fabricate components with joints tightly fitted and secured.

3. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with the design of component, except where specifically noted otherwise.

4. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

5. Continuously seal joined pieces by continuous welds.

6. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

City of Wilmington Luminaire.

1. The luminaire shall be a prismatic acrylic refractor globe with IES Type III, IV or V distribution as specified on the Plans, powered from a nominal 240 Volt, 60-Hertz source, and with NEMA twist lock photocell receptacle.

2. The lamp shall be 100 or 150-Watt high-pressure sodium (HPS) or as indicated on the plans.

3. Sockets shall be mogul or medium base with a nickel-plated screw shell and center contact.

4. The optical assembly shall be a precisely molded acrylic reflector and refractor. The upper portion of this system shall incorporate a prismatic pattern that is molded directly into the black acrylic.

5. The ballast housing shall be cast aluminum. The housing / door shall be removable without the use of tools and be retained by an insulated line attached to the door and to the housing. The housing shall contain an acrylic “window” to allow light to reach the photocell.

6. A custom kit with black trim ribs, bands with a panel and “W” medallion shall also be installed. The photocell shall line-up vertically with the "W" and shall face the traveled roadway.

7. All electrical components shall be UL recognized and the fixture shall carry a UL label suitable for wet locations. Socket shall be mogul or medium base with a nickel-plated screw shall and center contact. The pulse start multi-tap ballast shall provide plus or minus 5% lamp power regulation with a plus or minus 10% input voltage regulation. Ballasts shall be factory wired to 120V and tested.

8. The luminaire shall withstand for an unlimited duration stresses caused by peak vibration acceleration of 1g. An adequate Vibration Test Report shall be submitted for approval.

Decorative Post and Base.

1. The lighting post shall be utility grade, all aluminum, one-piece construction, with a 12-flute base design. The shaft shall be 5” diameter, straight, fluted, with a tenon for luminaire mounting.

2. The post height and base diameter shall be as specified on the plans. The fluted shaft shall be 5 inches in diameter. At the top of the post, an integral 3 inch O.D. tenon with a transitional donut shall be provided for luminaire mounting.

   A. Item 746659 - DECORATIVE LIGHT STANDARD AND FIXTURE, SINGLE, includes a 12 ft. pole.
   B. Item 746829 - DECORATIVE LIGHT STANDARD AND FIXTURE, SINGLE, includes a 10 ft. pole.

3. The post assembly shall be shipped with a black powder coat finish.

4. The decorative base shall be heavy-wall, cast aluminum (ASTM 356.1) formed true to pattern with complete detail. The shaft material shall be fluted aluminum extrusion (6061-T6). A grounding screw shall be provided inside the base, opposite the door.

5. The shaft shall be double welded to the base casting and shipped as one piece for maximum structural integrity. The shaft shall be circumferentially welded inside the base casting at the top of the access door, and externally where the shaft exits the base. All exposed welds below 8 feet shall be ground smooth.

6. All hardware shall be tamper resistant stainless steel.

7. The post shall be provided with four hot-dip galvanized anchor bolts to be installed on an 11" diameter bolt circle. A door shall be located in the base for anchorage and wiring access.

Construction:

1. Luminaires shall be installed complete with all equipment, materials, parts, attachments, devices, hardware, cables, and supports necessary to make a safe, complete and fully operative installation. Manufacturer of each luminaire shall supply complete installation instructions including diagrams, illustrations, etc. The Contractor shall install in strict conformance with such instructions.

2. Each pole and luminaire shall be installed at location shown on the plans. Where field conditions require deviation from location shown, the Engineer shall be so notified by the Contractor and final installation made as directed by the Engineer.

3. Install in accordance with manufacturer's shop drawings.

4. Thoroughly clean any dirt and residue from luminaires prior to installation.

5. Install components plumb and level, accurately fitted, free from distortion or defects.

6. Attach appropriate grounding straps where specified on drawings to form a continuous grounding circuit where required.

7. Touch-up welds with primer. Grind welds smooth.

8. Conceal bolts and screws whenever possible.

9. Maximum allowable offset from true alignment: 1/4 inch.

10. Protect poles and luminaires from damage and defacement until acceptance by Owner. Replace any damaged or defaced fixtures with new units prior to acceptance at no additional cost to the Owner.

Method of Measurement:

The quantity of decorative light standards and fixtures will be measured as the actual number of decorative light standards and fixtures of each type provided and installed in accordance with these plans, specifications, complete, in place and accepted by the Engineer.

Basis of Payment:

The quantity of decorative light standards and fixtures will be paid at the Contract unit price per each decorative light standard and fixture. Price and payment will constitute full compensation for furnishing all materials, labor, materials, tools, equipment and incidentals to complete the work.

08/30/2016

746830 - REMOVAL OF CONCRETE POLE BASES AND CABINET FOUNDATIONS

Description:

This work consists of the removal of concrete pole bases and concrete cabinet foundations.

Materials:

Equipment as required to remove concrete pole bases and concrete cabinet foundations. Material as necessary to match the area surrounding the removed or graded masonry.

Construction Methods:

The masonry shall be completely removed.

Backfill remaining hole with material that matches the surrounding area in accordance with the appropriate items.

Method of Measurement:

The quantity of concrete will be measured as the number of cubic yards (cubic meters) of concrete removed including anchor bolts, reinforcing bars, conduits and any other hardware within the concrete.

Concrete or other materials moved or removed which is not a part of the item being removed, shall not be measured for the purpose of payment under this item.

Basis of Payment:

The quantity of concrete will be paid for at the unit price per cubic yard (cubic meter). Price and payment will constitute full compensation for all labor, equipment, tools, and incidentals required to complete the work.

5/5/16

746906 - FURNISH & INSTALL 4-CONDUCTOR #18 AWG SHIELDED OPTICOM CABLE
746907 - FURNISH & INSTALL 1-CONDUCTOR #2 AWG STRANDED COPPER
746908 - FURNISH & INSTALL 1-CONDUCTOR #4 AWG STRANDED COPPER
746909 - FURNISH & INSTALL 1-CONDUCTOR #6 AWG STRANDED COPPER
746910 - FURNISH & INSTALL 1-CONDUCTOR #8 AWG STRANDED COPPER
746911 - FURNISH & INSTALL 1-CONDUCTOR #10 AWG STRANDED COPPER
746912 - FURNISH & INSTALL 1-CONDUCTOR #14 AWG STRANDED COPPER
746913 - FURNISH & INSTALL 2-CONDUCTOR #14 AWG ALUMINUM SHIELDED COPPER
746914 - FURNISH & INSTALL #6 BARE STRANDED COPPER GROUND
746915 - FURNISH & INSTALL #8/2 WIRE UF W/GROUND
746916 - FURNISH & INSTALL #8/3 WIRE UF W/GROUND
746918 - FURNISH & INSTALL #2/0 AWG STRANDED COPPER
746919 - FURNISH & INSTALL #4/0 AWG STRANDED COPPER
746920 - FURNISH & INSTALL 14/4 TRAFFIC CONTROL CABLE
746921 - FURNISH & INSTALL 14/9 TRAFFIC CONTROL CABLE
746922 - FURNISH & INSTALL 14/16 TRAFFIC CONTROL CABLE
746923 - FURNISH & INSTALL 14/5 TRAFFIC CONTROL CABLE

Description:

The pay items listed above include furnishing, installing, and splicing if approved, the various types and sizes of cable in conduit, or overhead and lashed to a span wire. All conduit installation will be paid for under their respective items.

Materials:

Cable - All electrical cables shall be manufactured in conformance with the National Electrical Code, 600-Volt, UL approved.

1. Stranded or solid, single conductor copper cables shall be XLP Insulated; USE or RHW rated

2. Type UF cable shall include ground and the number and size of conductors as shown on the plans. Use cable conforming to ANSI/UL 493.

3. 14/4, 14/5, 14/9, 14/16 AWG Solid copper conductor Traffic Signal cable shall conform to IMSA Specification Number 19-1. Provide wire size and number of conductors as shown on the plans or as directed by the Engineer. Additional material requirements for Traffic Signal Cables are as follow:
   a. If requested, the Contractor shall provide independent test results to verify specification compliance. Costs of testing are incidental to the Cable item being supplied.
   b. All cables shall be supplied on reels with each reel containing one continuous length of cable.
   c. Color code to be used as established by IMSA Specifications. In addition to IMSA, DelDOT requires that individual tracers contrast with the base color to allow easy identification between each base color and the same base color plus tracer.

      To test for sufficient color contrast, remove the sheath for a length of 6 inches. All filler material and tapes shall be removed for the same length. All conductors of the same base color will be placed side by side and all other conductors will be hidden. The conductors will be held against a white or ivory surface and viewed from a distance of 6 feet. The base color, tracer,

and tracer color must be identified within a period of three seconds after being placed in position. The same test for contrast will also be made for base colors. If either the base color or tracer color test fails, the material will be rejected.

d. The tracer line width shall not exceed 3/20 inch when measured perpendicular to the edge of the line. Also, the total width of tracer lines on a conductor may not be equal to or greater than one-half the total circumference of the conductor.

4. Aluminum Shielded Cable shall be shielded two conductor controlled capacitance cable enclosed in an aluminized polyester shield within a polyethylene jacket, rated to 600 volts. The two conductors are AWG # 14 stranded copper. Cable shall meet IMSA 50-2. Referred to as "Home-run Cable".

5. Opticom Cable – must meet the manufacturer's recommended specifications

Splicing Materials –

1. Insulating (rubber) tape shall be of the self-bonding type and shall be 3M Company, Inc. (Cat. No. 130C, 2228); Plymouth Rubber (Cat. No. 2212); Permacel (Cat. No. 253, P280), or an approved equal.

2. Jacket (plastic) Tape shall be of the waterproof type and shall be 3M Company, Inc. (Cat. No. 33); Plymouth Rubber (Cat. No. 3117); Permacel (Cat. No. P29), or an approved equal.

3. For overhead traffic control cable splices:
   Wire Nuts – Ideal 74B or 76B, 3M Highland H-33, or approved equal

Cable Installation

Installation in Conduit:

This work consists of installing various types, sizes, and number of communications or electrical cable(s) in existing conduits, which may or may not contain an existing communications or electrical cable(s) or wire(s). Conduits may be located underground, within mast arms, on wood poles, or on metal poles.

The number of cables to be pulled through each conduit will be as shown on the plans or as directed by the Engineer.

Construction Methods:

All cable must be transported by and unreeled from a cable trailer(s). The laying of reels on the ground and subsequent removal of wire or cable from this position is prohibited. Avoid damaging cable insulation when removing cable from drums or reels, or during installation of the cable.

Hand pulling methods are required for conduit sizes of 1-1/2" or less and are **preferred** for all other sizes. Dynamometer is recommended for use when pulling other than by hand.

Prior to installation, **written approval by the Engineer is required** for the use of any power-assisted methods of pulling communications or electrical cable(s) or wire(s) into conduit. A short piece of material that will part if the strain exceeds the amount specified below shall be used between the pulling grip and the pulling medium, unless industry standards require less:

150 lbs. for all pulls up through 12 pair communications cable; and
300 lbs. for all larger cables

Any and all cable(s) pulled into any conduit without the use of an acceptable pulling grip, Kellems or equal, and without the use of a strain release element or by using methods which may have or did result in pulling forces in excess of strain release material, or using methods which may have or did result in pulling forces in excess of those set forth herein or prescribed by industry standards are **unacceptable.**

Any and all unacceptable cable(s) shall be removed and replaced with new cable(s) using correct methods at no cost to the Department.

The installation of cable(s) in existing conduits shall be accomplished by pulling the cable(s) through the conduits. If required, pulling lubricant of the type recommended by the cable manufacturer will be used. The cable(s) shall be prepared for pulling by reeling them from their respective reels as they enter the conduit or by taking sufficient length from the reel(s) to comprise the set to be pulled. Care shall be taken to avoid damaging insulation and to eliminate any twists or kinks and to marry the cables in a straight lay. Care shall also be taken to prevent entry of moisture into the cable at all times during installation. Cable ends will be sealed using rubber tape and painted with a sealing type of waterproof compound until final splices are made.

The cable(s) shall be hand fed into the conduit. When, in the opinion of the Engineer, additional radius is required to prevent damage to the cable(s) a sleeve shall be used. There shall be no additional payment made for sleeves or their use.

Underground cable runs shall be started at one terminal point and shall be continuous without splices to the final terminal point except for "Home Run Cable" to "Loop Detector Wire". Opticom cable shall not be spliced in any application.

Additional cable(s) shall be left and arranged in a neat and orderly manner as noted:

1. When pulled through junction wells, 6 feet of copper cable, supported on cable rack assemblies
2. At the control box and other splice locations, 6 feet of cable, neatly arranged and laced with cable ties

When cable already exists in a conduit, the Contractor shall ensure that the placement of a fish does not damage or entangle the existing wire or cable(s). The lead end of a fish shall contain a blunt terminal. Bending and/or taping the end of the fish shall not be satisfactory nor shall any termination which contains rough edges or any sort of hook that might engage an existing wire or cable when the fish is extracted.

Where two or more wires occupy the same conduit, they shall be drawn in together and kept parallel to each other by means of a pulling head. Phase legs shall be arranged circumferentially and in sequence around the neutral wires.

All conduit ends shall be duct sealed after cable installations.

Installation on Span Wire Overhead:

This work consists of installing electrical cable on an existing span wire.

Construction Methods:

All electrical cable must be transported by and unreeled from a cable trailer(s). The laying of reels on the ground and subsequent removal of wire or cable from this position is prohibited. Avoid damaging cable insulation when removing cable from drums or reels, or during installation of the cable.

The electrical cable will not be spliced at the top of the pole but will continue on to be taped onto the span wire. The electrical cable shall be oriented so water will not run along its length and run into the steel pole. The electrical cable shall be installed on the underside of the span wire with no crossover or wraps around the span wire. The electrical cable shall be pulled tight without any kinks and the jacket (plastic) tape wrapped tight around the span wire and electrical cable at least six wraps every twelve to fourteen inches.

At each signal head location, there will be a loop of signal cable 36 inches long.

Splicing:

Traffic Control Cable and Single Conductor Stranded Wire :

General – Traffic signal cable splicing shall only be made above ground in pole hand-holes, transformer bases or on span wire at the signal head. Underground traffic control cable splices (except between loop detector wire and "home-run" cable) or splices in between conduit runs are prohibited. After cables have been installed and pending permanent splicing, the end of each section of cable in the control box and at all splice locations shall be carefully sealed, using rubber tape, and painted with a sealing type of waterproof compound. The circuit number of all cables and wires shall be identified by color coded tape attached to each of the cables and wires in the control box and at all splice locations. The color coded tape shall be secured to the cable or wire with nylon cable ties. Any splices found to be faulty within 90 days of installation shall be remade at the Contractor's expense. Insulation from each conductor to be spliced shall be removed to expose ½ inch of copper. Use of any tool or method which might nick the conductor is prohibited. Each conductor not being spliced shall be inspected and trimmed so that the conductor does not extend beyond the insulation. After each conductor to be spliced is connected, all conductors both used and not used shall be returned to their original configuration before the insulation was removed and then sealed as specified.

Individual cables shall not extend beyond the splice of the last signal head for each signal phase.

Shielded Opticom cable shall not be spliced.

Shielded Aluminum Cable ("Home-Run cable") may be spliced only with the loop detector wire in a junction well. No splicing of the "home-run cable" outside of this junction well is permitted.

Overhead - Conductors to be electrically connected shall be placed side by side with the exposed copper aligned. The copper shall then be twisted clockwise with pliers until a good mechanical connection shall be effected. A proper size wire nut shall be installed and hand tightened. If necessary to cover all the copper, minor trimming may be done. The copper splice shall be 5/16 inch long when trimmed. Care shall be taken to ensure that no insulation is caught up in the copper area of the splice. It is essential that the splice be kept dry. Therefore, care must be taken during taping and by placement of the completed splice to prevent water from entering the splice between or around the cables.

1. **Termination of cable (Butt Splice) -** The sheath of each cable shall be removed as necessary. When all conductors to be joined have been completed, the splice shall be prepared for taping. The cables shall be placed in a butt position and all wires and wire nuts shall be positioned to ensure that no shorts exist and that the splice area is reduced to as small a diameter as possible. Taping shall begin with rubber tape two inches over the intact sheath. Taping shall proceed toward the other cable overlapping half of the tape width until a point two inches on the other cable sheath has been reached. Taping shall then be repeated in the other direction starting one tape width wider than the previous wrap. Where necessary to cover all areas of the splice, overlapping shall be increased. Every area of the splice shall have rubber tape at least four layers (two fully overlapped passes) deep. The rubber tape shall be covered with plastic tape applied in the same fashion.

2. **Taps or Tee Splices -** The sheath of the through cable shall be removed for a distance of 8 inches centered on the point of splice. The sheath of the branch cable(s) shall be removed for a distance of 4 inches. The through cable conductors which are to be joined to the conductors of the branch cable(s) are to be separated out from the others and cut. No other conductors shall be cut for any purpose. Depending upon the need, the branch cable(s) may be placed beside one of the through cables and the splicing proceed or the through cable may be doubled back so that the parts of the through cable and the branch cable(s) are placed side by side. When all conductors to be joined have been completed, the splice shall be prepared for taping. The cables shall be placed in approximately their final position and an inspection for shorts shall be made. After all wire nuts and wires are properly positioned, taping shall begin on the through cable 2 inches from the end for the sheath. It shall proceed with 1/2 inch width overlap across the splice area and onto the other through sheath for a distance of 2 inches. The taping shall start at the end point and return back across the splice to the branch cable(s). It shall proceed along the branch cable(s) and onto the sheath for a distance of one inch. A return along the branch back to the main cable shall be made and the remaining part of the splice shall be taped continuing as before. Every area of the splice shall have rubber tape at least four layers (two fully overlapped passes) deep. The cables shall be placed in their final position and taped with two fully overlapped passes of plastic tape. Plastic tape need not cover the interior areas covered by the rubber tape. The splice shall be placed so that the branch cable(s) enters the splice from below to prevent water from flowing along the branch cable(s) into the splice area.

3. **Termination End of Cable –** Dead ended cables shall have 3" of sheath removed. Each individual cable shall be rubber taped then bundled and re-taped with vinyl tape and coated with waterproofing compound.

Method of Measurement:

The quantity of cable will be measured as the actual number of linear feet of cable furnished and pulled through conduits (underground, in mast arms, or on poles) or installed on a span wire in accordance with these specifications, complete in place, and accepted.

All required cable slack left at termination points or in junction wells shall be measured as part of this item.

Basis of Payment:

The quantity of cable furnished and pulled through all conduit (underground, in mast arms, or on poles) or furnished and installed on a span wire will be paid for at the Contract unit price per linear foot of the applicable pay item. Splice installations and all costs related to the splice shall be incidental to the linear foot payment of the cable being spliced. Price and payment will constitute full compensation for all labor, equipment, tools, materials, material testing, splicing, taping, and incidentals required to complete the work as specified above.

7/14/14

746926 – FURNISH & INSTALL ELECTRICAL UTILITY SERVICE EQUIPMENT 120/240

Description:

Electrical service equipment consists of the equipment necessary to connect a utility company service to a traffic control device cabinet, lighting control cabinet, traffic monitoring station cabinet, or other traffic control device cabinet. Provide electrical service equipment at the phasing and amperage specified in the Contract Documents. This work includes coordinating the connection with the local utility company.

Materials:

Meter Sockets:

Provide either ringed or ringless type meter sockets as required by the utility company. If a meter is not required, provide a ringless socket with suitable shunts and a metallic cover plate. Provide stainless steel hardware for attaching the meter socket to a cabinet, wood post, or other structure.

Disconnect Switches:

Disconnect switches shall be NEMA standard KS 1-1990. The disconnect switch enclosure shall be Type 4 stainless steel, with external operating handle, enclosure cover interlock, and external switch mechanism handle with provisions for securing in both the ON and OFF positions by padlock. The switch mechanism shall be of heavy duty design with quick make, quick break type operations and visible blades.

The disconnect switch shall be fusible with integral fuse puller. Single phase disconnect switches shall have 2 poles with solid neutral and shall be rated at 240 Volts. Three phase disconnect switches shall have 3 poles with solid neutral and shall be rated at 600 Volts. The design of the neutral bar may be factory or field installable.

Construction Methods:

Utility Connection - Before any control equipment or material is ordered, arrange a meeting with the utility company representatives, Signal Construction Inspection representatives and the Engineer to establish a schedule for utility connections. Do not disconnect, de-energize, reconnect, tamper with, or otherwise handle any of the utility company's facilities. Make the utility service connection to the point of service supplied by the utility company. Make the necessary arrangements with the utility companies to ensure having needed utilities available at the time of turn on. Delays due to utility energization, connection, or disconnection will not be a basis for time extension. Report any difficulties in securing utility company services to the Engineer as soon as possible.

General Installation - Electrical Utility Service Equipment shall be installed per the standard construction or applicable plan details.

Measurement and Payment:

Electrical Utility Service Equipment will be measured and paid for at the Contract unit price per each at the phasing and amperage specified. The payment will be full compensation for the disconnect switch, meter socket, meter, shunts, cover plate, ground rods, wiring, conduit risers, elbows, conduit nipples and adapters, and for all material, labor, equipment, tools, and incidentals necessary to complete the work.

Underground conduit will be measured and paid for separately under the applicable conduit item(s).

Service lateral cable will be measured and paid for separately under the applicable cable item(s).

Utility connection coordination with the utility company will not be measured, but the cost will be incidental to other pertinent items.

Utility company energizing, connection, and disconnection costs will be the responsibility of the Department.

2/29/12

746953 - DIRECT GLARE LINE LIGHTING SYSTEM

Description:

This work consists of furnishing and installing long run LED delineation system on both sides of the bridge deck. Work includes, but is not limited to, furnishing and installing LED modules, conduits, electrical junction boxes, wiring, aluminum mounting profile, diffuser and power drivers.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman.
Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Catalog Cuts. Submit catalog cuts and shop drawings for approval.

Materials:

General.

1. All luminaires shall embody the highest standards of electrical and mechanical design, materials and workmanship, and shall be subject in all respects to the approval of the Engineer.
2. All luminaires shall be installed complete with lamps by the manufacturer specified or an equal approved by the engineer.
3. Manufacturers' packaging shall be marked to include identification by type, quantity of contents, and manufacturer's component designation.
4. Lighting standards shall meet or exceed the requirements of the 2009 edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals".
5. Use new materials, equipment and installations, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.
6. Provide LM-79 photometric test reports for all LED luminaires. LM-79 luminaire photometric reports shall be produce by an independent test laboratory and include the following:
    a. Name of test laboratory. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program.
    b. Report number
    c. Date
    d. Complete luminaire catalog number. Catalog number tested must match the catalog number of the luminaire submitted, except for variations which do not affect performance.
    e. Description of luminaire, LED light source(s), and LED driver(s)
    f. Goniophotometry
    g. Colorimetry
7. Provide LM-80 lumen maintenance test report for each LED luminaire.
8. Luminaire shall have external and internal labels per ANSI C136.15 and ANSI C136.22, respectively. Internal label shall identify the manufacturer, year and month of manufacture and the manufacturer's part number.
9. Luminaires shall be listed for wet locations.

Warranty.

1. Provide manufacturer's standard form in which manufacture agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship, corrode, fade, stain, or chalk due to the effects of weather or solar radiation within specified warranty period.
2. Warranty period for luminaires: Minimum five years from date of Substantial Completion.

Direct Glare Line Light.

1. General
   a. Must be capable of running up to 200 meters from an single power source
2. Housing
   a. Anodized aluminum mounting profile with no visible fasteners.
   b. Length: Capable of exceptionally long runs (up to 675 feet) from a single power source.
   c. Diffuser Tube:
      i. Impact resistant, UV stable and impact resistant acrylic round diffuser tube to present an evenly illuminated line of light.
      ii. Diffuser shims shall be used to secure the diffuser to the mounting profile to withstand from strong winds
3. LED Modules
   a. Fully sealed for outdoor use; IP66 rated
   b. 18 Mid-Power high-efficiency LEDs per 1ft. module.
   c. Installed in 4 module assemblies or 4ft. strings across entire length of bridge
   d. Perfectly even and saturated direct view illumination.
   e. Color Temperature: 3500K
   f. Lumen Maintenance: L70 greater than 115,000 hours.
   g. Color Rendering Index (CRI): Minimum CRI of 80.
   h. Through-wiring between modules through snap-in connectors

4. LED Drivers (Power Supply)
   a. Constant current LED power supply
   b. Input voltage: Universal 120V-240V, 47Hz to 63Hz
   c. Power output: Up to 3000 Watts at 380V DC
   d. Under-voltage, over-load and over-temperature protection.
   e. DC ground fault circuit interruption
   f. Power factor of 0.99
   g. IP66 anodized aluminum enclosure
   h. Attached leader cable for convenient field wiring.
5. Operating temperature: -40 ºC (-40ºF) to +50 ºC (+122ºF)
6. Wattage: 5 Watts maximum per 1ft.

