

FISHING DOCK REHABILITATION

Philadelphia, PA

Technical Specifications

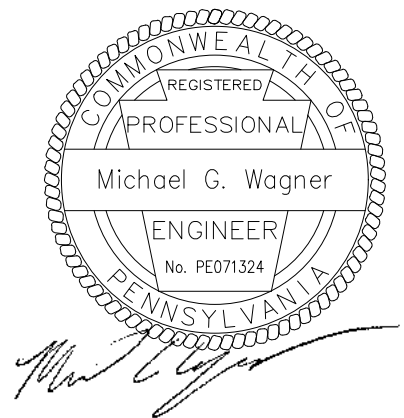
SCHUYLKILL RIVER DEVELOPMENT CORPORATION
(SRDC)

2401 WALNUT ST, #603
PHILADELPHIA, PA 19103

Issued For Bid
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Urban Engineers, Inc.
UEI Project # : 2019610049.000

SRDC Project # : BMFP - 001



SECTION 000110 - TABLE OF CONTENTS

TECHNICAL SPECIFICATIONS:

01 GENERAL REQUIREMENTS

- 01 11 00 Summary of Work
- 01 20 00 Price and Payment Procedures
- 01 33 00 Submittal Procedures
- 01 40 00 Quality Requirements
- 01 70 00 Execution and Closeout Requirements

02 EXISTING CONDITONS

- 02 40 00 Demolition

03 CONCRETE

- 03 20 00 Concrete Reinforcement
- 03 30 00 Cast-in-Place Concrete

05 METALS

- 05 12 00 Structural Steel Framing
- 05 52 13 Pipe and Tube Railings

06 WOODS, PLASTICS, AND COMPOSITES

- 06 13 33 Timber Pier Framing

09 FINISHES

- 09 90 00 Painting and Coating
- 09 96 26 Coating of Steel Waterfront Structures
- 09 97 00 Hot Dip Galvanizing

31 EARTHWORK

- 31 00 00 Earthwork
- 31 62 19 Timber Piles

SECTION 000110 - TABLE OF CONTENTS

31 63 29 Drilled Concrete Shaft

32 EXTERIOR IMPROVEMENTS

32 12 16 Asphalt Paving

- END OF SECTION -

SECTION 011100 – SUMMARY OF WORK

PART 1 : GENERAL PROJECT DESCRIPTION

1.01 PROJECT SITE

- A. The project site is located on the west side of the Schuylkill River approximately 200 feet north of the intersections of S 49th Street and Botanic Avenue in Philadelphia, PA.
- B. The site can be accessed from a gated entrance at the intersection of 49th Street and Botanic Avenue. SRDC will provide the Contractor with a key to this gate.

1.02 EXISTING CONDITIONS

- A. The existing pier at the site is abandoned and in disrepair. It is comprised of timber decking supported by fourteen round timber piles. There are seven bents in total and each bent has two round timber piles supporting a timber cap beam, which in turn supports series of timber stringer underlying the deck.
- B. Originally, the pier was used as a fuel transfer station. Hence, two steel pipe manifolds are present at the outshore end of the pier. Records indicate that these pipes have been drained and capped but may not have been flushed.
- C. Timber pile clusters are present immediately upriver and downriver of the pier.
- D. A timber retaining wall is present at the inshore end of the pier, comprised of horizontal timber lagging held back by timber soldier piles.
- E. A 2019 inspection found that most of the timber elements are severely deteriorated above the water line and some timber piles are out of plumb.

1.03 PROJECT STATEMENT

- A. The objective of the project is the rehabilitation of a dilapidated and abandoned industrial dock with the intent of repurposing the structure as a community scenic overlook and fishing dock. The facility, once completed will become part of the Schuylkill River Trail and greenway.
- B. The Contractor shall demolish the existing timber pier and build a new fishing dock in its place using steel pipe piles and other steel elements. A new path and associated site grading will provide access to the new dock. The existing timber retaining wall will be kept in place and some timber piles will be extracted for reuse at the retaining wall.

PART 2 : UNIQUE WORKING CONDITIONS

2.01 OWNER REQUIREMENTS AND ACTIVITIES

SECTION 011100 – SUMMARY OF WORK

- A. The Contractor is responsible for notifying all concerned local, State and Federal agencies of the construction work, including the U.S. Coast Guard, US Army Corps, and the PA Fish & Boat Commission. The Contractor is responsible for securing, and paying for, all necessary local permits and abiding by all permits. The Owner has obtained the US Army Corps and Pennsylvania DEP permits for the required work. The owner has obtained a Philadelphia zoning permit.
1. Note that the PA Fish & Boat Commission (PAFBC) has identified that the nearshore portion of the project area could potentially be occupied by a species of concern between October 15 and April 15. PAFBC will allow construction to take place in the nearshore areas provided that a qualified herpetologist performs a preconstruction survey immediately before construction begins at Bent 3 and removes any turtles present in the area to a safe location.
 2. The Owner shall contract directly with a qualified herpetologist to perform the preconstruction survey, and it is the Contractor's responsibility to provide a schedule to the Owner and allow adequate time for the survey to be scheduled.
 - a. The preconstruction screening is expected to take 1-2 days to complete.
 - b. No additional payment will be made for any delays associated with scheduling or performing the preconstruction survey.
 3. Note that demolition and extraction of timber piles, as well as the installation of piles at Bents 1 and 2, is not subject to the restrictions of the PAFBC letter.
 4. Refer to the PAFBC letter in the permit exhibits for further information.
- B. It is the contractor's responsibility to obtain the building permit. The contract includes an allowance to cover the City building permit fee, as described in Section 012000. The Engineer will provide the following documents for the Contractor's use in obtaining the building permit:
1. Zoning Permit
 2. No-Rise Certification
 3. Floodplain-Specific Permit Forms
- C. The Contractor must be registered with the City of Philadelphia. The Contractor or its performing subcontractors must hold current licenses with the City of Philadelphia for all relevant trades for the work they intend to perform to complete the project.
- D. The Contractor shall comply with all safety, security, and training requirements of the Owner. The Bidder shall clarify these requirements prior to submitting a bid for this project and include all associated costs in their bid.

SECTION 011100 – SUMMARY OF WORK

- E. The site is accessible to the public. The Contractor shall be responsible for maintaining a safe work area, both during working hours and after hours, locking up and storing all tools. The Contractor shall be responsible for taking all necessary steps, including fences, signage, barriers, and locks, to prevent public access of work areas and unfinished work.
- F. Crane work must be performed from the water and only small earth-moving equipment will be allowed on land. The Schuylkill Trail, which is adjacent to the project site, must remain open and safe for public use throughout construction.
- G. The contractor may bring equipment and vehicles that are actively engaged in the work onto the site within the boundaries indicated on the drawings. Private vehicles of workers and Contractor staff are not permitted on the worksite, trail, or greenway. Such vehicles must be parked on nearby streets.
- H. The Contractor must coordinate with the Owner to determine site access and parking requirements. These issues must be understood and accounted for in the Bidder's Proposal.

2.02 STANDBY

- A. The Bid Proposal shall provide a lump sum daily standby rate, including the labor, equipment, and other expenses that will apply in the case of an unscheduled "no-work day". These daily rates will include all associated mobilization and demobilization. The Bidder's Proposal shall also provide separate hourly billing rates for the labor and equipment for Owner review. The Owner approved hourly rates shall apply in case of a partial work-day loss due to unannounced refinery operations.

PART 3 : PRE-BID REQUIREMENTS

3.01 PRE-BID MEETING

- A. Details of the pre-bid process are included in Section 002113.