Conduits. Galvanized steel and PVC conduits and fittings shall be as specified under Section 745 of the Standard Specifications.

Junction Boxes. Galvanized steel. Sized per NEC.

<u>Construction Methods</u>:

General.

1. Luminaires shall be installed complete with all equipment, materials, parts, attachments, devices, hardware, cables, and supports necessary to make a safe, complete and fully operative installation. Manufacturer of each luminaire shall supply complete installation instructions including diagrams, illustrations, etc. The Contractor shall install in strict conformance with such instructions.

2. Each luminaire shall be installed at location shown on the plans. Where field conditions require deviation from location shown, the Engineer shall be so notified by the Contractor and final installation made as directed by the Engineer.
3. Install in accordance with manufacturer's recommendations and shop drawings.
4. Thoroughly clean any dirt and residue from luminaires prior to installation.
5. Install components plumb and level, accurately fitted, free from distortion or defects.
6. Protect luminaires from damage and defacement until acceptance by Owner. Replace any damaged or defaced fixtures with new units prior to acceptance at no additional cost to the Owner.
7. Clamps and attachment hardware shall be galvanized.

Direct Glare Line Light.

Aluminum mounting profile, LED modules, round diffuser, diffuser shim and power driver shall be combined to create the complete installation. Each LED module shall be connected end-to-end and snapped into the aluminum mounting profile, which shall securely fastened to the underside of the bridge deck, as shown in the Contract Plans. The modules shall be covered using round diffuser tube to present an evenly illuminated line of light across the entire length of the bridge.

The power driver shall be installed to supply power to the LED modules. Enclose the power driver in a structure mounted junction box. The contractor shall install and furnish galvanized rigid conduit to enclose the lead-in cable from the power driver to the lighting the fixture. Install flex conduit as needed to connect to the LED modules.

Electrical. Pull cables through underground and structure-mounted conduit and make connections as specified in the applicable cable items.

Electrical Testing. The system shall be tested in accordance with Item 746653 – Electrical Testing.

Method of Measurement:

The quantity of Direct Glare Line Lighting System will be measured as the lump sum item to include LED modules, mounting profiles, diffusers, diffuser shims, power drivers, power driver enclosures, lead-in cable, galvanized conduit connection from power driver to lighting fixture which will be furnished, installed, operational and accepted.

Basis of Payment:

The quantity of Direct Glare Line Lighting System shall be paid at the lump sum price of all components furnished and installed. Price and payment will constitute full compensation for furnishing all materials, including mounting hardware and supply cables, and supply and installation of LED modules, power drivers, lead-in cable and enclosures for power drivers The price will also include all labor, tools, equipment, testing and incidentals to complete the work.

Underground and structure mounted conduit between the control cabinet and driver (power supply) will be measured and paid for separately under the applicable conduit item(s).

Electrical wiring between the control cabinet and power driver will be measured and paid for separately under the applicable cable item(s).

4/15/2016

746954 - GIRDER WASH LIGHTING SYSTEM

Description:

This work consists of furnishing and installing LED spot lights on top of the bridge pier to wash the girder system underneath the bridge deck. Work includes, but is not limited to, furnishing and installing LED spot lights, optical kit, conduit, cable, electrical junction boxes, and all attachment hardware.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman.
Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Layout Drawing and Catalog Cuts. At least 60 days prior to installation, the contractor shall submit to DelDOT for review and approval a layout drawing for the Girder Wash Lighting System. The submittal with the layout drawing shall include the following:

1. Layout drawing shown the location of the girder wash lights, conduit routing, and junction box locations. A plan for attachment of the lighting system to the bridge structure, including any penetrations through structural elements, shall also be provided.
2. Specific technical details, including catalog cuts on the luminaires, junction boxes, conduits, wiring, and attachment.
3. Photometric plan, showing how the selected luminaire will wash the girder with light.

Materials:

Girder Wash Light.

1. General.

   a. All luminaires shall embody the highest standards of electrical and mechanical design, materials and workmanship, and shall be subject in all respects to the approval of the Engineer.
   b. All luminaires shall be installed complete with lamps by the manufacturer specified or an equal approved by the engineer.
   c. Manufacturers' packaging shall be marked to include identification by type, quantity of contents, and manufacturer's component designation.
   d. Lighting standards shall meet or exceed the requirements of the 2009 edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals".
   e. Use new materials, equipment and installations, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.
   f. Provide LM-79 photometric test reports for all LED luminaires. LM-79 luminaire photometric reports shall be produce by an independent test laboratory and include the following:
      i. Name of test laboratory. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program.
      ii. Report number
      iii. Date

iv. Complete luminaire catalog number. Catalog number tested must match the catalog number of the luminaire submitted, except for variations which do not affect performance.
v. Description of luminaire, LED light source(s), and LED driver(s)
vi. Goniophotometry
vii. Colorimetry

g. Provide LM-80 lumen maintenance test report for each LED luminaire.
h. Luminaire shall have external and internal labels per ANSI C136.15 and ANSI C136.22, respectively. Internal label shall identify the manufacturer, year and month of manufacture and the manufacturer's part number.
i. Luminaires shall be listed for wet locations.

2. Warranty.

a. Provide manufacturer's standard form in which manufacturer agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship, corrode, fade, stain, or chalk due to the effects of weather or solar radiation within specified warranty period.
b. Warranty period for luminaires: Minimum five years from date of Substantial Completion.

3. Housing

a. Style: Spot light.
b. Heavy duty die-cast aluminum.
c. Finish: Textured black powder coating and corrosion resistant finish for long lasting durability.
d. Dimensions: 5" diameter.
e. Lens: Tempered glass.

4. LED Luminaire

a. Initial lumens: Minimum 800 lumens.
b. Beam Angles: Provide optical kit to enable the flexibly of changing beam angles.
c. Color Temperature: 3500K
d. Lumen Maintenance: L70 greater than 75,000 hours.

5. Power Supply

a. Integral power supply
b. Input voltage: 120V
c. Fixture connections: 12" flying lead.

6. Operating temperature: -40 ºC (-40ºF) to +50 ºC (+122ºF)

7. Wattage: +/- 19 Watts.

Conduits. Conduits and fittings shall be as specified under the applicable conduit items.

Junction Boxes. Galvanized steel. Sized per NEC.

Cable. All electrical cables shall be manufactured in conformance with the National Electrical Code, 600-Volt, UL approved. Stranded or solid, single conductor copper cables shall be XLP Insulated; USE or RHW rated.

Construction Methods:

General.

1. Luminaires shall be installed complete with all equipment, materials, parts, attachments, devices, hardware, cables, and supports necessary to make a safe, complete and fully operative installation. Manufacturer of each luminaire shall supply complete installation instructions including diagrams, illustrations, etc. The Contractor shall install in strict conformance with such instructions.
2. Each luminaire shall be installed at location shown on the plans. Where field conditions require deviation from location shown, the Engineer shall be so notified by the Contractor and final installation made as directed by the Engineer.
3. Install in accordance with manufacturer's shop drawings.
4. Thoroughly clean any dirt and residue from luminaires prior to installation.
5. Install components plumb and level, accurately fitted, free from distortion or defects.
6. Protect luminaires from damage and defacement until acceptance by Owner. Replace any damaged or defaced fixtures with new units prior to acceptance at no additional cost to the Owner.
7. Clamps and attachment hardware shall be galvanized.

Girder Wash Light.

The girder wash lighting system shall consist 16 LED luminaires (eight lights per pier) installed on top pf the bridge pier and connected in series as shown on the contract plans. Each light shall be surface mounted to a small junction box provided by the contractor. Galvanized rigid conduit shall be used to enclose the electric circuitry connecting each of the LED lights on the bridge pier.

Install flexible metallic conduit between a junction box mounted on the diaphragm between bridge girders to the first girder wash light on the bridge pier. The flexible conduit shall be of a sufficient length to accommodate anticipated movement between the bridge pier and the girders.

The Contractor shall meet with representatives from DelDOT and the City of Wilmington to view the girder wash lighting system at night. The contractor shall adjust the aim of the girder wash lights to achieve the aesthetic look desired by DelDOT and the City of Wilmington.

Electrical.

Install conduits as indicated in the applicable conduit specifications. Pull cables through structure-mounted conduit and make connections as specified in the applicable cable specifications.

Electrical Testing. The system shall be tested in accordance with Item 746653 – Electrical Testing.

Method of Measurement:

The quantity of Girder Wash Lighting System will be measured as the lump sum item to include all lighting and electrical elements between the diaphragm-mounted junction box and the girder wash lights.

Basis of Payment:

The quantity of Girder Wash Lighting System shall be paid at the lump sum price of all components furnished and installed. Price and payment will constitute full compensation for furnishing and installing all materials, including conduit, cable, junction boxes, luminaires, mounting hardware, and clamps between the diaphragm-mounted junction box and girder wash lights. The price will also include all labor, tools, equipment, testing and incidentals to complete the work.

Underground conduit and bridge mounted conduit between the electrical control cabinet and the diaphragm mounted junction box at each pier will be measured and paid for separately under the applicable conduit item(s).

Electrical wiring between the electrical control cabinet and the diaphragm mounted junction box at each pier will be measured and paid for separately under the applicable cable item(s).

4/14/2016

746955 - PEDESTRIAN UNDERPASS LIGHTING SYSTEM

Description:

This work consists of furnishing and installing LED luminaires for underpass lighting and accent lighting within the underpass. Work includes, but is not limited to, furnishing and installing LED luminaires, conduits, electrical junction boxes, wiring, dimming controls, and electrical cabinet enclosure with necessary breakers and terminal switches.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman.
Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Catalog Cuts. Submit catalog cuts and shop drawings for approval.

Materials:

General - Luminaires.

1. All luminaires shall embody the highest standards of electrical and mechanical design, materials and workmanship, and shall be subject in all respects to the approval of the Engineer.
2. All luminaires shall be installed complete with lamps by the manufacturer specified or an equal approved by the engineer.
3. Manufacturers' packaging shall be marked to include identification by type, quantity of contents, and manufacturer's component designation.
4. Lighting standards shall meet or exceed the requirements of the 2009 edition of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals".
5. Use new materials, equipment and installations, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.
6. Provide LM-79 photometric test reports for all LED luminaires. LM-79 luminaire photometric reports shall be produce by an independent test laboratory and include the following:
    a. Name of test laboratory. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program.
    b. Report number
    c. Date
    d. Complete luminaire catalog number. Catalog number tested must match the catalog number of the luminaire submitted, except for variations which do not affect performance.
    e. Description of luminaire, LED light source(s), and LED driver(s)
    f. Goniophotometry
    g. Colorimetry
7. Provide LM-80 lumen maintenance test report for each LED luminaire.
8. Luminaire shall have external and internal labels per ANSI C136.15 and ANSI C136.22, respectively. Internal label shall identify the manufacturer, year and month of manufacture and the manufacturer's part number.
9. Luminaires shall be listed for wet locations.

Luminaire Warranty.

1. Provide manufacturer's standard form in which manufacture agrees to repair or replace luminaires or components of luminaires and lamps that fail in materials or workmanship, corrode, fade, stain, or chalk due to the effects of weather or solar radiation within specified warranty period.
2. Warranty period for luminaires: Minimum five years from date of Substantial Completion.

Pedestrian Underpass Ceiling Light.

1. Housing
    a. Vandal resistant.
    b. Fabricated from 20 gauge cold rolled steel with housing ends welded into place.
    c. Finish: White polyester powder coating finish for long lasting durability.
    d. Length: 8 ft.
    e. Diffuser:
        i. Nominal 13 inch inch wide, gently curved profile design.
        ii. Extruded from high transmission unbreakable polycarbonate frosted material.
        iii. Linear ribbing for high LED performance.
        iv. Secured by heavy-gauge steel retaining strips and tamperproof screws.

2. LED Modules
    a. High performance, linear configured LED module boards
    b. Each module board shall consist of multiple mid-power, high-efficacy LEDs in a layout that eliminates the need for supplemental heat sinking.
    c. LED board shall produce an even and diffuse light that maximizes optical efficiency.
    d. Compatible with dimming performance of the LED driver.
    e. Color Temperature: 3500K
    f. Initial lumens: minimum 9100 lumens
    g. Lumen Maintenance: L80 greater than 60,000 hours.
    h. Color Rendering Index (CRI): Minimum CRI of 80.

3. LED Drivers
    a. Constant current LED power supply
    b. Input voltage: Universal 120V-277V, 50Hz to 60Hz
    c. Dimming: Specification grade dimmer down to 10% on 0-10V dimming controls.

4. Operating temperature: -20 ºC (-4ºF) to +40 ºC (+77ºF)

5. Wattage: +/- 131 Watts

Pedestrian Underpass Wall Light.

1. Housing
    a. 6063-T5 extruded aluminum with welded ends.
    b. Pressure equalizing vent to prevent condensation.
    c. Finish: Powder-coat matte white.
    d. Length: 8 ft.
    e. Lens: Solid acrylic diffuse snap-in lens with matte finish, gasketed for complete wet seal.
    f. Mounting: Wall mount.

2. LED Modules
    a. Compatible with dimming performance of the LED driver.
    b. Color Temperature: 4000K

c. Initial lumens: minimum 325 lumens per foot
d. Lumen Maintenance: L80 greater than 60,000 hours.
e. Color Rendering Index (CRI): Minimum CRI of 80.

3. LED Drivers
   a. Constant current LED power supply
   b. Input voltage: Universal 120v-277V, 50Hz to 60Hz
   c. Dimming: 0-10V dimming controls

4. Operating temperature: -30 °C (-22°F) to +40 °C (+77°F)

5. Wattage: 4.7 watts per foot

Conduits. Galvanized steel and PVC conduits and fittings shall be as specified under Section 745 of the Standard Specifications.

Junction Boxes. Galvanized steel. Sized per NEC.

Dimmer.

1. Voltage: 120/277VAC, 50/60Hz

2. Load:
   a. Up to 20 combined amps
   b. Integral current monitoring of total connected load
   c. On/Off/Dim local override button for each load

3. Class 2 Dimming Control Signal: 0-10VDC, sinks up to 100mK per channel for control of compatible ballasts

4. Class 2 output to DLM local network: 24VDC, up to 250mA across 4 RJ45 ports

5. Digital Lighting Management (DLM) Local Network Parameters:
   a. Maximum Current: 800mA
   b. Cat 5e Cable: 150’ per device to 1,000’ max
   c. Up to 64 loads
   d. Up to 48 communicating devices.
   e. Maximum 4 room controllers

6. Ability to store up to 16 preset levels for each dimmed output

7. UL (88T9) and cUL listed

8. FCC part 15 compliant

9. Operating temperature: 0 °C (32°F) to +70 °C (+158°F)

10. Warranty: minimum 5 year warranty

Digital Zone Controller.

1. Input Voltage: 115/277VAC, 50/60Hz

2. Class 2 connection to two independent digital lighting management local networks:
   a. 24VDC output, up to 250mA across 2 RJ45 ports per local network or up to 400mA per network with optional power booster

3. Removable terminal for connection to DLM segment network

4. Capable of supporting astronomical, time-based and photocell based events

5. Provide hand-held configuration tool to remotely configure and report dimming parameters, including light levels and time set-points.
   a. Power: Three AAA Batteries
   b. OLED display 1.4”W x 0.75”H
   c. Infrared Transceiver
   d. IR range: up to 32 ft.
   e. Carrying case with belt clip
   f. Operating Temperature: 32-104 ºF
   g. FCC Part 15 Compliant
   h. Five Year Warranty

6. UL and cUL listed (E207852)

7. FCC part 15 compliant

8. Operating temperature: 0 ºC (32ºF) to +50 ºC (+122ºF)

9. Warranty: minimum 5 year warranty

Electrical and Dimming Control Cabinet.

1. DelDOT standard Type M cabinet with enclosure material properties as specified in 747513 – Lighting Control and Distribution Enclosure.

2. Cabinet base shall be as specified in 747515 – Cabinet Base Type M.

<u>Construction Methods</u>:

General.

1. Luminaires shall be installed complete with all equipment, materials, parts, attachments, devices, hardware, cables, and supports necessary to make a safe, complete and fully operative installation. Manufacturer of each luminaire shall supply complete installation instructions including diagrams, illustrations, etc. The Contractor shall install in strict conformance with such instructions.
2. Each luminaire shall be installed at location shown on the plans. Where field conditions require deviation from location shown, the Engineer shall be so notified by the Contractor and final installation made as directed by the Engineer.
3. Install in accordance with manufacturer’s shop drawings.
4. Thoroughly clean any dirt and residue from luminaires prior to installation.
5. Install components plumb and level, accurately fitted, free from distortion or defects.
6. Protect luminaires from damage and defacement until acceptance by Owner. Replace any damaged or defaced fixtures with new units prior to acceptance at no additional cost to the Owner.
7. Clamps and attachment hardware shall be galvanized.

Pedestrian Underpass Ceiling Lighting.

The underpass ceiling lighting system shall consist of 3 eight-foot linear LED lights, connected in series as shown on the contract plans. Each light shall be directly mounted to the ceiling. Provide a junction box, embedded in the underpass ceiling, at each luminaire to enclose all connections. The luminaire shall conceal the junction box. The junction box shall be located along the length of the light fixture at the manufacturer recommended location Coordinate junction box location with structure design so that rebar support can be modified if needed to avoid the junction box.

Pedestrian Underpass Wall Lighting.

The underpass wall lighting system shall consist of 4 eight-foot linear LED lights on each vertical wall (8 total lights) to provide accent lighting for the recessed art panels. The lights shall be connected in series as shown on the contract plans. Each light shall be surface mounted using manufacturer recommended junction boxes. These junction boxes will also contain wiring for the luminaires to enclose splices.

Electrical.

Pull cables through underground and structure-embedded conduit and make connections as specified in the applicable cable items.

Dimming.

Connect the underpass ceiling and wall lighting to a digital 0-10 volt dimming controller to enable adjustments to the luminaire output with respect to the available natural light. The contractor shall meet with representatives from DelDOT and the City of Wilmington to view the pedestrian tunnel light levels during daylight and night time hours. Dimming controls shall be adjusted to optimize the preferred light output by time of day.

Establish connection between the dimming controller and digital zone controller using a CAT-5 cable. Both of these controllers shall be enclosed in a DelDOT standard Type M cabinet not more than 200 feet from the first connected light fixture. Controllers shall be securely mounted to the cabinet's backplate.

Install #18 AWG control wires between dimming controller and luminaires as shown on the plans.

Electrical and Dimming Control Cabinet.

Install DelDOT standard Type M cabinet at the location shown on the plans and as specified in 747513 – Lighting Control and Distribution Enclosure.

Install cabinet base at the location shown on the plans and as specified in 747515 – Cabinet Base Type M.

Electrical Testing. The system shall be tested in accordance with Item 746653 – Electrical Testing.

<u>Method of Measurement</u>:

The quantity of Pedestrian Underpass Lighting System will be measured as the lump sum item to include LED ceiling and wall light fixtures, junction boxes, dimming controller, digital zone controller, control wiring to luminaires, and DelDOT standard Type M cabinet and base will be furnished, installed, operational and accepted.

Basis of Payment:

The quantity of Pedestrian Underpass Lighting System shall be paid at the lump sum price of all components furnished and installed. Price and payment will constitute full compensation for furnishing all materials, including mounting hardware, and supply and installation of LED ceiling and wall light fixtures, junction boxes, dimming controller, digital zone controller, control wire to luminaires and DelDOT standard Type M cabinet and base. The price will also include all labor, tools, equipment, testing and incidentals to complete the work.

Underground conduit will be measured and paid for separately under the applicable conduit item(s).

Structure embedded conduit will be measured and paid for separately under the applicable structure item(s).

Electrical wiring between the control cabinet and luminaires will be measured and paid for separately under the applicable cable item(s).

4/15/2016

747508 - LIGHTING CONTROL CENTER – 100A

Description:

This work consists of providing and installing load center cabinets with all necessary conduits, underground facilities, equipment, wiring, supports, and concrete pad as indicated on the Plans or as directed by the Engineer. This work includes coordination with the local Utility Company.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman.
Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Catalog Cuts. Submit catalog cuts and shop drawings for approval.

Materials:

General. Use new materials, equipment and installations, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.

Steel Posts. Square Steel Tube Posts, A570 Grade 50. Minimum 12 gauge with 7/16" die punched circular holes or perforated knock-outs.

Mounting Panels. Aluminum, minimum 0.08" thickness.

Bolts. Stainless steel bolts, flat washers, and nylon lock nuts.

Concrete. Portland Cement Concrete, Class B.

Conduits. Galvanized steel conduits and fittings shall be as specified under Section 745 of the Standard Specifications.

Service conduit. Provide 2" rigid galvanized steel conduit from the lighting control center to nearest utility facility as indicated on plan or directed by the Engineer. Conduit will include mounting to utility pole. Installation is to meet utility company requirements.

Wiring. Wiring internal to the cabinet shall be 600 V, copper, plastic insulated, nylon jacketed and shall meet UL Type THWN/THHN and bear the applicable UL labels denoting type, size, stranding, manufacturer's name and surface marking or molded ridges for phase and neutral identification. Ground wire shall be solid, bare copper. Sizes shall be as specified on the Plans.

Ground Rod. Ground Rod shall be sectional, copper-clad 3/4″ DIA by 10 feet long. Provide approved clamps for connecting the ground conductor to the ground rod.

Enclosures. Enclosures shall meet the NEMA type specified and be dead front type weatherproof metal enclosed self-supporting structures, as specified. Free standing enclosures shall be fabricated from sheet aluminum and be as specified herein. Panel and control equipment cabinets shall be the manufacturer's standard enclosure for the type and application specified. They shall have door clamps, solid neoprene gaskets, welded seams, stainless steel external hardware, and continuous hinges with stainless steel pins. Enclosures shall have two weep holes in the bottom and shall be equipped for padlocking.

Circuit Breakers. Circuit breakers shall be molded case type having a minimum rating of 22,000 amp interrupting capacity (AIC) and be quick make, quick break, thermal magnetic, trip indicating, and have common trip on all multiple breakers with internal tie mechanism. Use of single pole breakers with handle ties is prohibited. Breakers shall conform to Federal Specification W-C-375. They shall have the current and voltage ratings and number of poles as specified in the Contract Documents, and shall be treated to resist fungus and be ambiently compensated for the enclosure and proximity to adjacent breakers. All circuit breakers shall be the bolt in type. Breakers shall be capable of accepting up to a #2AWG conductor. Provide spare circuit breakers where indicated on the plans.

Panel Boards. Federal Specification W-P-115 and shall be suitable for operation on the voltage and type service specified. They shall be UL listed and labeled. Panel boards shall be equipped with the number and size circuit breakers specified. Circuit breakers in panel boards shall meet Federal Specification W-C-375 and shall be bolted to copper busses. Buss ratings shall be as specified.

Disconnect Switch. Disconnect switch shall be NEMA standard KS 1-1990. The disconnect switch enclosure shall be Type 4 stainless steel, with external operating handle, enclosure cover interlock, and external switch mechanism handle with provisions for securing in both the ON and OFF positions by padlock. The switch mechanism shall be of heavy duty design with quick make, quick break type operations and visible blades. The disconnect switch shall be fusible with integral fuse puller. Single phase disconnect switches shall have 2 poles with solid neutral and shall be rated at 240 Volts. The design of the neutral bar may be factory or field installable.

Photoelectric Controls. Photocell control shall be integral to each installed luminaire.

Power Distribution and Terminal Blocks. Sized per NEC and wire size required by the project plans.

Construction Methods:

Service conduit shall be installed in accordance with DelDOT standard specification and utility company requirements. Extend the service conduit 10 ft. up the utility pole. Coil sufficient slack cable at the top of the conduit for the utility company to run wire to the top of pole and make connections.

Set concrete footings for square tube steel posts. Install 12"x12"x36" footing with 3"x3"x7/16" square tube anchor base. Install square tube anchor so that at least 1'-6" is in the concrete footing and +/-1" sticks out (enough for one full hole to be above grade). Maintain 3" clearance on the base of footing.

Backfill around the conduit and concrete footings and dispose of excess or unsuitable materials to grade of the bottom of concrete footings. Backfill may be placed after the first twenty-four (24) hours and is to be accomplished in six (6) inch (150 mm) layers, and each lift mechanically tamped. All excess material is to be removed and used elsewhere on the project as approved by the Engineer.

Set square tube steel posts. Finished length of the Tubular Steel Posts shall be determined by adding the total height of the disconnect and lighting control cabinet to 5 Ft.

Attach pedestal board to square tube steel posts using long grade bolts, nylon lock nuts and flat washers.

Install ground rods as specified. Measure the ground resistance as indicated in Item 746653 – Electrical Testing.

Electrical equipment shall be installed as indicated on the plans. Mount components to the back panel with manufacturer supplied mounting brackets or permanently attached screw studs.

Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling.