3.02 VERIFICATION OF SITE CONDITIONS

- A. The Bidder will be required to evaluate the existing site conditions in order to determine if all work described in the Summary of Work and Technical Specifications and as shown on the Contract Drawings can be performed as indicated or provide written notification that this has been waived. Should the Bidder wish to perform additional due diligence pre-proposal

SECTION 011100 – SUMMARY OF WORK

inspections by land, the Bidder may contact the Owner with a minimum 24 hours of notice to make arrangements. The Bidder is responsible for performing this pre-proposal inspection in a timely manner prior to submitting a Proposal.

- B. No additional compensation shall be made beyond the base Proposal for delays or costs associated with obstructions or other field issues.
- C. The Bidder shall field verify the location of existing structures, obstructions and utilities during the proposal phase of the project. Potential interferences shall be clearly stated in the Proposal. The selected Contractor shall temporarily relocate and support the interfering utilities during construction, as required, but only with prior approval by the Owner. Utilities shall be reinstalled at their original location, immediately after the construction work in that area is complete. Costs associated with these activities shall be included in the base Proposal. The selected Contractor shall repair any damage to the utilities and structures during construction at no cost to the Owner. Information regarding the existing utilities can be obtained from site visits prior to the submission of the Proposal.

3.03 PROPOSAL PREPARATION

- A. The Bidders shall familiarize themselves with site operations and submit a Work Plan and Work Schedule with the Proposal. Any discrepancies regarding the schedule shall be resolved prior to the award of work.
- B. The Bidder shall include all planned storage, personnel, and equipment locations during construction within the Proposal. Staging areas and water equipment needs shall also be identified within the Proposal.
- C. Any exceptions and/or modifications to the Contract drawings and specifications shall be clearly stated in the Proposal. No additional exceptions will be approved after the award of work.

PART 4 : GENERAL SCOPE OF WORK

4.01 GENERAL STATEMENT

- A. The scope of work includes providing the labor, material, equipment, and all other services and expense as may be necessary for, and incidental to, the proper execution and completion of work including but not limited to performing the following tasks.

4.02 PREPARATION

SECTION 011100 – SUMMARY OF WORK

- A. Obtain all local permits necessary to perform the work and submit all applicable permits to the Owner one (1) week prior to mobilization. Only the legal permit fee shall be paid by the Owner.
- B. Utilize the One Call System between 3 and 10 days before initiation of construction activities having the potential to affect utilities.
- C. Review the available geotechnical information.
- D. Make timely submittals required by the Contract and as requested by the Engineer for review. The Contractor shall not initiate a construction activity prior to receiving **all** of the submittals, reviewed by the Engineer, related to the construction activity, indicating an authorization to proceed with the construction activity. Any construction activity performed without this authorization shall be at the Contractor's risk and cost. Delays arising due to failure in making timely submittals shall be at the Contractor's cost. The Contractor shall not be compensated for construction activities performed without the authorization of the Engineer.
- E. Attend a kick-off meeting and any additional progress meetings, which will take place at the SRDC main office building or remotely. A Contractor employee with the authority of making decisions must be present at each of these meetings.
- F. Written authorization from the Engineer must be obtained for any deviation(s) from the Contract Drawings and/or Technical Specifications. All requests must be submitted to the Engineer via the contract RFI procedure

4.03 EXECUTION OF WORK

- A. Mobilize.
- B. Give notice to all environmental agencies, in accordance with the permits, and the Mariners Advisory Committee, if applicable, and install all E&S and wildlife protection devices described in the Contract Drawings and permits.
- C. Procure, fabricate, paint and/or galvanize (if required) all materials; handle and transport the construction material(s) to the site as and when required. Coordinate all material staging and/or storage needs (barge locations or landside) with the Owner.
- D. Install temporary barriers and signs prohibiting access to any structures where construction or demolition work is in progress. Such barriers and signage shall remain in place until the completion of the work, when the structure is safe for access. The Contractor is solely responsible for the safety of its employees and all other personnel, including trail users, in the vicinity of the work area during construction.