Install wiring identification tags that indicate the circuit number for each lighting circuit. Each tag shall be marked with minimum ¼ inch letters using lettering dies, engraving devices, or other permanent marking process approved by the Engineer.

Method of Measurement:

The quantity of load centers will be measured as the actual number of load centers, each consisting of the cabinets, all equipment, conduit and wiring, complete in place, operational and accepted.

Basis of Payment:

The quantity of load centers will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for furnishing all materials, excavation and backfilling for the footings, excavation and backfilling for service conduit and for all labor, equipment, tools and incidentals necessary to complete the item.

Underground conduit will be measured and paid for separately under the applicable conduit item(s).

Service lateral cable will be measured and paid for separately under the applicable cable item(s).

Utility connection coordination with the utility company will not be measured, but the cost will be incidental to other pertinent items.

6/27/16

747513 - LIGHTING CONTROL AND DISTRIBUTION ENCLOSURE (120/240)

Description:

This work consists of furnishing all materials and installing light panels, control and distribution equipment for any highway lighting system.

Coordination of Electrical Work. Use experienced personnel in the type of work required by the Contract Documents to provide a complete and satisfactory fitting and fully operational installation. Perform all electrical work either by, or under the immediate supervision of an electrical journeyman.
Meet NEC, NESC, local utility company requirements, and State and local laws and ordinances governing the work.

Catalog Cuts. Submit catalog cuts and shop drawings for approval.

Materials:

General. Use new materials, equipment and installations, UL listed or labeled, and meet NEC, NESC, NEMA, IES, and local codes and ordinances applicable to the installation.

Enclosures. Enclosures shall be dead front type weatherproof metal enclosed self-supporting structures. Free standing enclosures shall be fabricated from sheet aluminum. Enclosures shall conform to the NEMA 3R. They shall have door clamps, solid neoprene gaskets, welded seams, stainless steel external hardware and continuous hinges with stainless steel pins. Enclosures shall have two weep holes in the bottom and shall be equipped for padlocking.

For ventilation, all cabinets shall be provided with louvered vents in the front door with a removable air filter.

(a) Louvers shall satisfy the NEMA Rod Entry Test for 3R rated ventilated enclosure.
(b) Filters for all cabinets shall be 16 in. (400mm) long, 12 in. (300mm) wide, and 1 in. (25mm) thick. The filter shall cover the vents and be held firmly in place with top and bottom brackets and a spring loaded upper clamp.
(c) Exhaust air shall be vented out of the cabinet between the top of the cabinet and the main access door. The exhaust area shall be screened with a screen type material having a maximum hole diameter of 1/8 in. (3.125mm)

Circuit Breakers. Circuit breakers shall be molded case type having a minimum rating of 22,000 amp interrupting capacity (AIC) and be quick make, quick break, thermal magnetic, trip indicating, and have common trip on all multiple breakers with internal tie mechanism. Use of single pole breakers with handle ties is prohibited. Breakers shall conform to Federal Specification W-C-375. They shall have the current and voltage ratings and number of poles as specified in the Contract Documents, and shall be treated to resist fungus and be ambiently compensated for the enclosure and proximity to adjacent breakers. All circuit breakers shall be the bolt in type. Breakers shall be capable of accepting up to a #2AWG conductor. Provide a minimum of 2 spare circuit breakers.

Photoelectric Controls. Photoelectric controls shall be solid state, cadmium sulfide type with hermetically sealed silicone rectifier rated 120/240 or 277 volts, 60 cycle AC and 1000 watts maximum load. Built in surge protection shall be provided, and a failsafe operating feature shall be included so that the lighting circuits will remain energized in the event the photo control components become inoperative. Nominal operating levels of this control shall turn on at a minimum vertical illumination value of 3 FC (32 lux) and turn off at a maximum vertical illumination value of 6 FC (65 lux). These limitations shall be set by the manufacturer, and

tolerances of plus or minus 20 percent for the specified value will be acceptable. Photoelectric controls for luminaires and lighting controls shall be twist lock type. A suitable mounting bracket with locking type receptacle and all other necessary mounting hardware shall be furnished.

Contactors and Relays. Contactors of the current ratings and number of poles specified in the Contract Documents shall be held by permanent magnets. They shall be fully rated for all classes of load to 600 volts AC and shall have an interrupting rating of 600 percent of rated current. A HAND-OFF-AUTOMATIC selector switch shall be provided in the photoelectric cell circuit. Relays shall be the type, size and contact ratings as specified in the Contract Documents.

Panel Boards. Panel boards shall conform to Federal Specification W-P-115 and shall be suitable for operation on the voltage and type service specified in the Contract Documents. They shall be listed and labeled by the Underwriters' Laboratories, Inc. Panel boards shall be equipped with the number and size circuit breakers specified. Circuit breakers in panel boards shall conform to Federal Specification W-C-375 and shall be bolted to copper busses. Buss ratings shall be as specified. Panel shall be provided with modular Transient Voltage Surge Suppressors. (TVSS).

Lightning Arresters. Lightning arresters shall be secondary type, having the specified number of poles and 0-650 volts RMS. Arresters shall be provided with suitable mounting brackets and all other necessary mounting hardware.

Control Power Transformers. Control power transformers shall be the dry type, two windings, of the size and voltage ratings specified in the Contract Documents.

Thermostats and Fans. A thermostatically controlled cooling fan shall be provided for all cabinets. The fan and thermostat shall be rated for 125 percent of capacity and they shall be mounted at the top of the cabinet.

(a) Thermostats shall be the inline type, single pole, 120 volts, 10 amps with a minimum range of 70F to 160F.

(b) The fan shall have a minimum rated capacity of 100 CFM air flow and a minimum rated design life of 100,000 hours.

Identification Tags. Nylon, self-clinching type, non-conductive band with adequate sized tab for labeling.

Wiring. Wiring internal to the cabinet shall be 600 V, copper, plastic insulated, nylon jacketed and shall meet UL Type THWN/THHN and bear the applicable UL labels denoting type, size, stranding, manufacturer's name and surface marking or molded ridges for phase and neutral identification. Sizes shall be as specified.

Construction Methods:

Type M and Type R Cabinets. Furnish and install all equipment necessary to provide a complete functioning lighting cabinet as specified. Mount cabinets on concrete base. Place a bead of sealant under the cabinet on three sides. Do not seal side with the lowest elevation to provide drainage from within the cabinet. Coat bolts with anti-seize compound. Bolt cabinet to base. Place a bead of sealant on the outside of the cabinet on the same three sides as before.

Install photoelectrical control on the side of back of the lighting control cabinet using and LB conduit fitting. After installing the photoelectrical control and LB conduit fitting, seal the area around the hole in the cabinet so that water cannot enter the cabinet.

Mount components to the back panel with manufacturer supplied mounting brackets or permanently attached screw studs.

Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling.

Install wiring identification tags that indicate the circuit number for each lighting circuit. Each tag shall be marked with minimum ¼ inch letters using lettering dies, engraving devices, or other permanent marking process approved by the Engineer.

Seal all unused conduits install in cabinets at both ends to prevent water and dirt from entering the conduit and cabinet with approved sealing material.

Method of Measurement:

The number of Lighting Control and Distribution Enclosures to be measured per each under these items shall be the actual number in accordance with these special provisions complete in place and accepted.

Basis of Payment:

The number of Lighting Control and Distribution Enclosure as determined above, shall be paid for at the contract unit price bid for each item "Lighting Control and Distribution Enclosure 120/ 240 Volts" installed in accordance with the requirements contained herein, complete in place and accepted, which price and payment shall constitute full compensation for furnishing all materials, including panels, control devices concrete pad foundation and for all labor and equipment necessary for the installation of the electrical equipment specified.

5/6/16

747514 - CABINET BASE TYPE F
747515 - CABINET BASE TYPE M
747516 - CABINET BASE TYPE P
747517 - CABINET BASE TYPE R

Description:

This work consists of constructing cabinet base Type F, M, P and R in accordance with the Standard Construction Details or applicable Plan Details and at locations as directed by plans or the Engineer.

Materials:

Class B Concrete
3/4" x 10' sectional copperclad steel ground rods
5/8" Zinc plated or Stainless Steel Drop-in Anchors manufactured by Hilti Systems, Concrete Fastening Systems, or approved equal
5/8" x 1-1/2" galvanized hex bolts
3/4" acorn type ground clamps
PVC conduit sweeps

Construction Methods:

The base shall conform to the dimensions as indicated in the cabinet base detail on the Standard Construction Details or applicable Plan Sheets. A concrete collar is only required when installed in earth areas or as directed by the engineer. Conduits entering the base must enter only in the designated area. A minimum distance of 1 inch shall be maintained between conduits and a minimum distance of 2 inches between conduits and the ground rods.

A minimum of 8 foot of the ground rods must be driven into undisturbed soil through the 2 inch PVC sleeve. The PVC sleeve shall be driven into the ground so that the top of the sleeve will be flush with the concrete when the base is poured.

Method of Measurement:

The quantity of cabinet bases will be measured as the number of bases constructed in accordance with these specifications, complete in place, and accepted.

All conduit sweeps extending into the cabinet base as shown on the Plans or Standard Details as applicable shall be included in the price for each cabinet base..

Basis of Payment:

The quantity of cabinet bases will be paid for at the Contract unit price per each. Price and payment will constitute full compensation for all concrete, ground rods, labor, equipment, tools, conduit sweeps, and incidentals required to complete the work as shown on the standard details or applicable plan sheets.

10/9/2012

749532 – SUPPLY OF FLAT SHEET ALUMINUM SIGN PANEL TYPE IX RETROREFLECTIVE SHEETING
749534 – SUPPLY OF EXTRUDED ALUMINUM SIGN PANEL TYPE IX RETROREFLECTIVE SHEETING
749579 - SUPPLY OF FLAT SHEET ALUMINUM SIGN PANEL TYPE XI RETROREFLECTIVE SHEETING
749580 - SUPPLY OF EXTRUDED ALUMINUM SIGN PANEL TYPE XI RETROREFLECTIVE SHEETING

Description:

This work shall include fabrication and furnishing new sign panels constructed of either flat sheet aluminum panels OR extruded aluminum sign panels as specified in the job order. Supply of sign overlays will be part of flat sheet aluminum panels. The sign panels shall have a reflective sheeting background, and all complete with demountable copy or direct applied or silk screened copy. Included with the sign panel will be connections to supports, and other incidentals shown on the Plans or as described in the special provisions. Installation of flat sheet aluminum panels and extruded aluminum panels are paid for under other items in this contract.

The removing and transporting of the existing sign panels before fabricating and erecting new sign panels, if such requirement is specified shall be paid for under other items in this contract.

Design:

Sign panels and their connections to supports shall be designed for applicable loadings and allowable stresses specified for supports. All panels, stiffeners and subframing shall conform with any pertinent requirements set forth in the 1985 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals" with subsequent revisions. The Contractor shall submit working drawings showing the details for fabrications of the panels and support connections for prior approval.

Sign panel sections shall be fabricated of standard width, readily available, aluminum sheets not less than 3'-0" wide and not more than 5'-6" wide, except that not more than one sheet of 2'-0" minimum width will be permitted.

Sections 12 feet and under: Sign panel sections including those twelve (12) feet in height shall run from the top edge to the bottom edge of the sign face without horizontal joints in the aluminum sheets.

Sections 12 feet and Over: Sign panel sections over twelve (12) feet in height shall be fabricated of two or more sheets with horizontal joints which butt and fasten securely together and may be disassembled for simplified handling and erection in the field. Each horizontal joint in sign panel sheets shall be located at point of contraflexure in the sign face.

Fasteners and Backing Strips: Sign panel sections shall be provided with suitable fastenings, as shown on the Plans, to permit easy attachment to the supporting frames and these fastenings shall be so designed as to carry the full design load with a factor of safety of 1.6 against the minimum yield stress of the materials.

Sign panel sections shall be provided with backing strips at the joints, held firmly in place to keep the abutting panel sections in proper alignment. All sign panel fastenings and backing strips, accepting the fastening of letters, symbols and border to the sign face, shall be applied without causing visible projections or indentations of the sign face. Each sign panel section shall be designed to engage and hang from two or

more horizontal structural members of the supporting frame. The method of fastening to obtain secure close butt joints between panels may vary as recommended by the fabricator. Shop drawings will be required showing proposed method of attachment for approval of the Engineer.

Supporting Frame: The supporting sign frame shall consist of horizontal and vertical stringers as shown on the plans. The horizontal members of the supporting sign frame shall be fabricated of new material in one piece. Where large signs necessitate splicing the stringers, such splices shall be located at points of contraflexure and shall be held to a minimum, but splice must develop full section of member.

Sign Panel Size: Sizes of sign panels having demountable copy shall be based on the manufacturer's spacing charts. All letters shall be placed in accordance with manufacturer's spacing charts. Overall horizontal and vertical dimensions shall be in six-inch increments.

Materials:

Aluminum Flat Sheet Panels: Sign panels shall be of aluminum sheet type conforming to ASTM Designation B209 (alloy 6061-T6 or 5052-H38). The minimum panel sheet thickness shall be 0.125 inches. Stringers or horizontal structural sign supporting members and vertical connections shall be fabricated of 6061-T6 or 6062-T6 ASTM B221 aluminum alloy. All sign panels shall be fully reflectorized unless otherwise indicated on the Plans.

All sign hardware shall be stainless steel or galvanized steel or 2024-T4 aluminum alloy ASTM B211 or ASTM B221. Hardware for attachment to overhead members shall be Type 304 passivated stainless steel, except that stainless steel lock washers shall be Type 302 stainless steel alloy. Connections to the sign support structure shall be of steel conforming to the requirements of ASTM Designation A36 and galvanized to the requirements of ASTM Designation A123.

Extruded Aluminum Sign Panels: Extruded aluminum sign panels and edge strips shall conform to B 221, alloy 6063 T6. (See Extruded Aluminum Detail Sheets)

Hardware: Hardware shall be clear anodized, conforming to one of the following: ASTM B 209, alloy 2024 T4; B 211, alloy 2024 T4, 6262 T9, 6061 T6, 7075 T6 or 2017 T4.

Sheeting: The sheeting shall consist of prismatic lens elements with a distinctive interlocking pattern visible from the face of a smooth surface, unless otherwise specified on the plans. The sheeting shall have a precoated adhesive protected by an easily removable liner.

Retroreflective properties will be measured in:

Minimum Coefficient of Retroreflection Ra
($cd/lux/m^2$)

- All measurements shall be made after sign cleaning according to sheeting manufacturer's recommendations.
- The coefficients of retroreflection observation angles shall be 0.2°, 0.5°, 1.0°.
- The coefficients of retroreflection entrance angles shall be -4° and 30°.

Letter of Certification

The contractor shall send a letter of certification stating that the sign sheeting materials meet the required Minimum Coefficient of Retroreflection described in the charts below. The letter shall be sent to:

Delaware Department of Transportation
Signs and Markings Section
Attn: Traffic Operations Manager
P.O. Box 778
Dover, Delaware 19901

Warranty

The sheeting manufacturer shall submit with each lot or shipment, a certification that states the material supplied will meet all the requirements listed herein.

Type IX Retro-Reflective Sheeting

White	-4	30
0.2	380	215
0.5	240	135
1	80	45

Blue	-4	30
0.2	17	10
0.5	11	6
1	3.6	2

Yellow	-4	30
0.2	285	162
0.5	180	100
1	60	34

FYG	-4	30
0.2	300	170
0.5	190	110
1	64	36

Red	-4	30
0.2	76	43
0.5	48	275
1	16	9

FY	-4	30
0.2	230	130
0.5	145	81
1	48	27

Green	-4	30
0.2	38	22
0.5	24	145
1	8	4.5

FO	-4	30
0.2	115	65
0.5	72	41
1	24	14

Type XI Retro-Reflective Sheeting

White	-4	30
0.2	570	215
0.5	400	150
1	120	45

Blue	-4	30
0.2	26	10
0.5	18	6.8
1	5	2

Yellow	-4	30
0.2	425	160
0.5	300	110
1	90	34

FYG	-4	30
0.2	455	170
0.5	320	120
1	96	36

Red	-4	30
0.2	87	33
0.5	63	23
1	18	7

FY	-4	30
0.2	340	130
0.5	240	90
1	72	27

Green	-4	30
0.2	57	21
0.5	40	15
1	12	4.5

FO	-4	30
0.2	170	64
0.5	120	45
1	36	14

Sheeting Manufacturer's Replacement Obligation:

Standard Colors where it can be shown that retroreflective signs supplied and used according to the sheeting manufacturer's recommendations, have not met the performance requirements of this specification the sheeting manufacturer shall cover restoration costs as follows for sheeting shown to be unsatisfactory during the period listed below.

80% of the values listed in the tables for 12 years.

Non-reflective black material that is used on the signs will carry the same warranty period and replacement obligation. This material will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that it is visibly cracked or has experienced shrinkage of more than a 1/8" from the edge of the metal it is applied. For temporary signing, fluorescent orange, where it can be shown that the retroreflective sheeting fails to conform to the performance requirements of this section, the sheeting manufacturer shall cover restoration costs as follows for sheeting shown to be unsatisfactory during the period listed below.

80% of the values listed in the tables for 3 years.

The remedy to any failure will be:

The sheeting manufacturer will replace the sign in it's entirety inclusive of the sign panel, sign sheeting, labor, and M.O.T required to restore the sign surface to its original effectiveness.

Government Obligation

The agency shall be responsible for requiring the dating of all signs at the time of application. That date constitutes the start of the field performance obligation period.

All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

Natural causes include effects of exposure to weather. Natural causes exclude (without limitation) damage from exposure to chemicals, abrasion and other mechanical damage (such as from fasteners used to mount the sign, collisions or mishandling), vandalism, or malicious mischief.

Applicable Documents

The following documents, of the issues in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

ASTM Standards

D 4956 Standard Specification for Retroreflective Sheeting for Traffic Control

E 810 Standard Test Method for Coefficient of Retroreflection of Retroflective Sheeting

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals

Construction Methods:

Sign Face Finishing: All reflective sheeting, backgrounds, letters, numerals, symbols, and borders shall be clean-cut and sharp, and the messages on all signs shall be as indicated on the plans. Application of reflective sheeting to aluminum panels shall be in accordance with sheeting manufacturer's recommendations. Reflective sheeting shall be color matched and marked. The height of characters and the alphabet series to be employed for the signs shall conform to the Plans and their references. The alphabet series used on the sign panels shall conform to the Plans and the "Standard Alphabets for Highways Signs" of the Federal Highway Administration.

The working drawings prepared by the Contractor shall clearly indicate the proposed spacing of the letters and the locations and arrangements of symbols and borders.

Sheeting applications shall meet ambient temperature requirements as specified by the manufacturer.

Whenever it is necessary to construct the background of a sign face with two or more pieces of reflective sheeting, they must be carefully matched for color prior to application and sign fabrication, to provide uniform appearance and brilliance, day and night. Each full width section of reflective sheeting mounted adjacent to another full width section taken consecutively from the same roll shall be rotated and mounted 180 degrees with respect to that adjacent section. This rule shall also be observed as a guide when partial width sheets of reflective sheeting are used.

Non-conformance may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting which will render signs unacceptable. The entire background of each sign shall be uniform in color, brilliance, texture, and general appearance as seen in the daytime and under typical automobile illumination at night. No more sections of reflective sheeting shall be used for backgrounds than is necessary; remnants, scraps, and odd sized pieces of sheeting shall not be used in the fabrication of any signs manufactured for this contract. Joints between reflective sheeting sections shall either butt or overlap no more than 3/8 of an inch.

Transporting Sign Panel: Signs shall be slip-sheeted, packed, and shipped in such manner as to ensure arrival at their respective places of erection in an undamaged condition. All signs arriving at the erection site(s) in a condition which in the opinion of the Engineer, renders them unsuitable for use, shall be removed and replaced by the Contractor at his sole expense.

Identification Tags: The Contractor shall furnish and place identification tags or decals which state the contract number, month and year of erection on the lower reverse side of the panel, near the point closest to the roadway shoulder.

Method of Measurement:

The quantity of sign panels is to be measured as the square footage of front sign face installed for the type and sheeting grade specified under this item complete and accepted. The area will be computed from the maximum width and height dimensions of each sign panel, as shown on the Plans, or on the approved sign panel working drawings, (verified by field measurements). All sign panels will be considered either square or rectangular in shape, as the case may be, and no area deductions will be made for rounding corners.

Basis of Payment:

The quantity of sign panels will be paid for at the unit price per square foot for the type and sheeting grade specified. Price and payment shall constitute full compensation for furnishing, fabricating, and delivering sign panels complete in place and accepted, with reflective materials, copy, symbols, borders, connections to supports, degreasing, etching, and for all labor, materials, tools, equipment, and incidentals required to complete the item.

4/22/14

749543 - REMOVAL OF LIGHTING UNIT

Description:

This item consists of the removal of light poles and luminaires (i.e. light units) and the necessary electrical and hardware components. This item also includes return of the lighting pole, luminaire and all parts to the Riverwalk Development Corporation (RDC).

Materials:

None.

Construction Methods:

The service cable shall be disconnected and the wires to the luminaire shall be removed. All electric shall be terminated in a safe manner. The luminaire and pole with related hardware assembles shall be carefully removed from the pole foundation and stored within the project limits prior to returning it to RDC. Contact Megan McGlinchey, RDC, at 302-425-4890 seven (7) days prior to returning the lighting unit for delivery instructions.

Method of Measurement:

The quantity of removal will be measured as the number of lighting units removed and returned to the Riverwalk Development Corporation.

Basis of Payment:

The quantity of removal will be paid for at the contract unit price per each. Price and payment will constitute full compensations for light pole removal, return to RDC, and all labor, equipment, tools, and incidentals required to complete the work.

4/15/2016

749690 - INSTALLATION OR REMOVAL OF TRAFFIC SIGN ON MULTIPLE SIGN POSTS

Description:

This work consists of installing traffic sign(s) on multiple sign posts at the locations indicated on the Plans or as directed by the Engineer.

Materials:

All materials shall be supplied by the Contractor. Signs, post and all mounting hardware to be used will be paid for under other items of this contract. The Contractor is responsible for the delivery of the signs and sign material to the site without any damage.

Construction Methods:

The Contractor shall install the signs in the locations indicated on the Plans in accordance with the plans or as directed by the Engineer. Signs and post are to be installed in a manner not to damage the sign nor post. The Contractor shall be responsible for obtaining all necessary utility clearances before the signs may be installed.

Method of Measurement:

The quantity of sign installations will be measured as the total square foot of the sign(s) installed and accepted.

Basis of Payment:

The quantity of sign installations will be paid for at the Contract unit price per square foot. Price and payment will constitute full compensation for installing signs, post, and for all labor, equipment, tools, and incidentals required to complete the work. Signs that are not installed accordance with the plans or signs installed in the incorrect location shall be moved at no additional cost to the Department.

4/13/16

759502 - FIELD OFFICE, SPECIAL I

Description:

The field office work shall consist of furnishing, erecting, equipping, maintaining, and removing a doublewide modular office and adjacent parking area. Equivalent rented space may be substituted for the modular field office and its parking area as approved by the Engineer. Rented space may be no more than one mile from the project limits. The Contractor shall submit a specific location layout drawing and construction details for the proposed field office and its parking area for approval by the Engineer. The field office and parking area shall be for the exclusive use of Department Officials, Engineers, Designers, North Region Construction (NRC) Personnel, Consultants, and Inspectors.

The field office structure shall be free of asbestos and/or other hazardous materials. The field office and its parking area shall be constructed and installed in accordance with all applicable city, county, state, and federal codes. The Contractor shall be responsible for obtaining all required licenses and permits for installation and placement of the field office and its parking area. The costs of obtaining such licenses and permits to be incidental to the "Field Office, Special I" Item. The field office shall be available for use by the Department continuously throughout the duration of the project.

Construction and Equipment:

The double wide field office shall be new and have a minimum floor space of 1,200 square feet with minimum exterior dimensions of 50'-0" length by 24'-0" width. The floor to ceiling height shall be nominal 8'-0". The exterior walls, ceiling, and floor shall be insulated. The field office shall be of weather-proof construction, tightly floored and roofed, constructed with an air space above the ceiling for ventilation, supported above the ground, safely secured to its support if the support is an inground anchored foundation or otherwise by tie-downs to the ground, and fully skirted with rigid watertight covering overlapping the bottom of the exterior siding to the existing ground.

The Contractor shall provide entries to the field office by constructing a stair and deck platform with canopy at each exterior door. Each entry shall have an exterior light. These entries shall be fabricated using treated dimension lumber, be constructed with hand and safety railing, be designed to last the life of the Contract, and conform to the requirements of the Architectural Accessibility Board and other federal, state and local boards, bodies and/or courts having jurisdiction in the Contract limits.

The Contractor shall construct and maintain an all weather parking area adjacent to the office of at least 5000 square feet and having a minimum of 10 functional parking spaces striped for full size cars. Lighting of the parking area shall be provided. All weather pathways from the parking area to the entrances of the field office shall also be constructed and maintained. This parking area and entrance pathways shall have a minimum of 2" type "C" hot mix on top of minimum 6" graded aggregate subbase. Snow and/or ice shall be removed from the parking area and from the entrance pathways to the field office within 12 hours after each occurrence. Costs for furnishing, placing, and maintaining the aggregate base and hot mix, and for snow and/or ice removal, to be incidental to the Field Office, Special I" Item.

The ground area 30'-0" from around the perimeter of the field office to the field office shall be landscaped and maintained. If the earthen grounds do not have a stand of weed free grass, the surface of this area shall be loosened to a depth of 4" and a satisfactory seedbed shall be prepared free of debris and extraneous matter. The area shall be seeded to a healthy stand of grass or sodded, after which the area shall be watered, mowed, and trimmed a minimum of three times a month during the growing seasons. Cost for this landscaping and maintenance to be incidental to the "Field Office, Special I" Item.

The field office shall have full carpeting, kitchenette facilities, interior paneling, lighting, and plumbing fixtures. The field office shall have a minimum of two (2) exterior doors, each door having a passage and a deadbolt lock. These door locks shall be keyed alike and at least 6 complete sets of keys shall be supplied to the Engineer's representatives. The exterior doors shall be insulated or have storm doors. The field office shall have a minimum of six (6) windows, each window having a minimum glass area of 1150 square inches and a horizontal mini-blind covering the full glass area. The windows shall be insulated or have storm windows. All windows shall be equipped with a locking device. All doors and windows shall have screens installed and repaired when damaged.

At least two (2) outside water service connections shall be provided at the field office. Each water connection shall have a 3/4" frost proof hose bib with vacuum breaker and shall include 100 linear feet of 5/8" minimum diameter reinforced, industrial or commercial grade, and soft rubber hose with spray nozzle per connection.

The field office shall be provided with sufficient natural and artificial light and shall be adequately heated and cooled to provide comfortable working conditions.

The field office shall have satisfactory lighting, electrical outlets, heating equipment, exhaust fan, and air-conditioning connected to an operational power source. Plan and drawing areas shall have individual fluorescent lights situated over their worktables. Replacement fluorescent lights shall be furnished as required. Electrical current, water, and any fuel for heating equipment shall be furnished and the cost of such shall be borne by the Contractor. Maintenance of the heating, exhaust fan, and air-conditioning equipment shall be provided for by validated service contracts for the length of the Contract. These service contracts shall allow a Department authorized project person to deal directly with the service organization to request repair.

The Contractor shall furnish and maintain two fire extinguishers and provide one lighted "Exit" sign for each exterior passage door. Fire extinguisher(s) may be chemical or dry powder and shall be UL Classification 10-B:C(min.) and shall be suitable for Types A:B:C fires. A commercial or industrial type first aid and safety kit suitable for project conditions and hazards (including snakebite) shall be provided and maintained to full capacity on a monthly basis.

The Contractor shall provide an alarm system for field office security with electronic, direct connection to a security service provider. The security system shall have interior motion, window, and entrance detectors and built in manual fire alarm. All windows of the field office shall be covered with steel bar grids as a deterrent to forced entry. The Contractor shall provide validated monitoring and service contracts for the length of the Contract. These contracts shall allow a Department authorized project person to deal directly with the security service provider to request service and/or repair.

The Contractor shall furnish and maintain an adequate supply of cold potable water, a minimum 23 cubic foot new refrigerator, and a minimum 1000-watt new microwave oven. Maintenance of the potable water supply equipment, refrigerator, and microwave shall be provided for by validated service contracts for the length of the Contract. These service contracts shall allow a Department authorized project person to deal directly with the service organization to request repair.

Suitable indoor toilet facilities, conforming to the requirements of the State and Local Boards of Health or of other bodies or courts having jurisdiction in the area, shall be provided. Signs indicating the toilet facilities as being for Men, Women, or Restroom shall be placed on the door and an adequate positive locking system shall be provided on the inside of the doorway to insure privacy. The facility(s) shall be maintained by the Contractor to be clean and in good working condition and shall be stocked by the Contractor with adequate lavatory and sanitary supplies at all times during the period of the Contract.

The Contractor shall be responsible for performing or for making arrangements for all necessary telephone connections and for their maintenance; for providing a new telephone equipment system, for payment of all connections and the new telephone system equipment and its installation; and for final disconnection of the telephones.

The telephone system for the field office shall have a total of 3 lines consisting of 2 direct single lines with call forward busy feature and 6 six-button key sets having privacy feature (1 set which may be for wall mounting) and 1 TLS or T1 circuit line for data transmission, all for the official and exclusive use of the Engineer and other representatives of the Department. Location of telephone lines and key sets shall by as directed by the Engineer. Arrangement shall be made to allow a Department authorized project person to deal directly with the telephone company to report outages and/or request repair. The Contractor shall arrange for the installation and initial setup of the specified telephone system including phone company provision of a termination point with smart-jack. Initial installation and setup costs shall be the responsibility of the Contractor as well. All subsequent monthly billings, after initial installation and setup, for the field office telephone system and the TLS or T1 circuit line shall be received and paid by the Contractor. A copy of each of these subsequent bills shall be forwarded to the Engineer for reimbursement on the contract pay estimate and the reimbursement will be for the amount of the bill only and shall not include any additional mark-up or profit.

For all other utilities, the Contractor shall be responsible for performing or for making arrangements for all necessary utility connections and for their maintenance; for payment of all utility connections, installations, service fees and bills; and for final disconnection of utilities.

The field office interior shall be furnished by the Contractor. The Contractor shall provide new and maintain the following office furnishings, all which are to be approved by the Engineer prior to installation in the field office. Placement of these furnishings shall be as directed by the Engineer. These furnishings consist of 2 drafting tables with sufficient drawers for standard size plans either attached to the tables or in cabinet form each drafting table to have a fully adjustable ergonomic design spring back stool with five leg base having wheel casters, 6 full size office desks each with filing drawer and fully adjustable ergonomic design swivel chair with armrests and five leg base having wheel casters, 1 computer station with acoustical panels having minimum 60 NRC rating for privacy screen and fully adjustable ergonomic design swivel chair with armrests and five leg base having wheel casters, 1 large conference table for a minimum of 16 people with surrounding chairs with armrests, 2 folding tables minimum 6'-0" by 3'-0" each with ergonomic design straight back chair with armrests, 1 work table, 1 supply cabinet, 2 rough plan racks, 2 legal size filing cabinets with 4 drawers, 2 legal size fire-resistant filing cabinets with lock and key with 4 drawers and meeting fire underwriters' approval for not less than one hour test, 2 book shelves minimum 3'- 6" by 4'- 6", 3 vertical surface legal size three compartment pockets, 2 dry erase boards minimum 4' by 3' each with markers and erasers, and 2 cork bulletin boards minimum height 3' by 2'. These office furnishings will remain the property of the Contractor at the conclusion of the project.

The Contractor shall also furnish new and maintain the following office equipment for the field office, all which are to be approved by the Engineer prior to installation. Location of the office equipment shall by as directed by the Engineer. The required equipment will enable the Department to synchronize project record keeping and office functions. The equipment shall be delivered in working and useable condition:

4 heavy-duty calculators having extra large 12-digit fluorescent display, full size keyboard with contoured keys, two-color ribbon printer, and AC powered;

1 Canon Image Runner advance 4245 MFX-2855D or Toshiba e-STUDIO 2051c or approved equal all-in-one copier which includes scanner, printer, and fax. Copier to have high speed wireless and network capability. Copier shall have all necessary software and cables for proper operation and shall be connected to high speed wireless and connected for use to share on a local network. Copier to have

zoom and preset reduction and enlargement features, automatic two (2) sided copying, automatic document feeder with minimum 60 sheet capacity with automatic stapling capacity;

1 compact plain paper copying machine and cabinet with stationary platen, bypass feeding, and dual loading cassette system with cassettes for letter, legal, and ledger size paper. Copy machine to have zoom and preset reduction and enlargement features, automatic two (2) sided copying, automatic document feeder with minimum 30 sheet capacity, and 20 bin collator with automatic stapling capacity;

1 digital recorder, having fast playback, voice-activated system, silent auto-stop and pause, one-touch and follow-up, built-in condenser microphone, cue and review, and rechargeable with combination battery charger/AC adapter;

1 telephone answering machine having all-digital recording, 14 minute message capacity, selectable message time, voice prompt assistance, day/time stamp, call screening, two-digit LED message indicator, toll saver, power failure memory back-up, and message interrupt from any station;

2 compact digital cameras with 10 megapixels or greater, maximum dimensions of 3" x 5" x 3, built in flash, autofocus, video mode LCD for review of images, LCD viewfinder acceptable, removable memory compatible with compact flash, or secure digital (SD) or secure digital high capacity (SDHC), ISO compatible with 100, 200, 400 standard of quality of better, and memory cards supported by camera of 8 GB or better;

1 heavy duty 3-hole punch with minimum 40 sheet capacity;

1 extra heavy duty stapler with anti-jam feature having capacity up to 200 sheets; and

1 comb binding machine with manual punching capacity of 10 sheets having a minimum binding capacity of 150 sheets.

Consumables as required to manage the business of the project for the field office shall be provided for all office equipment for the length of the Contract. These consumables shall be furnished on request and shall include but not be limited to paper, tapes, ribbons, various size plastic combs, rolls, toner, cleaning kits, batteries, answering machine cassettes, camera batteries and memory cards/sticks, DVD and CD R/RW media, printer ink cartridges, etc.

Maintenance of all office equipment shall be provided for by a validated service contract for the length of the Contract. This service contract shall allow a Department authorized project person to deal directly with the service organization to request repair.

Computer Requirements for the Field Office:

Included in the unit price bid per month for the Field Office on this project will be three (3) IBM compatible Microcomputer Systems both which will be furnished and maintained by the Contractor for use by the Engineer. The specified computer systems will synchronize the construction management functions of the Department to monitor, report, and perform the accounting of the project work. The computer systems and all their related equipment specified below shall be furnished new and remain the property of the Contractor at the conclusion of the Contract. A detailed listing of the proposed computer systems and all their related equipment to be provided by the Contractor shall be submitted for approval by the Engineer prior to furnishing the Microcomputer Systems. The Microcomputer Systems shall be Laptop Computer Systems each with docking station. Each of the three (3) Microcomputer Systems shall consist of:

Central Processing Unit (CPU) – Lap Top

Intel Core i5 or Core i7 series processor and wireless networking capability included,

Minimum 8.0 GB RAM with expansion capability to at least 16.0 GB, and

Microsoft "Windows® 10 Pro with 64 bit support operating system with latest updates;

Memory (Storage)

DVD+RW or Blue Ray BD-RE (rewritable) drive with support for DVD RW support capability, and 256GB hard drive minimum, integrated Ethernet 10/100. Included software shall support system and data backups with the DVD/Blue Ray device using double/dual layer DVD discs;

Monitor (LCD)

Monitor for docking station and docking station. 21" minimum diagonal visual area flat panel capable of multiple frequency color graphics, 1440x900(wide) or 1280x1024 or better resolution, 16.7 million display colors, 5 ms response time, D-Sub and DVI video input ports and

Laptop - shall have 15.4” diagonal display minimum;

Color Graphics Card

PCIe video card or integrated video;

Keyboard

Keyboard shall be ergonomic, enhanced layout minimum with keyboard interface cable;

Printer

Laser printer, color, capable of printing 8-1/2”x 11”, 11”x17” and envelope, having wireless and hard line network connectivity, printers shall have all necessary software and cables for proper operation and shall be connected to high speed wireless and connected for use to share on a local network;

Software

The latest version programs for application management (operating system), word processing, spreadsheet, and anti-virus shall be provided with all user manuals. Upgrades, maintenance, and full technical support by the manufacturer shall be provided for the length of the Contract. The required software will enable the Department to synchronize accounting and record keeping functions between the project, District, and Department offices. A list of programs to be provided shall be submitted to the Engineer for approval. Software, other than for application management and anti-virus, is to be delivered unopened to the Department's administrative office. All software is to be compatible with and for use to run on "Windows® 10 Pro". The required applications software follows and is to be latest version unless noted:

collection - "Office 2010 Business Professional" with Word, Excel,
antivirus - "Norton™,
schedule - Primavera Project PlannerÒ version 3.1 SP3 or latest,
replication - Adobe Acrobat X Suite Software w/Adobe Photoshop® CS5 suite, and

software - supporting creation of DVD +/- R/RW disks (supporting double layer media writing) and DVDR and DVDRW disks using DVDRW drive, for example: Ahead Nero, Roxio DVD/CD Creator, or some equivalent product. Note: software commonly included as part of the standard CDRW upgrade/standalone package is acceptable if included with the unit,

An electrical outlet with dedicated circuit for the main computer unit,

A wireless optical mouse with proper driving software having complete Microsoft emulation,

Necessary cables for proper operation,

24 bit Sound Blaster compatible PCI soundcard with quality desktop speakers,

A combination surge, spike, and noise protection device with receptacles for all peripherals (may be in combination with the UPS power supply),

All cards, hardware, and operating, anti-virus, and equipment software to be fully installed and operational;

Related Equipment

Wireless networking hub/router, 802.11g or better with all associated hardware (adapters, cables, etc) and software to enable wireless networking for resource/equipment sharing among all office computers and printers, the cost of wireless and network connections and service to be incidental to the "Field Office, Special I" Item, and

An uninterruptible power supply (UPS) units for protection from power loss or fluctuation, minimum of 6 outlets, adequate to provide a minimum of 30 minutes backup power for an orderly shutdown of the computer system with software and connections for automatic system shutdown;

Maintenance and Service

Maintenance of all specified equipment and components shall be provided for by a validated service agreement for the length of the Contract. Maintenance (upgrades, replacement, and full technical support) for each software application shall be provided for by a validated maintenance agreement for the length of the Contract. These agreements shall allow an authorized project person to deal directly with the service organization to request repair or the maintenance organization to request assistance; and

Supplies

Consumables as required to manage the business of the project shall be provided for the Microcomputer Systems in the field office for the length of the Contract. These consumables shall be furnished on request and include but not be limited to memory cards/sticks compatible with provided digital cameras having 8 GB or greater capacity and compatible with provided computers, DVDR and DVDRW media compatible supporting operational minimum to maximum speed of the DVD/RW drive unit, cut sheet paper and labels compatible with the printers, hardware and screen cleaners, printer ink cartridges, and toner cartridges.

Maintenance of the field office including its entrance and adjacent parking area, for the time required, shall consist of maintenance and/or replacement of all provided items, security system, furniture and equipment, computer systems, providing lavatory supplies, providing trash containers and waste baskets, providing entrance mats at each door, providing replacement items for lighting fixtures, maintaining all

utilities, providing satisfactory and sanitary janitorial and waste disposal services twice a week, providing cleanup of trash and debris on the parking lot and landscaped area once a week, and shall be included in the monthly unit cost.

The Contractor shall provide and deliver a current copy of all validated field office, equipment, and computer maintenance, service, assistance and/or monitoring agreements and/or contracts as mentioned hereinabove to the Department's administrative office on or before the first day the field office is ready for use.

Method of Measurement:

This item will not be measured but will be paid for on a monthly basis. Partial months will be paid at the rate of 0.033 months per day.

Basis of Payment:

The field office will be paid for on a unit price bid per month, which price shall be full compensation for performing the work specified, obtaining all licenses and permits, and furnishing of all materials, labor, tools, equipment and incidentals necessary to maintain the field office and its adjacent parking area and restore the field office area and adjacent parking area to match the original site condition. No separate payment will be made for costs involved for removing hazardous material or underground tanks to install this field office or its parking area. One (1) unit of payment will constitute erecting, furnishing, equipping, maintaining, and removing the double wide field offices, its entrance and parking area.

Payment will be made only for the actual number of months that the office is acceptably provided by the Contractor.

Per Standard Specification subsection 108.02, the Engineer shall issue a Notice to Proceed and stipulate the date on or before which the Contractor is expected to begin work. The field office, its entrance, and parking area and all materials and equipment shall be ready for use at least seven calendar days prior to the date which the Contractor is expected to begin work as stipulated in the Notice to Proceed and before any construction operations begin. Contract time charges shall begin on the day work actually starts or on the date stipulated in the notice to proceed, whichever is earlier. There will be no delays in beginning the contract time charges due to delays in preparing the field office.

9/12/16

763501 - CONSTRUCTION ENGINEERING

1) **Description:**

This work consists of construction lay out including; stakes, lines and grades as specified below. Subsection 105.10 Construction Stakes, Lines and Grades of the Standard Specifications is voided.

Based on contract plans and information provided by the Engineer, the Contractor shall stake out right-of-way and easements lines, limits of construction and wetlands, slopes, profile grades, drainage system, centerline or offset lines, benchmarks, structure working points and any additional points to complete the project.

The Engineer will only establish the following:

(a) Original and final cross-sections for borrow pits.
(b) Final cross-sections: Top and bottom pay limit elevations for all excavation bid items that are not field measured by Construction inspection personnel. The Contractor shall notify the Engineer when these pay limit elevations are ready and allow for a minimum of two calendar days for the Engineer to obtain the information.
(c) Line and grade for extra work added on to the project plans.

2) Equipment. The Contractor shall use adequate equipment/instruments in a good working order. He/she shall provide written certification that the equipment/instrument has been calibrated and is within manufacturer's tolerance. The certification shall be dated a maximum of 9 months before the start of construction. The Contractor shall renew the certification a minimum of every 9 months. The equipment/instrument shall have a minimum measuring accuracy of [3mm+2ppmxD] and an angle accuracy of up to 2.0 arc seconds or 0.6 milligons. If the Contractor chooses to use GPS technology in construction stakeout, the Contractor shall provide the Engineer with a GPS rover and Automatic Level for the duration of the contract. The GPS rover shall be in good working condition and of similar make and model used by the Contractor. The Contractor shall provide up to 8 hours of formal training on the Contractor's GPS system to a maximum of four Engineer's appointees (DELDOT Construction Inspectors). At the end of the contract, the Engineer will return the GPS rover to the Contractor. If any of the equipment/instruments are found to be out of adjustment or inadequate to perform its function, such instrument or equipment shall be immediately replaced by the Contractor to the satisfaction of the Engineer. Choosing to use GPS technology does not give the contractor authority to use machine control.- Construction Engineering (GPS) Machine Control Grading shall only be used if noted in the General Notes in the plan set outlining the available files that will be provided to the Contractor and "the Release for delivery of documents in electronic form to a contractor" are signed by all parties prior to delivery of any electronic files. Only files designated in the General Notes shall be provided to the contractor. If machine control grading is allowed on the project see the "machine control" section of this specification. GPS technology and machine control technology shall not be used in the construction of bridges.

3) Engineering/Survey Staff. The Contractor shall provide and have available for the project an adequate engineering staff that is competent and experienced to set lines and grades needed to construct the project. The engineering personnel required to perform the work outlined herein shall have experience and ability compatible with the magnitude and scope of the project. Additionally, the Contractor shall employ an engineer or surveyor licensed in the State of Delaware to be responsible for the quality and accuracy of the work done by the engineering staff. When individuals or firms other than the Contractor perform any professional services under this item, that work shall not be subject to the subcontracting requirements of Subsection 108.01 of the Standard Specifications. The Contractor shall assume full responsibility for any errors and/or omissions in the work of the engineering staff described herein. If construction errors are caused due to erroneous work done under Construction Engineering the Contractor accepts full responsibility, no matter when the error is discovered. Consideration will not be given for any extension of contract time or additional compensation due

to delays, corrective work, or additional work that may result from faulty and erroneous construction stakeout, surveying, and engineering required by this specification.

Construction Methods:

4) Performance Requirements:

(a) Construction Engineering shall include establishing the survey points and survey centerlines; finding, referencing, offsetting the project control points; running a horizontal and vertical circuit to verify the precision of given control points. Establishing plan coordinates and elevation marks for culverts, slopes, subbase, subsurface drains, paving, subgrade, retaining walls, and any other stakes required for control lines and grades; and setting vertical control elevations, such as footings, caps, bridge seats and deck screed. The Contractor shall be responsible for the preservation of the Department's project control points and benchmarks. The Contractor shall establish and preserve any temporary control points (traverse points or benchmarks) needed for construction. Any project control points (traverse points) or benchmarks conflicting with construction of the project shall be relocated by the Contractor. The Contractor as directed by the Engineer must replace any or all stakes that are destroyed at any time during the life of the contract. The Contractor shall re-establish centerline points and stationing prior to final cross-sections by the Engineer. The Vertical Control error of closure shall not exceed 0.035 ft times [Square root of number of miles in the level run] (0.01 m times [square root of number of kilometers]). The Horizontal Control precision ratio shall have a minimum precision of 1:20,000 feet (1 meter per 20,000 meters or 1:20,000) of distance traversed prior to adjustment.

(b) The Contractor shall perform construction centerline layout of all roadways, ramps and connections, etc. from project control points set by the Engineer. The Contractor using the profiles and typical sections provided in the plans shall calculate proposed grades at the edge of pavement or verify information shown on Grades and Geometric sheets.

(c) The Contractor shall advise the Engineer of any horizontal or vertical alignment revisions needed to establish smooth transitions to existing facilities. The Contractor must immediately bring to the attention of the Engineer any potential drainage problem within the project limits. The Engineer must approve any proposed variation in profile, width or cross slope.

(d) The Contractor shall establish the working points, centerlines of bearings on bridge abutments and on piers, mark the location of anchor bolts to be installed, check the elevation of bearing surfaces before and after they are ground and set anchor bolts at their exact elevation and alignment as per Contract Plans. Before completion of the fabrication of beams for bridge superstructures, the Contractor shall verify by accurate field measurements the locations both vertically and horizontally of all bearings and shall assume full responsibility for fabricated beams fitting and bearing as constructed. After beam erection and concurrently with the Department project surveyors or their designated representative, the Contractor shall survey top of beam elevations at a maximum of 10-ft (3.0-meter) stations and compute screed grades. These shall be submitted to the Engineer for review and approval before the stay in place forms are set. Construction stakes and other reference control marks shall be set at sufficiently frequent intervals to assure that all components of the structure are constructed in accordance with the lines and grades shown on the plans. The Contractor will be responsible for all structure alignment control, grade control and all necessary calculations to establish and set these controls.

(e) The Contractor, using contract plans, shall investigate proposed construction for possible conflicts with existing and proposed utilities. The Contractor shall then report such conflicts to the Engineer for resolution. All stakes for utility relocations, which will be performed by others, after the Notice to Proceed has been given to the Contractor, shall be paid for under item 763597 - Utility Construction Engineering.

(f) The Contractor shall be responsible for the staking of all sidewalk and curb ramp grades in accordance with the plans and the Departments Standard Construction Details. The Contractor shall review the stakeout with the Engineer prior to construction. The Engineer must approve any deviation from plans, Department Standard Construction Details and Specifications in writing. The Contractor shall be responsible for any corrective actions resulting from problems created by adjustments if they fail to obtain such approval.

(g) If wetland areas are involved and specifically defined on the Plans the following shall apply:

i. It is the intent of these provisions to alert the Contractor, that he/she shall not damage or destroy wetland areas, which exist beyond the construction limits. These provisions will be strictly enforced and the Contractor shall advise his/her personnel and those of any Subcontractor of the importance of these provisions.

ii. All clearing operations and delineation of wetlands areas shall be performed in accordance with these Special Provisions. Before any clearing operation commences the Contractor shall demarcate wetlands at the Limits of Construction throughout the entire project as shown on the Plans labeled as Limits of Construction or Wetland Delineation to the satisfaction of the Engineer.

iii. The material to be used for flagging the limits of construction shall be orange vinyl material with the wording "Wetland Boundary" printed thereon. In wooded areas, the flagging shall be tied on the trees, at approximate 20-foot (6.1 meter) intervals through wetland areas. In open field and yard areas that have been identified as wetlands, 3 foot (one meter) wooden grade stakes shall be driven into the ground at approximate 20 foot (6.1 meter) intervals and tied with the flagging.

iv. If the flagging has been destroyed and the Engineer determines that its use is still required, the Contractor shall reflag the area at no cost to the Department. If the Contractor, after notification by the Engineer that replacement flagging is needed, does not replace the destroyed flagging within 48 hours, the Engineer may proceed to have the area reflagged. The cost of the reflagging by the Engineer will be charged to the Contractor and deducted from any monies due under the Contract.

v. At the completion of construction, the Contractor shall remove all stakes and flagging.

vi. The Contractor shall be responsible for any damages to wetlands located beyond the construction limits, which occurs from his/her operations during the life of the Contract. The Contractor shall restore all temporarily disturbed wetland areas to their preconstruction conditions. This includes restoring bank elevations, streambed and wetland surface contours and wetlands vegetation disturbed or destroyed. The expense for this restoration shall be borne solely by the Contractor.

(h) Whenever the Engineer will be recording data for establishment of pay limits, the Contractor will be invited to obtain the data jointly with the Engineer's Survey Crew(s) in order to agree with the information. If the Contractor's representative is not able to obtain the same data, then the information obtained by the Engineer shall be considered the information to be used in computing the quantities in question.

5) Submittals. All computations necessary to establish the exact position of all work from the control points shall be made and preserved by the Contractor. All computations, survey notes, electronic files, and other records necessary to accomplish the work shall be made available to the Department in a neat and organized manner at any time as directed by the Engineer. The Engineer may check all or any portion of the stakeout survey work or notes made by the Contractor and any necessary correction to the work shall be made as soon as possible. The Contractor shall furnish the Engineer with such assistance as may be required for checking all lines, grades, and measurements established by the Contractor and necessary for the execution of the work. Such checking by the Engineer shall not relieve the Contractor of his/her responsibility for the accuracy or completeness of the work. Copies of all notes must be furnished to the engineer at the completion of the project.

The Contractor shall submit any of the following at the Engineer's request:

(a) Proposed method of recording information in field books to ensure clarity and adequacy.
(b) A printout of horizontal control verification, as well as coordinates, differences and error of closure for all reestablished or temporary Control Points.
(c) A printout of vertical control verification, with benchmark location elevation and differences from plan elevation.
(d) Sketch of location of newly referenced horizontal control, with text printout of coordinates, method of reference and field notes associated with referencing control - traverse closure report.
(e) Description of newly established benchmarks with location, elevation and closed loop survey field notes - bench closure report
(f) All updated electronic and manuscript survey records.
(g) Stakeout plan for each structure and culvert.
(h) Computations for buildups over beams, screed grades and overhang form elevations.
(i) A report showing differences between supplied baseline coordinates and field obtained coordinates, including a list of preliminary input data.
(j) Any proposed plan alteration to rectify a construction stakeout error, including design calculations, narrative and sealed drawings.
(k) Baseline for each borrows pit location.
(l) Detailed sketch of proposed overhead ground mounted signs or signals showing obstructions that may interfere with their installation.
(m) Copies of cut sheets.

Machine Control Grading

This Section of the specification shall only be used if machine control is authorized for use on the project.

Description:

This specification contains the requirements for grading operations utilizing Global Positioning Systems (GPS).

Use of this procedure and equipment is intended for grading the subgrade surface; it is not intended for the use in constructing final surface grades.

The Contractor may use any manufacturer's GPS machine control equipment and system that results in achieving the grading requirements outlined in section 202 of the standard specifications. The Contractor shall convert the electronic data provided by the Department into the format required by their system. The Department will only provide the information outlined in this document and no additional electronic data will be provided.

The Contractor shall perform at least one 500 foot test section with the selected GPS system to demonstrate that the Contractor has the capabilities, knowledge, equipment, and experience to properly operate the system and meet acceptable tolerances. The engineer will evaluate and make the determination as to whether additional 500 foot test sections are required. If the Contractor fails to demonstrate this ability to the satisfaction of the Department, the Contractor shall construct the project using conventional surveying and staking methods.

Materials:

All equipment required to perform GPS machine control grading, including equipment needed by DelDOT to verify the work, shall be provided by the Contractor and shall be able to generate end results that are in accordance with the requirements of Division 200 - EARTHWORK of the Standard Specifications.

Construction:

a. DelDOT Responsibilities:

1. The Department will set initial vertical and horizontal control points in the field for the project as indicated in the contract documents, (plans set). If the Contractor needs to establish new control points they shall be traversed from existing control points and verified to be accurate by conventional surveying techniques.

2. The Department will provide the project specific localized coordinate system.

3. The Department will provide data in an electronic format to the Contractor as indicated in the General Notes.

    a. The information provided shall not be considered a representation of actual conditions to be encountered during construction. Furnishing this information does not relieve the Contractor from the responsibility of making an investigation of conditions to be encountered including, but not limited to site visits, and basing the bid on information obtained from these investigations, and the professional interpretations and judgments of the Contractor. The Contractor shall assume the risk of error if the information is used for any purpose for which the information is not intended.

    b. Any assumption the Contractor makes from this electronic information shall be at their risk. If the Contractor chooses to develop their own digital terrain model the Contractor shall be fully responsible for all cost, liability, accuracy and delays.

    c. The Department will develop and provide electronic data to the Contractor for their use as part of the contract documents in a format as indicated in the General Notes. The Contractor shall independently ensure that the electronic data will function in their machine control grading system.

4. The Files that are provided were originally created with the computer software applications MicroStation (CADD software) and INROADS (civil engineering software). The data files will be provided in the native formats and other software formats described below. The contractor shall perform necessary conversion of the files for their selected grade control equipment. The Department will furnish the Contractor with the following electronic files:

    a. CAD files
        i. Inroads -Existing digital terrain model (.DTM)
        ii. Inroads -Proposed digital terrain model (.DTM)
        iii. Microstation -Proposed surface elements - triangles

    b. Alignment Data Files:
        i. ASCII Format

5. The Engineer shall perform spot checks of the Contractor's machine control grading results, surveying calculations, records, field procedures, and actual staking. If the Engineer determines that the work is not being performed in a manner that will assure accurate results, the Engineer may order the Contractor to redo such work to the requirements of the contract documents, and in addition, may require the Contractor to use conventional surveying and staking, both at no additional cost to the Department.

B. Contractor's Responsibilities

1. The Contractor shall provide the Engineer with a GPS rover and Automatic Level, for use during the duration of the contract. At the end of the contract, the GPS rover and Automatic Level will be returned to the Contractor. The Contractor shall provide a total of 8 hours of formal training on the Contractor's GPS machine control system to the Engineer and up to three additional Department appointees per rover.

2. The Contractor shall review and apply the data provided by the Department to perform GPS machine control grading.

3. The Contractor shall bear all costs, including but not limited to the cost of actual reconstruction of work, that may be incurred due to application of GPS machine control grading techniques. Grade elevation errors and associated corrections including quantity adjustments resulting from the contractor's use of GPS machine control shall be at no cost to the Department.

4. The Contractor shall convert the electronic data provided by the Department into a format compatible with their system.

5. The Contractor's manipulation of the electronic data provided by the Department shall be performed at their own risk.

6. The Contractor shall check and if necessary, recalibrate their GPS machine control system at the beginning of each workday in accordance with the manufacturer's recommendations, or more frequently as needed to meet the requirements of the project.

7. The Contractor shall meet the accuracy requirements as detailed in the Standard Specifications.

8. The Contractor shall establish secondary control points at appropriate intervals and at locations along the length of the project. These points shall be outside the project limits and/or where work is performed. These points shall be at intervals not to exceed 1000 feet. The horizontal position of these points shall be determined by conventional survey traverse and adjustments from the original baseline control points. The conventional traverse shall meet or exceed the Department's Standards. The elevation of these control points shall be established using differential leveling from the project benchmarks, forming a closed loop. A copy of all new control point information including closure report shall be provided and approved by the Engineer prior to construction activities. The Contractor shall be responsible for all errors resulting from their efforts and shall correct deficiencies to the satisfaction of the Engineer and at no additional cost to the Department.

9. The Contractor shall provide stakes at all alignment control points, at every 500 foot stationing, and where required for coordination activities involving environmental agencies and utility companies at the Contractor's expense. Work that is done solely for utility companies and that is beyond the work performed under item 763501 - Construction shall follow and be paid for under item 763597 -Utility Construction Engineering.

10. The Contractor shall at a minimum set hubs at the top of finished grade at all hinge points on the cross section at 500 foot intervals on the main line and at least 4 cross sections on side roads and ramps as directed by the engineer or as shown on the plans. Placement of a minimum of 4 control points outside the limits of disturbance for the excavation of borrow pits, Stormwater Management Ponds, wetland mitigation sites etc. These control points shall be established using conventional survey methods for use by the Engineer to check the accuracy of the construction.

11. The Contractor shall preserve all reference points and monuments that are identified and established by the Engineer for the project. If the Contractor fails to preserve these items the Contractor shall reestablish them at no additional cost to the Department.

12. The Contractor shall provide control points and conventional grades stakes at critical points such as, but not limited to, PC's, PT's, superelevation points, and other critical points required for the construction of drainage and roadway structures.

13. No less than 2 weeks before the scheduled preconstruction meeting, the Contractor shall submit to the Engineer for review a written machine control grading work plan which shall include the equipment type, control software manufacturer and version, and proposed location of the local GPS base station used for broadcasting differential correction data to rover units.

14. The Contractor shall follow the guidelines set forth in the "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques" and follow a minimum of Second Order Class 1, (2-I) classification standards.

Automated equipment operations have a high reliance on accurate control networks from which to take measurements, establish positions, and verify locations and features. Therefore, a strong contract control network in the field which is the same or is strongly integrated with the project control used during the design of the contract is essential to the successful use of this technology with the proposed Digital Terrain Model (DTM). Consistent and well designed site calibration for all machine control operations (as described below under *Contract Control Plan*) are required to ensure the quality of the contract deliverables. The Contract Control Plan is intended to document which horizontal and vertical control will be held for these operations. Continued incorporation of the Base Station(s) as identified in the Contract Control Plan is essential to maintaining the integrity of positional locations and elevations of features. The Contract Control Plan shall be submitted to the Department for review and approval by the Departments Survey Section 3 weeks prior to the start of any machine control work. The Contractor shall operate and maintain all elements of the Machine Grade Control continuously once the operations begin until otherwise approved by the Engineer.

Contract Control Plan:

The Contractor shall develop and submit a Contract Control Plan for all contracts which use Machine Control Grading. Contract control includes all primary and secondary horizontal and vertical control which will be used for the construction contract. Upon the Contractor's completion of the initial survey reconnaissance and control verification, but prior to beginning primary field operations, the Contractor shall submit a Contract Control Plan document (signed and sealed by the Delaware licensed Land Surveyor or Delaware Professional Engineer who oversees its preparation) for acceptance by the Engineer, which shall include the following:

1. A control network diagram of all existing horizontal and vertical control recovered in the field as contract control.

2. Include a summary of the calculated closures of the existing control network, and which control has been determined to have been disturbed or out of tolerance from its original positioning.

3. An explanation of which horizontal and vertical control points will be held for construction purposes. If necessary include all adjustments which may have been made to achieve required closures.

4. An explanation of what horizontal and vertical control (including base stations) was set to accomplish the required stakeout or automated machine operation. Include how the position of these new control points was determined.

5. Describe the proposed method and technique (technology and quality control) for utilizing the control to establish the existing and/or proposed feature location and to verify the completed feature location and/or measured quantity.

6. A listing of the horizontal and vertical datums to be used and the combined factor to be used to account for ellipsoidal reduction factor and grid scale factor.

7. If the Contractor chooses to use machine control as a method of measuring and controlling excavation, fill, material placement or grading operations as a method of measuring and controlling excavation, fill, material placement or grading operations, the Contractor Control Plan shall include the method by which the automated machine guidance system will initially be site calibrated to both the horizontal and vertical contract control, and shall describe the method and frequency of the calibration to ensure consistent positional results.

8. Issues with equipment including inconsistent satellite reception of signals to operate the GPS machine control system will not result in adjustment to the "Basis of Payment" for any construction items or be justification for granting contract time extension.

Method of Measurement:

The quantity of Construction Engineering will not be measured.

Basis of Payment:

Payment will be made at the Lump Sum price bid for the item "Construction Engineering". The price bid shall include the cost of furnishing all labor, equipment, instruments, stakes and other material necessary to satisfactorily complete the work as herein described under this item for all roads and structures that are a part of the contract. Adjustment in payment will be made for the deletion or addition of work not shown in the contract documents.

Monthly payment will be made under this item in proportion to the amount of work done as determined by the Engineer.

3/27/15

763503 - TRAINEE

Description:

The item shall consist of providing training in the construction crafts in accordance with the requirements stated in the General Notices of this proposal under the Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246).

Basis of Payment:

The payment for the item shall be made at a fixed rate of $.80 per hour toward the hourly rate of the trainee.

5/2/02

763508 - PROJECT CONTROL SYSTEM DEVELOPMENT PLAN
763509 - CPM SCHEDULE UPDATES AND/OR REVISED UPDATES

Description:

The Contractor shall plan, schedule and construct the Project by using a Critical Path Method Project Schedule (CPM) meeting the requirements of these specifications. Use the CPM for coordinating and monitoring the Work specified in the Contract Documents including all activities of Subcontractors, vendors, suppliers, utilities, railroads, the Department, and all other parties associated with the construction of the Contract. Include all Work in the CPM; including but not limited to submittals, major procurement, delivery, and construction activities. Include all activities, including bid items, quantified in the Contract Documents. Base the CPM upon the entirety of the Contract Documents. Utilize CPM software that generates files compatible with Primavera P6 Project Management Release: 7.0.0.

Scheduling Representative:

Designate a scheduling representative prior to submission of the Original Critical Path Method Project Schedule (OCPM). The scheduling representative is the person primarily responsible for development and maintenance of the CPM schedule; the Contractor's representative in all matters regarding the schedule; and the Contractor's designated attendee for all schedule related meetings. The scheduling representative shall also be knowledgeable of the status of all parts of the Work throughout the duration of the Project. Replacement of the scheduling representative will require written approval from the Engineer.

Submit the qualifications of the scheduling representative to the Engineer for approval. This approval is required before the OCPM will be accepted. The scheduling representative shall have at least three years of verifiable experience for preparing and maintaining CPM project schedules on Contracts of similar size and complexity.

Critical Path, Project Completion Date, and Float:

The critical path is defined as the series of activities in a CPM that has the longest path in time. The submitted activity sequence and durations must generate a CPM with only one critical path. Divide Project wide activities such as Maintenance of Traffic, Construction Engineering, or Temporary Erosion Control that, by their nature, generate long durations and complement other activities into "establish" and "conclude" activities to prevent this type of Work from occupying a significant portion of the critical path.

The project start date, or initial data date, of the original CPM shall be the first chargeable day of Work. Nonproductive Work and administrative activities may begin and/or end prior to the project start date. The Original CPM must use all of the Contract Time and contain a critical path containing exactly zero float. Early completion schedules are not permitted. The schedule ending date of the Original CPM that uses all of the Project Time is the contract completion date.

Total Float is the difference between the schedule's finish date and the contract completion date. Free float is the difference in time between an activity's early finish and late finish. Free float is a shared commodity for the use of the Department and the Contractor and is not for the exclusive use or benefit of either party. Both parties have the full use of free float until depleted.

Submittal of the OCPM; the Start of Work and the Schedule of Record:

Complete and submit the proposed original CPM schedule (OCPM) database and the written narrative (WN) within 30 calendar days after Contract is Awarded. The WN is a description of any elements of the Schedule that deviate from the proposed construction sequence shown in the Contract Documents. Submit the OCPM in CPM format fully compatible with Primavera P6 Project Management Release: 7.0.0 by email or CD ROM as a single compressed database in CPM format.

The Engineer will complete the review of the OCPM within 30 calendar days after submittal. If required, a Joint Review Conference will be convened at which time the Engineer and Contractor may make corrections and adjustments to the proposed OCPM. If a revision is necessary due to the Engineer's review or the Joint Review Conference, submit the proposed revision within seven calendar days after receiving the Engineer's review comments or within seven calendar days after the date of the Joint Review Conference, whichever is the latest. Make revisions in accordance with the requirements for the OCPM. The Engineer will respond to the revised OCPM within seven calendar days after receipt. Clearly identify each submittal and resubmittal for clarity by labeling "2nd Draft", "3rd Draft", etc.

Do not start any Work until the OCPM is accepted. If the Engineer is ready to issue a Notice to Proceed but the OCPM is not yet accepted, the Engineer may issue the NTP and start Contract Time, but forbid Work to begin until the OCPM is accepted. The Engineer may partially accept a OCPM and allow Work to begin if the required corrections to the OCPM are minor, but the Engineer will not accept submittals that do not show the complete schedule. The Engineer will not pay any estimates until the OCPM is partially accepted. Once the OCPM is partially accepted, the Engineer will pay the first estimate. If the Contractor fails to make a good faith effort to address the Engineer's comments before the second estimate is due for payment, the Engineer will not pay the second estimate until a good faith effort is made by the Contractor to comply. The Engineer may not withhold an estimate payment if, within the estimate period in question, the Engineer has failed to provide timely review comments in response to the Contractor's submittal. The Engineer may, however, withhold the payment of subsequent estimates if the Contractor fails to make a good faith effort to address the Engineer's comments. Upon issuance of the Notice to Proceed, the start date utilized in the OCPM will be adjusted to comply with the first chargeable day of Work. Any delay in starting Work caused by the acceptance of the OCPM by the Engineer will not be considered as a basis for any adjustment in the Contract amount or time. For Contracts that have fast-tracked starts, the Engineer and the Contractor may agree to alter the response times and approval dates listed above. Upon notification that the OCPM has been accepted, the corrected copy will become the CPM of record. The CPM of record shall be the Contractor's work plan for completing the entire Contract as specified in the Contract Documents.

Requirements for the OCPM:

The format of the OCPM database shall be the precedence diagram method with days as the planning unit and shall be based on Calendar Days. Use the Department's partially predetermined coding structure (CS) that is furnished by the Engineer.

Activity Sequencing. Activity sequence must be logical and representative of the Contractor's order of the Work. Successors and predecessors determine the schedule logic or activity sequence. A given activity cannot start until all of the given activity's predecessors have been completed. Use only finish to start dependency relationships (links); do not use lag times without approval from the Engineer. The Engineer may request that the Contractor resequence the activities to reflect realistic job logic. When scheduling using multiple resources, each resource unit shall have a corresponding activity. Durations of activities include all the time necessary to complete the activity including, but not limited to, Contractor's non-work periods (other than those shown on the calendars), reasonably foreseeable inclement weather, weekends and holidays. Base schedule calculations on retained logic, contiguous durations, and total float as finish float.

Activity Resources. Sequence activities to reflect resource apportionment. Logically connect and code each activity to reflect the crew (resource) performing the operation. Submit a summary list of crews, their crew codes, and their operation(s) with each schedule submission, unless unchanged. Identify responsibility for each activity. Identify Subcontractors, DBE's, utilities and Work performed by others that affects the Schedule.

*Breakdown and Durations of Activities***.** An individual activity is required for each construction element or each activity not under the control of the Contractor that affects the sequence or progress of the Work. The Engineer reserves the right to require additional breakdown of the Work activities at any time. Each activity must be identified by a name, symbol and coding, and shall have a duration, sequence, responsibility and resource(s). Choose activity names that are descriptive and identify single construction elements. Activity symbols, or ID's, shall be unique and systematic.

Activity types must be either "task", "start milestone", or "finish milestone". Do not use "hammock" type activities. Date constraints, float and duration constraints, and/or flags for activities are not permitted.

Assign a reasonable duration to each activity representative of its scope. Durations may not exceed 14 calendar days unless approved by the Engineer. Determine the duration of each activity by using productivity rates based on Calendar Days.

Include the preparation and approval of Working Drawings as activities. Include phasing (staging) milestones as activities. Correlate phasing milestones with the sequence of construction provided in the Contract Documents. Use a separate start and finish milestone activity to delineate each phase (stage).

*Utility Work***.** Include all Work performed by utilities on the Project as activities in the OCPM. Include each utility item of Work shown in the Contract's Utility Statement as an activity. Durations for utility activities shall be the same as the durations shown in the Utility statement for each activity unless otherwise approved by the Engineer.

*Calendars***.** Assign a calendar to each activity in the schedule. Use a minimum of 6 calendars, when applicable: (1) Full Schedule; (2) Permit Requirements; (3) Winter Condition; (4) Concrete Work; (5) Asphalt Paving Work; and (6) Nighttime Asphalt Paving Work. Use additional calendars if needed. Calendar non-work periods shall reflect the average Delaware weather history for the jobsite and the restrictions identified in the Contract Documents. The Contractor may choose perform Work during an activity's calendar non-work period at no additional cost to the Department if weather conditions are favorable for such Work and the Work does not violate a set forth in the Contract Documents. The maximum allowable non-work period for each calendar is set forth below. The Contractor may choose to shorten non-work periods at his/her discretion.

CALENDAR	MAXIMUM NON-WORK PERIOD
Full Schedule	None
Winter Condition	December 1 through March 15
Concrete Work	December 1 through March 15
Asphalt Paving	November 15 through March 15
Nighttime Asphalt Paving	October 15 through April 30

Written Narrative (WN). Provide a written narrative (WN) as part of the OCPM explaining the following:

(a) Relationships between activities not obviously identified
(b) Equipment usage and limitations.
(c) Manpower usage and limitations.
(d) Use of additional shifts and overtime.

(e) Activity codes, abbreviations, and activity identification system.
(f) All calendars utilized in the CPM and the basis of determining each non-work period
(g) All abbreviations.
(h) Use of calendars.
(i) Any other conditions that affect the schedule and are not readily discernible in the database.

CPM Updates:

Provide monthly updates to the CPM of record. Meet with the Engineer once a month prior to submitting the update to review the status of the schedule's activities. Prepare an updated list of activities showing all of the actual start and actual finish for each of the schedule's activities so that both parties can agree on the dates. Use the dates that were agreed upon in the meeting to status the CPM of record and submit the updated schedule to the Engineer for approval. Assign a unique file name to each update (Number/version). The data date of the update shall be the next day after the end of the update period. As part of the monthly update, submit a written description that identifies any delays or disruptions to the schedule experienced during the period of an update, any change in manpower or equipment, and any potential delays to the completion date of the schedule.

Do not include any revisions to the CPM without prior approval. Failure to submit complete updates in a timely manner may result in the withholding of estimates by the Engineer. The Engineer agrees to refrain from withholding estimates unless the Contractor is habitually late in providing updates, is more than four weeks late in submitting an update or has failed to submit an update that is part of a resolution to a serious problem that must be addressed immediately.

Revisions to the Schedule of Record:

Revisions are defined as any changes to the database other than status updates, log entries and moving the data date. Discuss any proposed revisions to the CPM verbally with the Engineer. If the revision is minor in nature, the Engineer may allow the revision to be included on the next Update of the CPM. If the Engineer determines that the revision is not minor in nature, submit the proposed revision for review and approval prior to deviating from the approved CPM. When a revision to the CPM is required due to changes in the Contract initiated by the Engineer, immediately contact the Engineer to discuss the changes. The Engineer may allow a deviation from the approved CPM for specific mitigating activities.

The Engineer may direct the Contractor to revise the schedule of record at the Contractor's expense if: the critical path has less than minus ten (-10) Calendar Days of total float due to the Contractor's failure to perform the Work in accordance with the schedule; the Contractor requests to re-sequence the Work; and/or the Contractor has performed a significant amount of Work out of sequence. The Engineer may direct the Contractor to revise the schedule for any other reason; and such a revision will be paid at the unit cost for a CPM Revision.

The Engineer will review and respond to the proposed revision within 7 Calendar Days after receipt. Resubmit, if required, within seven calendar days after receipt of the Engineer's review comments. The Engineer reserves the right to reject any proposed revision that adversely impacts the Department, utilities, or other concerned parties.

Extensions of Contract Time and/or Incentive/Disincentive Dates.

Make requests for extension of Contract time in writing and subject to the notice and timeliness of submission provisions as provided for elsewhere in the Contract. Requests for an extension of Contract time or change in an incentive/disincentive date will be evaluated by the Engineer's analysis of the CPM of record and any proposed revision submitted. Include in the request a written narrative of the events that impacted the schedule and a detailed explanation of why the Contractor cannot meet the requirements of the schedule

of record. Only delays to activities that affect the Contract completion date or will be considered for an extension of Contract time. Only delays to activities that affect the completion duration of an incentive/disincentive period will be considered for an extension of an incentive/disincentive completion date. The extension of the specified Contract completion date or incentive/disincentive date will be based upon the number of Calendar Days the Contract completion date or incentive/disincentive date is impacted as determined by the Engineer's analysis. The Engineer and Contractor may agree to defer the analysis of a potential impact to the schedule until the completion of the activities that are affected. Such a deferment does not relieve the Contractor of his/her duty to identify potential impacts to the schedule in the applicable schedule updates.

All requests for extensions of Contract Time must be supported by the most recent CPM Update. If, within a reasonable period of time, the Contractor fails to make a good faith effort to produce an acceptable CPM update and uses an unacceptable CPM update to support a request for a time extension, the Contractor loses the right to receive that time extension; and/or the right to receive compensation for that delay caused in whole or in part by the Engineer.

Final As Built Schedule.

Submit a final CPM Schedule database within 14 Calendar Days of Substantial Completion. Failure to submit a final CPM Schedule may result in the withholding of estimates by the Engineer.

Method of Measurement:

The Project Control System will be measured in two items. The item, "Project Control System Development Plan" will be lump sum. The item "CPM Schedule Updates and/or Revised Updates" will be measured one each per update that is submitted and accepted.

Basis of Payment:

The item, "763508 – Project Control System Development Plan" will be paid at the Contract's lump sum bid price on the next monthly estimate after completion of the requirements of the Project Control System Development Plan, which includes the approval of the Original CPM Schedule. Price and payment will constitute full compensation for preparing the CPM database, acquiring the necessary software, attending all scheduling meetings with the Department, submitting and resubmitting all documents and for all labor, tools, equipment and incidentals necessary to complete the Work.

The item, "763509 – CPM Schedule Updates and/or Revised Updates" will be paid at the Contract unit price per each approved CPM schedule update as described above. Price and payment will constitute full compensation for preparing, submitting and resubmitting all CPM updates, for attendance at all scheduling meetings with the Department, for preparing and reviewing a list of actual start and actual finish dates with the Engineer, and for all labor, tools, Equipment and incidentals necessary to complete the Work.

2/11/2015

763522 - COAST GUARD SPECIFIC CONDITIONS

Description:

The Contractor shall prosecute his work in accordance with the specific requirements imposed by this Special Provision.

Under this item the contractor will be required to:

1. Prepare and furnish three copies of a plan and schedule for his operations within the waterway, for submission to Commander (AOWB), 5th Coast Guard District, 431 Crawford St., Portsmouth, VA 23704 for approval. The Contractor shall comply with all provisions of the Inland Rules of the Road. The Contractor shall give written notice to the Coast Guard of any planned temporary obstruction to the waterway navigation as well as copies of the plan and schedule of operations at least 30 days in advance of commencement of the work.

2. Coordinate any partial or complete navigation channel obstruction or closure with the Coast Guard's Amanda Boone at (215) 271-4814. The contractor shall coordinate at least 30 days in advance of channel obstruction. For waterway emergencies outside of normal business hours, contact the Coast Guard at (215) 271-4889 or (215) 271-4940.

3. Prepare and furnish three copies of as-built plans of the navigation clearance for submission to the Department. The as-built plans shall indicate the minimum navigable height under the structures above Mean High Water, channel width between piers and water depths under the structure. The as-built plans shall be signed by a surveyor licensed in the State of Delaware. The as-built plans shall be submitted within 30 days following completion of the work.

The plan and schedule of operations within the waterway shall include:

(a) A sketch of the waterway indicating:

(1) Locations of all restrictions that will be placed in the waterway, such as barges, anchors and anchor lines.

(2) The location and height above high mean water of any scaffolding or netting.

(b) A projected set of dates and length of time each operation will take, hours of each operation and whether or not the equipment will be removed at night.

2. Give immediate notice to the Coast Guard and to the Department, of any material, machinery or equipment lost, dumped, thrown overboard, sunk or misplaced during the progress of the work. The Contractor must remove the object with utmost dispatch. Until removal can be affected, the object or objects shall be properly marked in order to protect navigation. Notices to the Coast Guard and to the Department shall give a description and location of any such object and the action taken or being taken to protect navigation.

3. Furnish and install temporary obstruction lights as may be required by his operation and his permanent construction under this contract. Each temporary light shall consist of battery or power operated slow flashing amber light less than 60 flashes per minutes and visible for a range of 4 nautical miles on 90% of the nights of the year. Generally a lamp of 20 candle power will meet these requirements. If necessary to obtain the coverage required, a light or

lights on the upstream and downstream sides shall be installed. Bridge piers shall be so marked until the construction has been completed and permanent navigational lights have been installed and determined to be operating satisfactorily. Four copies of Plans showing the proposed temporary lights during construction shall be submitted to the Department for approval before work is commenced. Deviations from the prescribed temporary lights during periods of construction will be permitted only upon written Coast Guard approval.

In the event the Contractor fails to comply with these foregoing requirements and the Federal Government is required to take action in this matter for the protection of navigation, the Department reserves the right to recover costs for such work from the Contractor.

The Federal Government and the Department assume no responsibility for any damage sustained or caused by the Contractor's plant, equipment or barges being anchored or moored at the aforementioned location and approval by either agency shall not act as a waiver of liability for any damage that may result from the Contractor's operation.

The Contractor shall maintain the temporary obstruction lights on permanent construction until permanent navigational lights have been installed and made operable in accordance with the Coast Guard requirements.

Basis of Payment:

The quantity of coast guard specific conditions will be paid for at the Contract lump sum. Price and payment will constitute full compensation for compliance with specific conditions imposed by the Coast Guard Commandant and this specification including but not limited to preparation of required plans, coordination with the Coast Guard, and furnishing, installing, maintaining, and removing temporary lighting.

6/27/16

763626 - DIESEL FUEL COST PRICE ADJUSTMENT

I. Description: This section defines the criteria for payments to the Contractor to reflect increases or decreases in the cost of diesel fuel consumed in the performance of applicable construction work. To have the Diesel Fuel Cost Price Adjustment provisions apply to this project, a properly completed Diesel Fuel Cost Price Adjustment Option form must be submitted to the Department with the Bidder's bid proposal. If a properly completed Diesel Fuel Cost Price Adjustment Option form is not provided by the bidder, the Department will consider the option to apply the Diesel Fuel Cost Price Adjustment provisions for the project to be declined. No further opportunity to elect Diesel Fuel Cost Price Adjustment for the project will be made available.

a. General. These price adjustment provisions apply to contract items in the contract schedule of prices as grouped by category. Specific pay items to be adjusted are attached as an appendix to this Special Provision. General category descriptions and the fuel usage factors which are applicable to each are as follows:

1. Categories

1.a. Category A: Earthwork. The combined total of the applicable item plan quantities must exceed 5,000 CY.

1.b. Category B: Subbase and Aggregate Base Courses. The combined total of the applicable item plan quantities must exceed 500 tons.

1.c. Category C: Flexible Bases and Pavements. The combined total of the applicable item plan quantities must exceed 500 tons.

1.d. Category D: Rigid Bases and Pavements. The combined total of the applicable item plan quantities must exceed 5,000 CY.

1.e. Category E: Structures. Contract items will be based upon the total square foot price for each structure including any associated items of work, i.e. items not grouped under Categories A thru D.

2. Diesel Fuel Usage Factors – ENGLISH UNITS

Category	Factor	Units
A – Earthwork	0.34	Gallons per CY
B – Subbase and Aggregate Base Courses	0.62	Gallons per ton
C – Flexible Bases & Pavements	2.98	Gallons per ton
D – Rigid Bases & Pavements	0.98	Gallons per CY
E – Structures	8.00	Gallons per $1,000 of work performed

3. Quantity Conversion Factors – ENGLISH UNITS

Category	Conversion	Factor
B	SY to ton	90 lbs/Inch of depth/SY
C	SY to ton	112.5 lbs/Inch of depth/SY
D	SY to CY	Inches of depth/36

II. The posted index price will be the monthly price from the most recent data published by the U.S. Department of Energy, U.S. Energy Information Administration. The source information for the posted price for Central Atlantic (PADD 1B) No 2 Diesel Ultra Low Sulfur (0-15 ppm) Retail Prices (Dollars per Gallon) may be viewed at the following website:

http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2DXL0_PTE_R1Y_DPG&f=M

The applicable U.S. Department of Energy diesel fuel price is posted on the first Monday of the month.

The Base Price Index, FB, is the index price posted by the Department, determined as specified above, on the project advertisement date.

BASE PRICE INDEX (FB) FOR DIESEL FUEL

PER GALLON (PER LITER) = $ ~CEMENT_PRICE_72~

The price index for adjustment, FP, will be the index price posted by the Department, determined as specified above, for the month during which the Notice to Proceed (NTP) is issued, and the month that contains the first day of every 90 calendar days period thereafter.

III. Price Adjustment Criteria and Conditions. The following criteria and conditions will be considered in determining a price adjustment for diesel fuel cost fluctuations.

a. Price Adjustment Calculation. When the ratio FP/FB is calculated to be less than 0.95 or calculated to be greater than 1.05, the Department will adjust unit bid price prices in accordance with the following formula:

AUP = (FP-FB)(F)+(UBP)
where:

AUP = Adjusted Unit Price
FP = Fuel Price Index for the month in which prices are adjusted for applicable construction work.
FB = Fuel Price Index in the Bid Proposal
F = Diesel Fuel Usage Factor (See above chart in section 1.2 for usage factors.)
UBP = Unit Bid Price specified in the Contractor's Bid Proposal

b. Payment of Adjusted Unit Prices. The unit bid prices of work items affected by the fuel escalation will be adjusted by change order, either up or down, at Notice to Proceed and every 90 Calendar Days thereafter.

The affected items will be calculated using the Diesel Fuel Price Index posted for the month in which the first day of the 90 day period falls. The Diesel Fuel Price Index will be used for all the affected items performed during the 90 day period.

Every 90 days, the newly posted Diesel Fuel Price Index will be used to calculate the adjustment for the items performed the next 90 days.

c. Expiration of Contract Time. If the Contractor exceeds the authorized allotted completion time, the adjusted item prices on the last authorized allotted work day shall be the prices used during the time liquidated damages are assessed. However, if the posted price for diesel fuel goes down, the item prices shall be adjusted downward accordingly.

d. Final Quantities. Upon completion of the work and determination of final pay quantities, an adjusting work order will be prepared to reconcile any difference between estimated quantities previously paid and the final quantities. In this situation, the value for FP used in the price adjustment formula will be the average of all FP's previously used for computing price adjustments.

e. Inspection of Records. The Department reserves the right to inspect the records of the prime contractor and its subcontractors and material suppliers to ascertain actual pricing and cost information for the diesel fuel used in the performance of applicable items of work.

f. Extra Work. When applicable items of work, as specified herein, are added to the contract as Extra Work in accordance with the provisions of Section 104.08, no price adjustment will be made for fluctuations in the cost of diesel fuel consumed in the performance of the extra work, unless otherwise approved by the Engineer. The current price for diesel fuel is to be used when preparing required backup data for extra work to be performed at a negotiated price. For extra work performed on force account basis, reimbursement for material and equipment along with specified overhead and profit markups will be considered to include full compensation for the current cost of diesel fuel.

g. Subcontractors. Any Price Increases or Price Rebates that are calculated based on items of work performed by subcontractors will be added to or deducted from payments due to the Contractor in the appropriate pay period. The Contractor shall then accurately record on the appropriate CN-91 or CN-103 form the additions or deductions into adjusted contract value. The Contractor shall make payment to the subcontractor(s) who actually performed the work in accordance with DelCode Title 17, Chapter 8.

10/8/15

Appendix---Item 763626 Diesel Fuel Cost Adjustment

Contract: T201612101.01; Christina River Bridge

		Item No./s
Category A:	**Earthwork** Excavation & Embankment, Borrow (total qty must exceed 5000 CY)	202000, 207000, 208000, 209001, 209002, 210000
Category B:	**Subbase and Agg.** GABC, PTB, Soil Cement Base (total qty must exceed 500 T)	302007, 302514
Category C:	**Flexible Bases and Pavements** Warm Mix Asphalts (total qty must exceed 500 T)	401801, 401813, 401819
Category D:	**Rigid Bases and Pavements** Concrete, P.C.C. Patching (total qty must exceed 5000 CY)	N/A
Category E:	**Structures** Bridges, Large P.C.C. Structures	602001, 602003, 602007, 602011, 602013, 602014, 602015, 602017, 602512, 602668, 602771, 604000, 605001, 605607, 622008

905500 - SUPER SILT FENCE

Description:

This work consists of furnishing, installing, constructing, maintaining, and ultimately removing super silt filter fences as a temporary measure to control sedimentation within the limits of construction. Super silt fence shall be constructed as shown on the details in the Plans, at the locations shown on the Plans, and as directed by the Engineer.

Materials:

General. All materials shall be approved prior to use by the Department's Materials and Research Section.

Chain Link Fence. The construction requirements for the placement of the chain link fence shall be as specified in **SECTION 727 FENCES AND GATES** with the following exceptions:

(a) Concrete footings (727.07), Top Rail, Tension Wire, Horizontal Braces shall not be used.

Fasteners. Aluminized steel tie wires long enough to securely attach the fabric to the posts.

Seed. Seed shall conform to the requirements of Section 908.

Mulch. Mulch shall conform to the requirements of Section 908.

Geotextile. Geotextile shall conform to the requirements of Section 827. It shall be a minimum of 36" (900 mm) wide.

Construction Methods:

Construction of Super Silt Fence.

The Contractor shall excavate the trench along the upstream side of the post line as shown on Standard Construction Detail, Super Silt Fence. Posts shall be installed on the Downstream edge of the trench, along the established fence line. The geotextile shall be fastened to the upstream side of the chain link. The geotextile and chain link must extend a minimum of 33” above the ground. The chain link fabric and geotextile shall be embedded 8 inches into the excavated trench. The trench shall be backfilled and compacted over the chain link and geotextile to prevent water from flowing under the chain link and geotextile.

The super silt fence shall not be constructed across a ditch, or swale, or area of concentrated flow. On slopes, the terminal ends of super silt fence shall be turned upslope a sufficient distance to eliminate flow around the ends of the super silt fence. All geotextile damaged prior to installation, during installation, or during the life of the Contract shall be repaired or replaced
to the satisfaction of the Engineer.

Maintenance of Super Silt Fence.

Throughout the Project construction period, the super silt fence shall be maintained by removing trapped sediment. The Contractor shall clean the geotextile of trapped sediment by tapping the geotextile when dry. No trash shall be allowed to accumulate to the height of the fence. Any geotextile that does not function due to clogging or deterioration shall be replaced.

Sediment Removal.

After every heavy rainfall, the Contractor shall check for excessive buildups of sediment which must be removed so that the super silt fence can continue to function as intended. Remove accumulated sediment when it reaches 50% of the height of the super silt fence.

Removal of Super Silt Fence.

The super silt fence shall be removed when the Engineer determines that it is no longer required. The super silt fence and all materials incidental to the super silt fence construction shall be removed. All areas affected by the construction of the super silt fence shall be restored to the original or plan contours and stabilized with seed and mulch.

Method of Measurement:

The quantity of super silt fence will be measured as the actual number of linear feet (linear meters) of super silt fence placed and accepted.

Basis of Payment:

The quantity of super silt fence will be paid for at the Contract unit price per linear foot (linear meter) for each type of fence. Price and payment will constitute full compensation for furnishing all materials; for excavating and backfilling associated with the construction of the super silt fence; for maintaining the super silt fence during the Project construction period; sediment removal, for removing the super silt fence with all related hardware after completion of the Project; for restoring the site; for seeding and mulching; and for all labor, equipment, tools and incidentals required to complete the work. No payment will be made for any replacement of or repairs to the super silt fence damaged prior to installation, during installation, or during the life of the Contract. No payment will be made for the replacement of the super silt fence.

11/18/2014

907510 - COMPOST FILTER LOG

Description:

This item shall consist of furnishing all materials and constructing a compost filter log in accordance with the locations and notes on the Plans and/or as directed by the Engineer.

Materials:

The filter sock shall be 5 millimeter biodegradable HDPE material, and be at least 18" in diameter. The compost media used within the logs shall be a plant derived compost that complies with compost material standards and DNREC specifications (see table below), including being produced from a certified facility through the U.S. Composting Seal of Testing Assurance (STA) program.

Parameter	Range	Testing Method
Particle Size	For Amendments: 100% pass through a ½" screen For Compost Logs: 99% pass through a 2" screen; max. 40% pass through a 3/8" screen	TMECC 2.02-B
pH	6.0-8.0	TMECC 4.11
Manufactured Inert Material	<1% dry weight basis	TMECC 3.08-A
Organic Matter	35-95% dry weight basis	TMECC 5.07-A
Soluble Salt Concentratio	</= 6.0 mmhos/cm	TMECC 4.10-A
Carbon to Nitrogen Ratio	</= 25:1	
Stability (Carbon Dioxide evolution rate)	</= 2 C / unit VS / day	TMECC 5.08-B
Maturity (seed emergence and seedling vigor)	>90% relative to positive control	TMECC 5.05-A
Trace Metals	"Pass"	
Dry Bulk Density	12.5-25 lb/cu.ft.	
Moisture content	40-50%	

Construction Methods:

The compost filter logs shall be assembled by tying a knot in one end of the filter sock, filling the sock with the composted material, then knotting the other end once the desired length is reached. The compost shall be uniform throughout the sock and shall not have any gaps or the presence of large materials that would impede flow and/or create gaps. The compost filter log may be supplied pre-filled and simply rolled out in place.

The ends of the compost filter log should be angled upslope to prevent runoff from washing around the ends; minimum one foot (1') elevation difference. Stakes shall be installed through the middle of the compost filter log, maximum four feet (4') on center. The stakes shall be hardwood stakes, minimum 2" x 2" and 36" long. The stakes shall be set a minimum 12" below grade.

The compost filter logs shall be inspected weekly and after storm events. Accumulated sediment shall be removed when it reaches half of the effective height of the sock, and disposed of in an appropriate manner. If the sock fabric is torn or damaged prior to completion of the project, the compost filter log shall be replaced at the expense of the contractor. If the compost filter log has been flattened due to equipment or vehicular traffic, it shall be re-shaped back to proper dimensions. If the effective height cannot be restored, then the compost filter log shall be replaced at the expense of the contractor.

Upon completion of construction and stabilization of disturbed areas, the contractor shall remove the compost filter log in its entirety.

Method of Measurement:

The quantity of compost filter logs, completed in place and accepted, shall be paid for at the Contract bid per linear foot for "Compost Filter Logs"

Basis of Payment:

Price and payment shall constitute full compensation for furnishing all materials including filter socks, compost material, wooden stakes, disposal of surplus and unsuitable materials, removal and disposal of used filter sock and sediment during and upon completion of construction and for all labor, tools, equipment and incidentals necessary to complete the item.

6/8/15

908512 - TEMPORARY GRASS SEEDING - WET GROUND (TGS-WG)

Description:

This work consists of furnishing and placing seed. Mulch shall be placed within non-wetland areas only. No mulch shall be placed within wetland areas (as delinated on the Plans).

Materials:

Temporary Grass Seeding - Wet Ground (TGS-WG).

Species Name Common / (Latin)	Max. % Weed Seeds	Min. % Purity	Min. % Germination	Seeding Rate lb/Ac
Annual Barnyard Grass/Duck Millet (*Echinocloa* spp.) *Echinocloa muricata* or *Echinocloa walteri* are preferred	1.00	90	90	40
			Total Seed Quantity (lb/ac)	40

All seed shall be fresh, clean, from new crop seed, and delivered to the site in original unopened tagged packages in accordance with the Delaware Code and respective State laws.

Small Grain Straw: Straw for mulching will be from oats, wheat, rye, or other approved grain crops that are free from noxious weeds, mold, or other objectionable material. Straw mulch will be in an air-dry condition and will be suitable for placing with an approved mechanical blower.

Construction Methods:

Application of the Temporary Grass Seeding - Wet Ground Mix shall only occur between the following dates:

May 1 to October 1.

Seed may be broadcast or hydroseeded. No lime or fertilizer will be added. Unless specified on the plans, no mulch will be applied.

If specified on the plans, small grain straw will be uniformly and evenly applied immediately after seed has been placed. An approved mechanical blower will be used to apply the straw. Straw mulch applied by blowers will provide a loose depth of not less than 1/2 nor more than 2". Ninety-five percent of the blown and shredded straw mulch will be 6" or more in length when in place.

Straw mulch will be applied uniformly and evenly across the seeded area at the rate of 4,000 lb/ac. No crimpling or tracking is required of the seed or straw.

Acceptance of 908512 - Temporary Grass Seeding - Wet Ground (TGS-WG) will be made at time of placement, provided the seed and straw placed as specified herein and as directed on the Plans.

No Maintenance Bond is required for this work.

Method of Measurement:

The Engineer will measure the quantity of acceptably placed permanent seed. The quantity of seeding shall be measured in square yards of surface area.

Basis of Payment:

The quantity and type of seeding shall be paid for at the Contract Unit Price per square yard. Price and payment will constitute full compensation for preparing the ground; for furnishing and placing all materials including seed and mulch; and for all labor, equipment, tools, maintenance bond and incidentals required to complete the work.

Payment will be made at the time seed is acceptably placed.

3/9/16

UTILITY STATEMENT

STATE CONTRACT # T201612101
P3e# 16-12101
F.A.P. # STP-N029(5)
CHRISTINA RIVER BRIDGE
NEW CASTLE COUNTY

The following utility companies maintain facilities within the project limits:

AT&T
Comcast Cable of New Castle County
City of Wilmington - Sanitary Sewer
City of Wilmington – Water
Delmarva Power & Light – Electric Distribution
Delmarva Power & Light – Gas
New Castle County Department of Special Services - Sanitary Sewer
Private Water
Verizon Delaware LLC

Utility adjustments and/or relocations shall be performed as narrated, but are not limited to the following:

AT&T
AT&T maintains aerial and underground facilities within the limits of Contract T201612101 with no apparent conflicts with the proposed construction activities.

Any adjustments and/or relocations to the aforementioned Company's facilities will be performed by the appropriate Company's forces as necessary during construction.

Comcast
Comcast maintains aerial and underground facilities within the limits of Contract T201612101.

The Company shall perform the following relocations and adjustments:

New Sweden Street, Sta. 448+50 to Sta. 451+50, Lt:
Once new poles are installed by others, relocate existing overhead lines and services from utility poles 48359/42760, 48373/42758, and 48386/42756 to these new poles. Tie to existing pole 48386/42756.

Comcast estimates this work will take approximately 90 days to complete after notice to proceed.

City of Wilmington - Sanitary Sewer
The City maintains underground facilities within the limits of Contract T201612101 with no apparent conflicts with the proposed construction activities.

Should relocations and/or adjustments of City sewer facilities be needed, they shall be performed by the State's contractor in accordance with the respective agencies' standard specifications as directed by the Engineer. The State's contractor shall notify the City a minimum of seven (7) calendar days in advance of the State's contractor performing any necessary facility adjustments.

City of Wilmington - Water
The City maintains underground facilities within the limits of Contract T201612101.

The State's contractor shall perform the following relocations:

New Sweden Street, Sta. 445+00 to Sta. 451+15: Construct 615 LF of new 12" DIP water main.

New Sweden Street, Sta. 445+00, Lt.: Construct new fire hydrant.

New Sweden Street, Sta. 448+25, Lt.: Construct new fire hydrant.

East Bank Lane, Sta. 40+08 to Sta. 41+90: Construct 182 LF of new 12" DIP water main.

The relocations and/or adjustments of City water facilities described above shall be performed by the State's contractor in accordance with the respective agencies' standard specifications as directed by the Engineer. The State's contractor shall notify the City a minimum of seven (7) calendar days in advance of the State's contractor performing any necessary facility relocations and/or adjustments.

Delmarva Power & Light – Electric Distribution
The aforementioned Company maintains aerial and underground facilities within the limits of Contract T201612101.

The Company shall perform the following relocations and adjustments:

New Sweden Street, Sta. 431+34, Lt.: Remove pole 48290/42935.

New Sweden Street, Sta. 431+08 Rt.: Install 120/240V single phase pole mounted transformer pod located on pole 48189/42720 to provide two new lighting services, one metered and one unmetered, and make final connections.

New Sweden Street, Sta. 448+50 to Sta. 451+50, Lt.:
Once new poles are installed by others, relocate existing overhead lines and services from utility poles 48359/42760, 48373/42758, and 48386/42756 to these new poles. Tie to existing pole 48386/42756.

The State's Contractor will perform the following:
New Sweden Street, Sta. 430+85 Rt.: Install two 2 inch RGS conduits from lighting cabinet or meter to pole 48189/42720. Conduits will be stubbed 10 ft. above ground on Utility pole. The State's Contractor will coil sufficient wire at the top of each conduit for DP&L to run wire to top of pole, covered by a DP&L installed U-Guard.

Outages on the 25kv circuit will only be permitted as load, weather and other system conditions permit.

Delmarva Power Delivery would require **twenty seven (27) calendar days** to complete the proposed distribution work following **twenty-eight (28) calendar days** advance notice of completion of clearing and grubbing, cuts and fills made, staking of rights-of-way and back of curbs, the installation of drainage and completion of the Utility Pre-Construction Meeting for this contract scheduled by DelDOT North District Construction Department, and the procurement of any easements by DelDOT.

For exact location of electric facilities, please contact Miss Utility at (800) 282-8555.

16 Del. C. § 7405B ***requires notification to and mutually agreeable measures from the public utility from any person intending to carry on any function, activity, work or operation within dangerous proximity of any high voltage overhead lines. All contractors/other utilities must also maintain a distance of 10'-0" from all energized lines.***

Delmarva Power & Light - Gas
The aforementioned Company maintains underground facilities within the limits of Contract T201612101. Delmarva Power maintains 2", 4" and 8" plastic and steel high pressure gas mains along with a 12" steel transmission pressure gas main throughout the project limits.

The Company shall perform the following relocations and adjustments:

New Sweden Street, Sta. 452+07, 14' Rt.: Adjust gas manhole as required for construction access.

New Sweden Street, Approx. Sta. 428+00 to Existing Walnut Street: Install a 12" steel transmission gas main under the Christina River in advance of Contract T201612101 via horizontal directional drilling methods. The pipe layout staging area is expected to be on the west side of the River, and the horizontal directional drill construction is expected to begin in February, 2017 and last approximately three months. Prior to any construction activities, the State's Contractor shall coordinate with Delmarva Power & Light – Gas to determine the location of this installed line, and any requirements, procedures or precautions to be implemented when working in the vicinity of this gas line, including accessing the site, loading, excavating, driving sheeting, etc.

This work will take 150 days to construct. Project delays may occur depending on the winter weather. All facilities will be abandoned in place.

New Castle County Department of Special Services (NCC) - Sanitary Sewer
NCC maintains underground facilities within the limits of Contract T201612101 with no apparent conflicts with the proposed construction activities.

Should relocations and/or adjustments of NCC sewer facilities be needed, they shall be performed by the State's contractor in accordance with the respective agencies' standard specifications as directed by the District Engineer. The State's contractor shall notify NCC a minimum of seven (7) calendar days in advance of the State's contractor performing any necessary facility adjustments.

Private Water
Christina River Properties and Riverfront Development Corporation maintain underground water facilities within the limits of Contract T201612101:

The State's contractor shall perform the following relocations and adjustments:
New Sweden Street, Sta. 433+42 to Sta. 434+10: Remove and/or abandon 120 LF of 4" CIP water main and replace with 220 LF of 4" DIP.

Relocated Riverwalk, Sta. 15+50 to Sta. 18+50: Remove and/or abandon 300 LF of 8" CIP water main and relocate with 330 LF of 8" DIP.

Relocated Riverwalk, Sta. 15+30 to Sta. 18+70: Remove and/or abandon 340 LF of 10" DIP water main and relocate with 370 LF of 10" DIP.

Relocated Riverwalk, Sta. 16+41, Lt.: Construct new 6" DIP stub and fire hydrant.

Relocated Riverwalk, Sta. 17+24, Lt.: Relocate existing fire hydrant to Sta. 18+24, Lt.

The State's contractor shall notify Christina River Properties and Riverfront Development Corporation a minimum of seven (7) calendar days in advance of the State's contractor performing any removals/relocations and necessary facility adjustments.

Verizon Delaware LLC
The aforementioned Company maintains Aerial, Buried and Underground Copper and Fiber Optic cables within the limits of Contract T201612101 as follows:

West of Peterson Way at New Sweden St:
Verizon has an aerial cable that goes buried across New Sweden St at Sta. 430+55 and 431+00.

S Market Street:
Verizon maintains an 18 Duct structure along the West side of the street with a MH at Sta. 102+80 L (MH 233), 2 lateral conduits to pole 48398/42769 from MH 233 and 1 conduit to pole 48386/42756. Also there are aerial service wires along the west side of S Market St for pole 48398/42769 to 48387/42709.

New Sweden Street, Sta. 445+90 to 451+50:
Verizon maintains a pole line with an aerial cable on the North and an aerial cable on the South side of proposed New Sweden Street.

The Company shall perform the following relocations and adjustments:

Future Peterson Way, Sta. 38+13, Lt.: Reattach the aerial line to pole (48189/42720).

Market Street:
Verizon will place 4 –4" conduits from MH 233 at Sta. 102+80 to new Pole at 451+25 Lt. 61'. Also extend 2 of the conduit to pole on the south side of St at 451+48 Rt. 68'. Verizon will remove 8 Aerial service wires along the west side of the street from pole 48398/42769 to 48387/42709. Pole 48399/42757 and 48387/42737 will be removed by Verizon.

New Sweden St:
Verizon will place 3 poles and cable along the north side of St from Sta. 448+50 to 451+20. Existing poles and cable from Sta. 445+85 to 451+ 53 will be removed. Pole 48386/42757 will remain.

Verizon estimates this work will take approximately 60 days to complete after a 30 day notice to proceed.

Outside of the companies and facilities discussed above, no additional utility relocation involvement is anticipated. Should any conflicts be encountered during construction requiring adjustment and/or relocation the necessary relocation work shall be accomplished by the respective agencies, as directed by the District Engineer.

Any adjustments and/or relocations of municipally owned sewer or water facilities shall be performed by the State's contractor in accordance with the respective agencies' standard specifications as directed by the District Engineer.

General Notes

1. **The Contractor's attention is directed to Section 105.09 Utilities, Delaware Standard Specifications, August 2001. The Contractor shall contact Miss Utility (1-800-282-8555) two working days prior to any excavation. The Contractor is responsible for the support and protection of all utilities when excavating. The Contractor is responsible for ensuring proper clearances, including safety clearances, from overhead utilities for construction equipment. The Contractor is advised to check the site for access purposes for his equipment and, if necessary, make arrangements directly with the utility companies for field adjustments for adequate clearances.**

2. It is understood and agreed that the Contractor has considered in his bid all permanent and temporary utility appurtenances in their present and relocated positions as shown on the plans or described in the Utility Statement or are readily discernible and that no additional compensation will be allowed for any delays, inconvenience, or damage due to any interference from the utility facilities and appurtenances or the operation of moving them, except that the Contractor may be granted an equitable extension of time.

3. The Contractor shall follow all requirements of the Delaware Code, Title 26, Chapter 8. Underground Utility Damage Prevention And Safety. Chapter 8 includes, among other requirements, Section 806. Duties of Excavators which contains the requirement for the Contractor to excavate prudently and carefully and to take all reasonable steps necessary to properly protect, support and backfill underground utility lines. This protection shall include but may not be limited to hand digging, within the limits of the planned excavation or demolition, starting two (2) feet of either side of the extremities of the underground utility line for other than parallel type excavations and at reasonable distances along the line of excavation for parallel type excavations.

4. As outlined in Chapter 3 of the DelDOT Utilities Manual, individual utility companies are responsible for obtaining all required permits from municipal, State and federal government agencies and railroads. This includes but is not limited to water quality permits/DNREC Water Quality Certification, DNREC Subaqueous Lands/Wetlands permits, DNREC Coastal Zone Consistency Certification, County Floodplain permits (New Castle County only), U.S. Coast Guard permits, US Army Corps 404 permits, sediment and erosion permits, and railroad crossing permits.

5. Individual utility companies are required to restore any areas disturbed in conjunction with their relocation work. If an area is disturbed by a utility company and is not properly restored, the Department may have the highway contractor perform the necessary restoration. Any additional costs incurred as a result will be forwarded to the utility company.

6. Coordination and cooperation among the Utility Companies and the State's Contractor are of prime importance. Therefore, the Contractor is directed to contact the Utility Company representatives with any questions regarding this work prior to submitting bids and work schedules. Proposed work schedules should reflect the Utility Companies' proposed relocations. The Utility Companies do not work on weekends or legal holidays.

Jay Everly	AT&T	610-328-6465
Brian Aster	Christina River Properties	302-504-1099
Steve Mosher	Comcast	302-420-0400
Sean Duffy	City of Wilmington (Sewer/Water)	302-576-3074
Angel Collazo	Delmarva Power - Electric Distribution	302-454-4370
Ted Waugh	Delmarva Power – Gas	302-429-3706

David Clark	**NCC Dept. of Special Services**	**302-395-5741**
Megan McGlinchey	**Riverfront Development Corporation**	**302-425-4890**
George Zang	**Verizon Delaware LLC**	**302-422-1238**

PREPARED AND RECOMMENDED BY:

Carey D. Well — 10/7/16

Rummel, Klepper & Kahl, LLP
Consulting Engineers

Date

APPROVED AS TO FORM BY:

Eric C. Cross — 10/7/16

Utilities Engineer, DelDOT

Date

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
PO BOX 778
DOVER, DELAWARE 19903

CERTIFICATE OF RIGHT-OF-WAY STATUS

STATE PROJECT NO. T201612101

F.A.P. NO. STP-N029(5)

CHRISTINA RIVER BRIDGE

NEW CASTLE COUNTY

Certificate of Right-of-Way Status – 100%

STATUS - LEVEL 1

As required by 23 CFR, Part 635, and other pertinent Federal and State regulations or laws, the following certifications are hereby made in reference to this highway project:

All necessary real property interests have been acquired in accordance with current FHWA/State directives covering the acquisition of real property; and,

All necessary rights-of-way, including control of access rights when pertinent, have been acquired including legal and physical possession; and,

All project rights of way are currently available in accordance with the project right-of-way plans; and,

Any residential displaced individuals or families have been relocated to decent, safe and sanitary housing, or adequate replacement housing has been made available in accordance with the provisions of the current Federal Highway Administration (FHWA) directive(s) covering the administration of the Highway Relocation Assistance Program; and,

All occupants have vacated the lands and improvements; and,

The State has physical possession and the right to remove, salvage, or demolish any improvements acquired as part of this project, and enter on all land.

REAL ESTATE SECTION

Robert M. Cunningham
Chief of Right of Way

October 25, 2016

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

JENNIFER COHAN
SECRETARY

October 17, 2016

STIPULATED

ENVIRONMENTAL REQUIREMENTS

for

Christina River Bridge
State Contract No.: T201612101
Federal Aid Project Number: STP-NO29(5)

In accordance with the procedural provisions for implementing the National Environmental Policy Act of 1969, as amended, the referenced project has been processed through the Department's Environmental Review Procedures and has been classified as a Level C/ Class III Action.

PERMIT REQUIREMENTS:

The proposed construction work for the Christina River Bridge requires permit approval from those agencies listed below. It is the responsibility of the contracting agency, the Delaware Department of Transportation, Division of Transportation Solutions to obtain the necessary permits to ensure that the contractor complies with the requirements and conditions established by the regulatory agencies.

REQUIRED PERMITS AND APPROVAL STATUS:

- U.S. Coast Guard (USCG) – Bridge Permit – Pending
- U.S. Army Corps of Engineers (USACE) – Nationwide Permit (NWP) 14 and NWP 15 – a**pproved 05/31/16**, CENAP-OP-R-2011-0175-1, ***expires 03/18/2017***
- Delaware Department of Natural Resources and Environmental Control (DNREC) Subaqueous Lands Permit – SP-423, dated 7/26/16, ***expires 7/26/19***

- Delaware Department of Natural Resources and Environmental Control (DNREC) Wetland Permit – WE-433/15, dated 7/26/16, ***expires 7/26/19***

- DNREC – 401 Water Quality Certification – For USACE, ISSUED as part of NWP #14, ***expires 5/18/17***; for USCG, WQC-435/15 dated 7/26/16. ***expires 7/26/19***

- DNREC – Coastal Zone Consistency – **Approved 12-30-2015** – No expiration

- New Castle County Floodplain Permit – **Approved 06-15-2016**, NCC Application #20160395 – ***Expires 180 days (12/13/16)***

- City of Wilmington Floodplain Permit – Approved 09-28-16

SPECIFIC REQUIREMENTS:

Compliance with all requirements of the permits is the responsibility of the contractor. The contractor will follow all special conditions or requirements as stated within those permits or as indicated below. The contractor will be subject to penalties, fines, and the risk of shut down as mandated by law if conditions of the permits or other additional requirements are violated or ignored.

Additional requirements by DelDOT not specified within the permits, but listed below, or on the Environmental Compliance Sheets are also the responsibility of the contractor and are subject to risk of shut down at the contractor's expense.

1. The contractor shall employ measures during construction to prevent spills of fuels, or lubricants, if a spill should occur, efforts shall be undertaken to prevent its entry into wetlands, aquatic, or drainage areas. Any spills entering wetlands, aquatic, or drainage areas shall be removed immediately. The Division of Water Resources (DNREC), Wetlands & Aquatic Protection Branch, 302-739-4691, shall be notified of any spill(s) within six (6) hours of their occurrence. That office will determine the effectiveness of spill and contamination removal and specify remediation efforts as necessary.[The DNREC Division of Waste and Hazardous Substances 24-hour Spill Line, 1-800-662-8802, shall be notified of any spill larger than 25 gallons within (6) hours of their occurrence. The State Emergency Response Team will determine the effectiveness of spill and contamination removal and specify remediation efforts as necessary.]

2. All construction debris, excavated material, brush, rocks, and refuse incidental to such work shall be placed either on shore above the influence of flood waters or on some suitable disposal site approved by the department.

3. The disposal of trees, brush, and other debris in any stream corridor, wetland surface water or any drainage ditch is prohibited.

4. There shall be no stockpiling of construction materials or temporary fills in wetlands or subaqueous lands unless otherwise specified on project plans and approved by permitting agencies that govern them. It is the contractor's responsibility to coordinate and secure those additional permits/amendments in deviating from the plan.

5. The effort shall be made to keep construction debris from entering adjacent waterways, wetlands, ground cover, or drainage areas. Any debris that enters these areas shall be removed immediately. Netting, mats, or establishing confined work areas in stages may be necessary to address these issues.

6. If routine maintenance of worker equipment and heavy machinery is necessary during the construction period, refuse material is prohibited from being disposed or deposited onto or into the ground. All used oils and filters must be recycled or disposed of properly.

7. Harmful chemical wash water applied to clean equipment or machinery shall be discouraged. If undertaken, the residue water and/or material must be collected or contained such that it will be disposed of properly. By no means, shall it be deposited or disposed of in waterways, streams, wetlands, or drainage areas.

8. The contractor shall follow all requirements as indicated in the Environmental Compliance Sheet. It will be the contractor's responsibility, expense, & effort to ensure that workers also follow these requirements. As part of the restrictions, please note the timetables reflected in the contract for the in-stream/water work for endangered species protection.

CULTURAL RESOURCE REQUIREMENTS:

1. The contractor will submit to the District, the location(s) of permanent disposal sites to be used for the disposition of clean wasted materials resulting from the construction contract. The contractor will submit at the Preconstruction meeting, a location map and a plot plan (sketch or diagram) of where on the property clean wasted material is to be placed. The limits of the site(s) will be physically staked or surveyed on the property. The District will submit the contractor's disposal site location(s) to the State Historic Preservation Office for approval.

   The SHPO will determine if a cultural resource survey is required before the site can be approved. If additional survey work is required, it will be the contractor's responsibility to hire a qualified professional to assess the site(s) for the presence or absence of cultural resources (i.e. historic or prehistoric archeological sites). The contractor's consultant will be responsible for producing documentation of the survey results for submission to the SHPO.

   If the contractor proposes the use of disposal sites outside the State of Delaware, the contractor must provide written approval from the State Historic Preservation Office of each respective state.

A project's disposal operation will not commence until the SHPO has notified the DelDOT District office that the site location(s) is approved for use.

The use of the disposal site will not result in discharge of materials into the Corps of Engineer or DNREC jurisdictional wetlands or waters. It is the responsibility of the contractor to provide any site surveys or wetland delineations needed to preclude wetland encroachment.

The contractor will be responsible for all sediment and erosion control measures and subsequent approvals required for the disposal site(s) operations.

It is the contractor's responsibility to obtain all other appropriate Federal, State, or local approvals required by law for use of the disposal site(s).

NATURAL RESOURCES SPECIFIC REQUIREMENTS :

The contractor shall pay special attention to specific construction requirements listed below **[The specific regulatory agency from which a comment originated is noted in brackets]**:

1. Any deviation in construction methodology or project design of the regulated activities from that shown on the construction plan sheets must be approved by Corps of Engineers Philadelphia Office, in writing, prior to performance of the work. All modifications to the construction plans shall be approved, in writing by the Corps of Engineers. No work shall be performed prior to written approval of the Corps of Engineers [USACE].

2. The permittee will continue to coordinate project plan development for work in regulated wetlands and waters of the United States to assure that the identified impacts remain the same, and that if possible, further reductions in impacts to the aquatic environment may be identified.

3. The permittee is responsible for ensuring that the contractor and/or workers executing the activity(s) authorized by this permit have knowledge of the terms and conditions of the authorization and that a copy of the permit document is at the project site throughout the period the work is underway.

4. Discharges of dredged or fill materials and in-stream work into the Christina River are prohibited between March 1 and June 30 of any calendar year [USACE]. Coordination with National Marine Fisheries (NMFS) and DNREC is ongoing for the exemption of drilled shaft and pier construction activities from time of year restrictions, including the initial seating of a 6' diameter steel casing into the mudline, auguring within the steel casing, and recirculation of polymer or mineral slurry for the removal of spoils during the drilling process.

5. No stockpiling or storage of equipment, materials, or structural steel; no staging areas; and no installation of ancillary facilities such as concrete or asphalt plants or construction trailers shall be permitted within any wetland or stream areas outside of identified storage areas as approved by the Corps of Engineers. No construction materials, aggregates, or earth shall be stockpiled or stored in a manner that would affect wetlands or streams, and such stockpiles shall have erosion and sediment controls approved by DelDOT.

6. Clearing in wetland areas shall be kept to a minimum absolutely necessary for construction access. All equipment traversing wetlands and subaqueous land shall be supported on mats. In wetland areas that are cleared, there shall be no grubbing except where necessary to construct project components such as foundations and riprap protection. Vegetation shall be cut flush with the ground, i.e. no disturbance of the root mat.

7. The permittee shall undertake and complete the wetland mitigation work described in the following document prior to or concurrently with the authorized fill activities: Compensatory Wetland Mitigation Plan for the Christina River Bridge and Approaches Project, Wilmington, New Castle County, Delaware, dated May 2016. This plan was prepared for Delaware Department of Transportation, by Rummel, Klepper and Kahl, LLP. This plan provides for the restoration and enhancement of 1.2694 acres of freshwater tidal marsh on an adjacent property known as the Roger W. Peterson Urban Wildlife Refuge [USACE].

8. As a part of the earthen grading activities associated with surface water management and runoff, and/or the restoration of temporary drainage and diversion activities associated with project construction, the permittee shall assure that any wetlands or waters of the United States outside of the approved limit of construction (LOC) and not shown as impacted on the plans identified in special condition 1 are not adversely affected by the project. These adverse effects would include, but are not limited to, the removal of wetland hydrology (surface or subsurface), and the increased scour and erosion of stream channels within the project area. In the event that any adverse effects are identified, the permittee will immediately contact this office and coordinate with this office to develop and implement corrective or remedial measures.

9. All excess excavated material not used in highway or compensatory mitigation site construction shall be disposed of at upland, non-wetland disposal site(s). The excavated material shall be properly contained and stabilized to prevent its entry into any adjacent wetlands or waterways. No disposal/wasting operation shall commence until the permittee obtains written approval of any disposal site(s) from the Corps of Engineers to ensure that there are no unauthorized discharges of fill into waters of the United States, including jurisdictional wetlands.

10. Any changes to or deviations from these plans requested by the contractor must be reviewed and approved by the Engineer prior to conducting any work. Approval may take a significant amount of time to complete and all changes may not be approved. The contractor shall have no claim against the department for costs or delays associated with the approval or rejection of requested changes or deviations from these plans.

STATE OF DELAWARE
DEPARTMENT OF TRANSPORTATION
800 BAY ROAD
P.O. BOX 778
DOVER, DELAWARE 19903

JENNIFER COHAN
SECRETARY

RAILROAD STATEMENT
For

State Contract No.: T201612101

Federal Aid No.: STP-N029(5)

Project Title: Christina River Bridge

The following railroad companies maintain facilities within the contract limits:

- ☐ Amtrak
- ☐ CSX
- ☐ Delaware Coast Line
- ☐ East Penn
- ☐ Maryland & Delaware
- ☐ Norfolk Southern
- ☐ Wilmington & Western
- ☑ None

DOT Inventory No.: No. Trains/Day: Passenger Trains (Y / N):

In accordance with 23 CFR 635, herein is the railroad statement of coordination (check one):

☑ No Railroad involvement.

☐ Railroad Agreement unnecessary but railroad flagging required. The contractor shall follow requirements stated in the DelDOT Maintenance of Railroad Traffic Item in the Special Provisions. Contractor shall coordinate railroad flagging with DelDOT's Railroad Program Manager at (302) 760-2183.

☐ Railroad Agreement required. The necessary railroad agreement, attached, is complete and fully executed. Railroad related work to be undertaken and completed as required for proper coordination with physical construction schedules. The Contractor shall follow requirements stated in the DelDOT Maintenance of Railroad Traffic Item in the Special Provisions. Contractor shall coordinate railroad flagging with DelDOT's Railroad Program Manager at (302) 760-2183.

Approved As To Form:

Robert A. Perrihe
DelDOT Railroad Program Manager

1/25/16
DATE

BID PROPOSAL FORMS

CONTRACT T201612101.01

FEDERAL AID PROJECT STP-N029(5)

UNLESS OTHERWISE DIRECTED, SUBMIT ALL FOLLOWING PAGES TO:

DEPARTMENT OF TRANSPORTATION
BIDDERS ROOM (B1.11.01)
800 BAY ROAD
DOVER, DELAWARE 19901

Identify the following on the outside of the sealed envelope:
- Contract Number T201612101.01
- Name of Contractor

CONTRACT ID: T201612101.01 PROJECT(S): STP-N029(3)

All figures must be typewritten.

CONTRACTOR :_____

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
SECTION 0001 ROAD						
0010	201000 CLEARING AND GRUBBING	LUMP	LUMP			
0020	202000 EXCAVATION AND EMBANKMENT	12084.000 CY				
0030	202505 SETTLEMENT PLATFORM	10.000 EACH				
0040	202514 PIEZOMETER	5.000 EACH				
0050	202518 SETTLEMENT MONUMENT	10.000 EACH				
0060	202521 INCLINOMETER	4.000 EACH				
0070	207000 EXCAVATION AND BACKFILL FOR STRUCTURES	3297.000 CY				
0080	208000 EXCAVATION AND BACKFILLING FOR PIPE TRENCHES	1467.000 CY				
0090	209001 BORROW, TYPE A	11180.000 CY				
0100	209002 BORROW, TYPE B	600.000 CY				

CANNOT BE USED FOR BIDDING

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0110	209006 BORROW, TYPE F	10437.000 CY				
0120	210000 FURNISHING BORROW TYPE "C" FOR PIPE, UTILITY TRENCH, AND STRUCTURE BACKFILL	1421.000 CY				
0130	211000 REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LUMP	LUMP			
0140	212000 UNDERCUT EXCAVATION	500.000 CY				
0150	302007 GRADED AGGREGATE BASE COURSE, TYPE B	3539.000 CY				
0160	401801 BITUMINOUS CONCRETE, SUPERPAVE, TYPE C, 160 GYRATIONS PG 64-22 (CARBONATE STONE)	175.000 TON				
0170	401813 BITUMINOUS CONCRETE, SUPERPAVE, TYPE B, 160 GYRATIONS, PG 70-22	700.000 TON				
0180	401819 BITUMINOUS CONCRETE, SUPERPAVE, BITUMINOUS CONCRETE BASE COURSE, 160 GYRATIONS, PG 64-22	1660.000 TON				
0190	601520 TEMPORARY TIMBER MAT	LUMP	LUMP			

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0200	602001 PORTLAND CEMENT CONCRETE MASONRY, CLASS A	540.000	CY				
0210	602003 PORTLAND CEMENT CONCRETE MASONRY, ABUTMENT FOOTING, CLASS A	229.000	CY				
0220	602007 PORTLAND CEMENT CONCRETE MASONRY, PIER ABOVE FOOTING, CLASS A	402.000	CY				
0230	602011 PORTLAND CEMENT CONCRETE MASONRY, SUBSTRUCTURE, CLASS A	206.000	CY				
0240	602013 PORTLAND CEMENT CONCRETE MASONRY, SUPERSTRUCTURE, CLASS D	937.000	CY				
0250	602014 PORTLAND CEMENT CONCRETE MASONRY, APPROACH SLAB, CLASS D	135.000	CY				
0260	602015 PORTLAND CEMENT CONCRETE MASONRY, ABUTMENT ABOVE FOOTING, CLASS A	298.000	CY				
0270	602017 PORTLAND CEMENT CONCRETE MASONRY, PARAPET, CLASS A	168.000	CY				
0280	602512 REINFORCED CONCRETE LANDSCAPE WALL	133.000	LF				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0290	602520 EPOXY PROTECTIVE COATING FOR CONCRETE	413.000	SY				
0300	602528 PRECAST PIER FOOTING, FORMWORK	118.000	CY				
0310	602529 PRECAST CONCRETE EPS WALL	2435.000	SF				
0320	602549 FORM LINERS	6589.000	SF				
0330	602627 PRECAST WALL CAP	133.000	LF				
0340	602668 PORTLAND CEMENT CONCRETE STAIRS	83.000	SF				
0350	602707 SILICONE ACRYLIC CONCRETE SEALER	LUMP		LUMP			
0360	602770 LIGHTWEIGHT FOAMED CONCRETE FILL	1189.000	CY				
0370	602771 MECHANICALLY STABILIZED EARTH RETAINING WALLS	3514.000	SF				
0380	602774 PCC MASONRY FOR LIGHT POLE FOUNDATIONS	8.000	CY				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0390	602798 PREPRODUCTION DMM TEST PROGRAM	LUMP	LUMP			
0400	602799 PRODUCTION DMM TEST PROGRAM	LUMP	LUMP			
0410	602800 DMM QC/QA PROGRAM	LUMP	LUMP			
0420	604000 BAR REINFORCEMENT, EPOXY COATED	788307.000 LB				
0430	605001 STEEL STRUCTURES	14680.000 LB				
0440	605607 JACKING BRIDGE	LUMP	LUMP			
0450	605659 STRIP SEAL EXPANSION JOINT, 3"	50.000 LF				
0460	605660 STRIP SEAL EXPANSION JOINT, 4"	50.000 LF				
0470	605725 ELASTOMERIC WATERPROOF COATING	2330.000 SF				
0480	606501 METAL BRIDGE RAILING	1752.000 LF				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0490	606503 STEEL HAND RAILING	868.000	LF				
0500	606504 ALUMINUM HANDRAIL	15.000	LF				
0510	606505 LED ILLUMINATED HANDRAIL	LUMP		LUMP			
0520	606510 HANDRAIL, TYPE I	88.000	LF				
0530	607000 REMOVAL OF EXISTING MASONRY	261.000	CY				
0540	612002 REINFORCED CONCRETE PIPE, 15", CLASS III	266.000	LF				
0550	612003 REINFORCED CONCRETE PIPE, 18", CLASS III	87.000	LF				
0560	612005 REINFORCED CONCRETE PIPE, 24", CLASS III	62.000	LF				
0570	612021 REINFORCED CONCRETE PIPE, 15", CLASS IV	40.000	LF				
0580	612022 REINFORCED CONCRETE PIPE, 18", CLASS IV	75.000	LF				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0590	612216 REINFORCED CONCRETE ELLIPTICAL PIPE, 14"X23", CLASS IV	32.000 LF				
0600	614508 WATERMAIN AND ACCESSORIES	LUMP	LUMP			
0610	614604 INSTALLING LANDSCAPE WATER SYSTEM	LUMP	LUMP			
0620	617002 REINFORCED CONCRETE FLARED END SECTION, 15"	4.000 EACH				
0630	617003 REINFORCED CONCRETE FLARED END SECTION, 18"	4.000 EACH				
0640	617005 REINFORCED CONCRETE FLARED END SECTION, 24"	1.000 EACH				
0650	618533 NAVIGATION LIGHTS FOR FIXED BRIDGES	LUMP	LUMP			
0660	618534 VIBRATION MONITORING	LUMP	LUMP			
0670	618562 DRILLED SHAFT IN SOIL, 36"	377.000 LF				
0680	618563 DRILLED SHAFT IN SOIL, 48"	2422.000 LF				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0690	618564 DRILLED SHAFT IN ROCK, 48"	450.000	LF				
0700	618565 DRILLED SHAFT IN SOIL, 72"	573.000	LF				
0710	618566 DRILLED SHAFT IN ROCK, 72"	246.000	LF				
0720	618567 LOAD TESTING OF DRILLED SHAFTS	2.000	EACH				
0730	618568 CROSSHOLE SONIC LOGGING TESTING	35.000	EACH				
0740	618569 PERMANENT CASING FOR DRILLED SHAFT, 72" DIAMETER	291.000	LF				
0750	619511 EXPLORATORY DRILLING	900.000	LF				
0760	622008 STEEL SHEET PILES, PZ 27	3770.000	SF				
0770	623543 POST-TENSIONING	LUMP	LUMP				
0780	623544 POST-TENSIONED PRESTRESSED REINFORCED CONCRETE MEMBERS, BULB TBEAM	LUMP	LUMP				

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0790	701014 PORTLAND CEMENT CONCRETE CURB, TYPE 1-6	28.000 LF				
0800	701023 INTEGRAL PORTLAND CEMENT CONCRETE CURB & GUTTER, TYPE 3-6	1003.000 LF				
0810	705001 P.C.C. SIDEWALK, 4"	3230.000 SF				
0820	705002 P.C.C. SIDEWALK, 6"	5550.000 SF				
0830	705007 SIDEWALK SURFACE DETECTABLE WARNING SYSTEM	48.000 SF				
0840	705517 PORTLAND CEMENT CONCRETE SIDEWALK, SPECIAL	9850.000 SF				
0850	708045 LAWN INLET	3.000 EACH				
0860	708051 DRAINAGE INLET, 34" X 24"	2.000 EACH				
0870	708052 DRAINAGE INLET, 48" X 30"	1.000 EACH				
0880	708057 DRAINAGE INLET, 72" X 24"	7.000 EACH				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
0890	708111 MANHOLE, 48" X 30"	2.000	EACH				
0900	708583 PERSONNEL GRATE FOR PIPE INLET	2.000	EACH				
0910	708585 JUNCTION BOX, 48" X 30"	1.000	EACH				
0920	712005 RIPRAP, R-4	85.000	SY				
0930	712006 RIPRAP, R-5	550.000	SY				
0940	713001 GEOTEXTILES, STABILIZATION	3022.000	SY				
0950	713003 GEOTEXTILES, RIPRAP	635.000	SY				
0960	715510 TEMPORARY DRAINAGE PIPE, 12"	311.000	LF				
0970	720550 P.C.C. BARRIER, MODIFIED	159.000	LF				
0980	720587 P.C.C. SAFETY BARRIER PERMANENT, DOUBLE FACE, MODIFIED	24.000	LF				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE DOLLARS	UNIT PRICE CTS	BID AMOUNT DOLLARS	BID AMOUNT CTS
0990	727004 CHAIN-LINK FENCE, 6' HIGH	3600.000 LF				
1000	727006 TERMINAL POSTS FOR 6' CHAIN-LINK FENCE	36.000 EACH				
1010	727012 VEHICULAR GATES	2.000 EACH				
1020	727014 CONSTRUCTION SAFETY FENCE	850.000 LF				
1030	727015 MONUMENTS	19.000 EACH				
1040	727519 RELOCATE CHAIN LINK FENCE	195.000 LF				
1050	727538 RELOCATE GATE	1.000 EACH				
1060	743000 MAINTENANCE OF TRAFFIC	LUMP	LUMP			
1070	743023 TEMPORARY BARRICADES, TYPE III	68400.000 LFDY				
1080	743024 TEMPORARY WARNING SIGNS AND PLAQUES	21204.000 EADY				

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1090	743552 PEDESTRIAN CHANNELIZING BARRICADE	246240.000 LFDY				
1100	743553 TEMPORARY PEDESTRIAN PATHWAY	25.000 SY				
1110	744506 CONDUIT JUNCTION WELL, TYPE 7, PRECAST POLYMER CONCRETE	2.000 EACH				
1120	744529 P.C.C. BARRIER JUNCTION WELL	26.000 EACH				
1130	744530 CONDUIT JUNCTION WELL, TYPE 11, PRECAST CONCRETE/ POLYMER LID-FRAME	14.000 EACH				
1140	744531 CONDUIT JUNCTION WELL, TYPE 14, PRECAST CONCRETE/ POLYMER LID-FRAME	2.000 EACH				
1150	745604 FURNISH & INSTALL UP TO 4" SCHEDULE 80 PVC CONDUIT (TRENCH)	2450.000 LF				
1160	745606 FURNISH & INSTALL UP TO 4" GALVANIZED STEEL CONDUIT (TRENCH)	1820.000 LF				
1170	745609 FURNISH & INSTALL UP TO 4" GALVANIZED STEEL CONDUIT (ON STRUCTURE)	1470.000 LF				

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LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS		UNIT PRICE DOLLARS	CTS	BID AMOUNT DOLLARS	CTS
1180	746515 FURNISH & INSTALL 1-CONDUCTOR #6 AWG STRANDED INSULATED COPPER GROUND WIRE	3970.000	LF				
1190	746537 RELOCATING EXISTING LIGHT STANDARDS	5.000	EACH				
1200	746552 FURNISH AND MAINTAIN TEMPORARY LIGHTING	LUMP		LUMP			
1210	746577 FURNISH & INSTALL 1-CONDUCTOR #8 AWG STRANDED INSULATED COPPER GROUND WIRE	1830.000	LF				
1220	746596 JUNCTION BOX ON STRUCTURE	6.000	EACH				
1230	746605 FURNISH & INSTALL 1-CONDUCTOR #10 AWG STRANDED INSULATED COPPER GROUND WIRE	460.000	LF				
1240	746653 ELECTRICAL TESTING	LUMP		LUMP			
1250	746659 DECORATIVE LIGHT STANDARD AND FIXTURE, SINGLE, 12' POLE	2.000	EACH				
1260	746829 DECORATIVE LIGHT STANDARD AND FIXTURE, SINGLE, 10' POLE	16.000	EACH				

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1270	746830 REMOVAL OF CONCRETE POLE BASES AND CABINET FOUNDATIONS	5.000 CY				
1280	746904 FURNISH & INSTALL 1-CONDUCTOR #4/0 AWG STRANDED INSULATED COPPER GROUND WIRE	510.000 LF				
1290	746909 FURNISH & INSTALL 1-CONDUCTOR #6 AWG STRANDED COPPER	15260.000 LF				
1300	746910 FURNISH & INSTALL 1-CONDUCTOR #8 AWG STRANDED COPPER	7980.000 LF				
1310	746919 FURNISH & INSTALL #4/0 AWG STRANDED COPPER	1520.000 LF				
1320	746926 FURNISH & INSTALL ELECTRICAL UTILITY SERVICE EQUIPMENT 120/240	1.000 EACH				
1330	746953 DIRECT GLARE LINE LIGHTING SYSTEM	LUMP	LUMP			
1340	746954 GIRDER WASH LIGHTING SYSTEM	LUMP	LUMP			
1350	746955 PEDESTRIAN UNDERPASS LIGHTING SYSTEM	LUMP	LUMP			
1360	747508 LIGHTING CONTROL CENTER - 100 A	1.000 EACH				

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1370	747513 LIGHTING CONTROL AND DISTRIBUTION ENCLOSURE (120/240; 100 AMP)	1.000 EACH				
1380	747517 CABINET BASE, TYPE R	1.000 EACH				
1390	749532 SUPPLY OF FLAT SHEET ALUMINUM SIGN PANEL, TYPE IX RETROREFLECTIVE SHEETING	56.000 SF				
1400	749543 REMOVAL OF LIGHTING UNIT	1.000 EACH				
1410	749570 GALVANIZED STEEL SIGN POST ONLY, 12' X 2"	4.000 EACH				
1420	749690 INSTALLATION OR REMOVAL OF TRAFFIC SIGNS ON MULTIPLE SIGN POSTS	56.000 SF				
1430	758000 REMOVAL OF EXISTING PORTLAND CEMENTCONCRETE PAVEMENT, CURB, SIDEWALK, ETC.	1200.000 SY				
1440	759502 FIELD OFFICE, SPECIAL I	24.000 EAMO				
1450	762002 SAW CUTTING, CONCRETE, FULL DEPTH	94.000 LF				

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1460	763000 INITIAL EXPENSE	LUMP	LUMP			
1470	763501 CONSTRUCTION ENGINEERING	LUMP	LUMP			
1480	763503 TRAINEE	1040.000 HOUR	0.80000		832.00	
1490	763508 PROJECT CONTROL SYSTEM DEVELOPMENT PLAN	LUMP	LUMP			
1500	763509 CPM SCHEDULE UPDATES AND/OR REVISED UPDATES	24.000 EAMO				
1510	763522 COAST GUARD SPECIFIC CONDITIONS	LUMP	LUMP			
1520	905001 SILT FENCE	6375.000 LF				
1530	905004 INLET SEDIMENT CONTROL, DRAINAGE INLET	7.000 EACH				
1540	905005 INLET SEDIMENT CONTROL, CURB INLET	10.000 EACH				
1550	905500 SUPER SILT FENCE	1412.000 LF				

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1560	906001 PORTABLE SEDIMENT TANK	4.000 EACH				
1570	907012 TEMPORARY SLOPE DRAIN, 12"	89.000 LF				
1580	907510 COMPOST FILTER LOG	276.000 LF				
1590	908004 TOPSOIL, 6" DEPTH	10050.000 SY				
1600	908014 PERMANENT GRASS SEEDING, DRY GROUND	78100.000 SY				
1610	908017 TEMPORARY GRASS SEEDING	15000.000 SY				
1620	908020 EROSION CONTROL BLANKET MULCH	8500.000 SY				
1630	908023 STABILIZED CONSTRUCTION ENTRANCE	308.000 TON				
1640	908512 TEMPORARY GRASS SEEDING, WET GROUND	1500.000 SY				
1650	909004 TURBIDITY CURTAIN, FLOATING	789.000 LF				
	SECTION 0001 TOTAL					
	TOTAL BID					

CANNOT BE USED FOR BIDDING

Contract No. T201612101.01

Diesel Fuel Cost Price Adjustment Option

The Bidder is required to submit this form with his/her Bid Proposal at the time of bid opening. When this form is not provided by the Bidder at the time of Bid, the Option-OUT will be automatically selected and no further option is available to the Contractor and no Diesel Fuel Cost Adjustments will be made.

OPTION-IN

☐ Checking here selects the option to participate in the 763626 - Diesel Fuel Cost Price Adjustment.

OPTION-OUT

☐ Checking here declines the option to participate in the 763626 - Diesel Fuel Cost Price Adjustment.

The undersigned hereby certifies that he/she is authorized to make this Option on behalf of the bidder in compliance with the special provision 763626 - Diesel Fuel Cost Price Adjustment.

Sealed and dated this _____ day of _____ in the year of our Lord two thousand and _____ (20__).

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____ _____
Title

SWORN TO AND SUBSCRIBED BEFORE ME this ____ day of _____, 20___.

Notary Seal

_____
Notary

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BREAKOUT SHEET INSTRUCTIONS

BREAKOUT SHEET(S) MUST BE SUBMITTED EITHER WITH YOUR BID DOCUMENTS; OR WITHIN SEVEN (7) CALENDAR DAYS FOLLOWING THE BID DUE DATE BY THE LOWEST APPARENT BIDDER.

BREAKOUT SHEETS ARE TO BE SUBMITTED TO DELDOT'S CONTRACT ADMINISTRATION AS SHOWN BELOW. BREAKOUT SHEETS CANNOT BE CHANGED AFTER AWARD. THE DEPARTMENT WILL REVIEW THE FIGURES SUBMITTED ON THE BREAKOUT SHEET(S) TO ENSURE THEY MATCH THE RESPECTIVE LUMP SUM BID AMOUNT(S). MATHEMATICALLY INCORRECT BREAKOUT SHEETS WILL BE RETURNED FOR IMMEDIATE CORRECTION.

BREAKOUT SHEETS MAY BE SUBMITTED;

VIA E-MAIL TO: DOT-ASK@STATE.DE.US
SUBJECT: **T201612101.01** Breakout Sheet

OR MAILED TO: DELDOT
CONTRACT ADMINISTRATION
PO BOX 778, DOVER, DE 19903

'BREAKOUT SHEET' AND THE PROJECT NUMBER
MUST APPEAR ON THE ENVELOPE.

BREAKOUT SHEET 1 **CONTRACT NO. T201612101**

ITEM 211000 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
1	1	EA	Pedestrian Bridge	$	$
2	1	EA	Wooden Walkway	$	$
3	5	EA	Wooden Piles	$	$
4	30	LF	Railroad Tracks and Ties	$	$
5	1	EA	Submerged Steel Pipe	$	$

TOTAL ITEM 211000 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS $_____
(LUMP SUM BID PRICE FOR ITEM 211000)

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BREAKOUT SHEET 2 **CONTRACT NO. T201612101**

ITEM 614508 - WATER MAIN AND ACCESSORIES

ITEM NO.	APPROX. QTY.	UOM	DESCRIPTION	UNIT PRICE	AMOUNT
1	210	LF	DUCTILE IRON PIPE CLASS 350, CEMENT LINED, 4"	$	$
2	70	LF	DUCTILE IRON PIPE CLASS 350, CEMENT LINED, 6"	$	$
3	320	LF	DUCTILE IRON PIPE CLASS 350, CEMENT LINED, 8"	$	$
4	340	LF	DUCTILE IRON PIPE CLASS 350, CEMENT LINED, 10"	$	$
5	800	LF	DUCTILE IRON PIPE CLASS 350, CEMENT LINED 12"	$	$
6	6	LF	BENDS 45 DEGREES, 4"	$	$
7	6	EA	BENDS 45 DEGREES, 8"	$	$
8	6	EA	BENDS 45 DEGREES, 10"	$	$
9	2	EA	M.J. TAPPING SLEEVE - 4" X 4"	$	$
10	2	EA	M.J. TAPPING SLEEVE - 8" X 8"	$	$
11	2	EA	M.J. TAPPING SLEEVE - 10" X 10"	$	$
12	1	EA	M.J. TEE, 12" X 12"	$	$
13	2	EA	M.J. TEE, 12" X 6"	$	$
14	2	EA	M.J. TEE, 10" X 6"	$	$
15	2	EA	M.J. TEE, 6" X 6"	$	$
16	2	EA	GATE VALVE, 4"	$	$
17	4	EA	GATE VALVE, 6"	$	$
18	2	EA	GATE VALVE, 8"	$	$
19	2	EA	GATE VALVE, 10"	$	$
20	3	EA	GATE VALVE, 12"	$	$
21	2	EA	VALVE BOX, 4"	$	$

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22	4	EA	VALVE BOX, 6"	$	$
23	2	EA	VALVE BOX, 8"	$	$
24	2	EA	VALVE BOX, 10"	$	$
25	3	EA	VALVE BOX, 12"	$	$
26	2	EA	END CAP, 6"	$	$
27	3	EA	END CAP, 12"	$	$
28	2	EA	PERMANENT DOUBLE CAP AND BLOCK, 4"	$	$
29	2	EA	PERMANENT DOUBLE CAP AND BLOCK, 8"	$	$
30	2	LF	PERMANENT DOUBLE CAP AND BLOCK, 10"	$	$
31	40	EA	CONCRETE BUTRESS	$	$
32	1	EA	RELOCATE FIRE HYDRANT	$	$
33	3	EA	FIRE HYDRANT	$	$
34	1800	LF	POLYETHYLENE WRAP	$	$
TOTAL ITEM 614508 - WATER MAIN AND ACCESSORIES $_____ (LUMP SUM BID PRICE FOR ITEM 614508)					

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"ATTENTION"

TO BIDDERS

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SUBJECT:**T201612101.01** Breakout Sheet

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PO BOX 778, DOVER, DE 19903

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MUST APPEAR ON THE ENVELOPE.

AFFIDAVIT
OF
EMPLOYEE DRUG TESTING PROGRAM

4104 Regulations for the Drug Testing of Contractor and Subcontractor Employees Working on Large Public Works Projects requires that Contractors and Subcontractors implement a program of mandatory drug testing for Employees who work on Large Public Works Contracts funded all or in part with public funds.

We hereby certify that we have in place or will implement during the entire term of the contract a Mandatory Drug Testing Program for our employees on the jobsite that complies with this regulation:

Contractor/Subcontractor Name: _____

Contractor/Subcontractor Address: _____

_____

_____

Authorized Representative (typed or printed):_____

Authorized Representative (signature): _____

Title: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED, NOTARIZED, AND RETURNED WITH YOUR BID.

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CERTIFICATION

Contract No. T201612101.01
Federal Aid Project No. STP-N029(5)

The undersigned bidder, _____

whose address is _____

and telephone number is _____hereby certifies the following:

I/We have carefully examined the location of the proposed work, the proposed plans and specifications, and will be bound, upon award of this contract by the Department of Transportation, to execute in accordance with such award, a contract with necessary surety bond, of which contract this proposal and said plans and specifications shall be a part, to provide all necessary machinery, tools, labor and other means of construction, and to do all the work and to furnish all the materials necessary to perform and complete the said contract within the time and as required in accordance with the requirements of the Department of Transportation, and at the unit prices for the various items as listed on the preceding pages.

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Bidder's Certification Statement [US DOT Suspension and Debarment Regulation (49 CFR 29)]:

NOTICE: All contractors who hold prime contracts (Federal Aid) with DelDOT are advised that the prime contractor and subcontractors are required to submit to DelDOT a signed and notary attested copy of the Bidder Certification Statement for each and every subcontract that will be utilized by the prime contractor. This Certification **must** be filed with DelDOT prior to written approval being granted for each and every subcontractor. Copies of the Certification Form are available from the appropriate District Construction Office.

Under penalty of perjury under the laws of the United States, that I/We, or any person associated therewith in the capacity of (owner, partner, director, officer, principal, investigator, project director, manager, auditor, or any position involving the administration federal funds):

a. am/are not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any federal agency;
b. have not been suspended, debarred, voluntarily excluded or determined ineligible by any federal agency within the past 3 years;
c. do not have a proposed debarment pending; and,
d. have not been indicted, convicted, or had a civil judgement rendered against (it) by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

Exceptions will not necessarily result in denial of award, but will be considered in determining bidder responsibility. For any exception noted, indicate below to whom it applies, initiating agency, and dates of action. Providing false information may result in criminal prosecution or administrative sanctions.

_____

_____

_____

(Insert Exceptions)

DBE Program Assurance:

NOTICE: In accordance with 49 CFR Part 26 the undersigned, a legally authorized representative of the bidder listed below, must complete this assurance.

By its signature affixed hereto, assures the Department that it will attain DBE participation as indicated:

Disadvantaged Business Enterprise _____ percent (blank to be filled in by bidder)

The foregoing quantities are considered to be approximate only and are given as the basis for comparison of bids. The Department of Transportation may increase or decrease the amount of any item or portion of the work as may be deemed necessary or expedient. Any such increase or decrease in the quantity for any item will not be regarded as a sufficient ground for an increase or decrease in the unit prices, nor in the time allowed for the completion of the work, except as provided in the contract.

Accompanying this proposal is a surety bond or a security of the bidder assigned to the Department of Transportation, for at least ten (10) percentum of total amount of the proposal, which deposit is to be forfeited as liquidated damages in case this proposal is accepted, and the undersigned shall fail to execute a contract with necessary bond, when required, for the performance of said contract with the Department of Transportation, under the conditions of this proposal, within twenty (20) days after date of official notice of the award of the contract as provided in the requirement and specifications hereto attached; otherwise said deposit is to be returned to the undersigned.

I/We are licensed, or have initiated the license application as required by Section 2502, Chapter 25, Title 30, of the Delaware Code.

By submission of this proposal, each person signing on behalf of the bidder, certifies as to its own organization, under penalty of perjury, that to the best of each signer's knowledge and belief:

1. The prices in this proposal have been arrived at independently without collusion, consultation, communication, or Agreement with any other bidder or with any competitor for the purpose of restricting competition.
2. Unless required by law, the prices which have been quoted in this proposal have not been knowingly disclosed and will not knowingly be disclosed by the bidder, directly or indirectly, to any other bidder or competitor prior to the opening of proposals.
3. No attempt has been made or will be made by the bidder to induce any other person, partnership, or corporation to submit or not to submit a proposal for the purpose of restricting competition.

==========

I/We acknowledge receipt and incorporation of addenda to this proposal as follows:

No.	Date	No.	Date	No.	Date	No.	Date	No.	Date

BIDDERS MUST ACKNOWLEDGE RECEIPT OF ALL ADDENDA

MUST INSERT DATE OF FINAL QUESTIONS AND ANSWERS ON WEBSITE: _____

==========

Sealed and dated this _____ day of _____ in the year of our Lord two thousand _____ (20___).

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

SWORN TO AND SUBSCRIBED BEFORE ME this ____ day of _____, 20____.

Notary Seal

_____
Notary

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BID BOND

TO ACCOMPANY PROPOSAL
(Not necessary if security is used)

KNOW ALL MEN BY THESE PRESENTS That:_____

of_____ in the County of _____and State of _____ as **Principal**, and _____ of _____ in the County of _____ and State of _____ as **Surety**, legally authorized to do business in the State of Delaware ("**State**"), are held and firmly unto the **State** in the sum of _____ _____Dollars ($_____), or _____ percent not to exceed _____

_____ Dollars ($_____) of amount of bid on Contract No. T201612101.01, to be paid to the **State** for the use and benefit of its Department of Transportation ("**DelDOT**") for which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators, and successors, jointly and severally for and in the whole firmly by these presents.

NOW THE CONDITION OF THIS OBLIGATION IS SUCH That if the above bounden **Principal** who has submitted to the **DelDOT** a certain proposal to enter into this contract for the furnishing of certain materiel and/or services within the **State**, shall be awarded this Contract, and if said **Principal** shall well and truly enter into and execute this Contract as may be required by the terms of this Contract and approved by the **DelDOT**, this Contract to be entered into within twenty days after the date of official notice of the award thereof in accordance with the terms of said proposal, then this obligation shall be void or else to be and remain in full force and virtue.

Sealed with _____ seal and dated this _____ day of _____ in the year of our Lord two thousand and _____ (20___).

SEALED, AND DELIVERED IN THE presence of

_____
Name of Bidder (Organization)

Corporate Seal

By: _____
Authorized Signature

Attest _____

_____
Title

_____
Name of **Surety**

Witness:_____

By: _____

_____
Title

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