SECTION 011100 – SUMMARY OF WORK

- E. Perform specific work as described in Part 5 of this section, in accordance with the technical specifications, and as directed by the Engineer.
- F. Submit weekly progress schedules that forecast the work to be performed in the coming two week period.
- G. Notify the Engineer prior to any pile installation and other activities as requested. Coordinate, schedule and provide access for the Engineer to monitor all pile installation and other phases of the construction.
- H. Coordinate with the Design Professional in Responsible Charge of Special Inspections (DPRC-SI) and the Special Inspection Agency to accommodate the special inspections mandated by the Building Code. Notify all parties at least 3 working days before the commencement of any activities noted in the building permit as requiring periodic or continuous special inspections, and provide safe physical access to the special inspector to perform the required inspection. No additional compensation will be made for compliance with special inspections, or any resulting required remediation or repair.
- I. The selected Contractor shall cooperate and provide access to the Engineer and Owner for inspection of the work upon request, including access to work platforms and minimal periodic photo/video documentation of the work progress.

4.04 PROJECT CLOSE-OUT

- A. Walkthrough the project area with the Engineer when near completion to develop a punch list, then address all punch list items to the Engineer's satisfaction.
- B. All demolished material shall be disposed of offsite in accordance with the applicable local and federal rules and regulations, unless shown otherwise on the Contract Drawings or specifically directed otherwise in writing by the Owner.
- C. Submit As-Built drawings of all work to the Owner, following the Owner's required format.
- D. Clean the work area.
- E. Demobilize.

PART 5 : SPECIFIC SCOPE OF WORK

5.01 PREPARATION

SECTION 011100 – SUMMARY OF WORK

- A. Submit a schedule to the Owner and confirm that the qualified 3rd party herpetologist can perform the preconstruction turtle screening before construction work is set to begin at Bent 3.
- B. Use a registered land surveyor to survey the existing benchmarks, establish control points, and layout the new work points.
- C. Perform and submit a driveability analysis to select an appropriate hammer to drive the reused timber piles.
- D. Select an appropriate drill rig and drilling setup to advance the new piles into the rock, and submit for approval.

5.02 DEMOLITION

- A. Prior to the removal of existing structures, submit to the Engineer a plan describing the demolition and removal methods including equipment to be used. Do not proceed with the demolition work until the plan has been reviewed and accepted. Within the plan, provide methods for the protection of the general public and means to contain possible floating debris within the water column.
- B. Remove the existing structures as indicated and properly dispose of all material removed. Conduct work so as to prevent damage to the existing and adjacent structures remain in place.
- C. Carefully extract existing timber piles and remove the abandoned fuel pipe line so it can be reinstalled. Allow the Engineer to inspect extracted timber piles to select piles for reuse.

5.03 NEW PIER

- A. Allow the qualified 3rd party herpetologist to perform the preconstruction turtle screening at bent 3 before now pile installation, including falsework, is initiated.
- B. Layout work points and erect necessary falsework
- C. Set, drill, and install the balance of piles as directed in the contract documents and fill with concrete.
- D. Auger or drive through the river silt and decomposed (weathered) rock to the elevations indicated on the drawings while advancing the pipe shaft. Advance the pipe as far as possible into weathered rock without underreaming. Do not create an annular space between the pipe shaft and the weathered rock. Underream as needed below the pipe to reach the penetration shown into quality rock. Remove water and spoils from inside

SECTION 011100 – SUMMARY OF WORK

of the pipe pile. All spoils shall be contained, collected and disposed of off-site.

- E. Provide means for the inspector to verify that the pile shaft is clear of debris prior to placing reinforcement and concrete.
- F. Place reinforcement, and Tremie-pour concrete as indicated on the contract documents.
- G. Trim the pile tops.
- H. Erect steel bracing and platform, and install decking and railings.
- I. Install a new ladder and a small craft mooring cleat.

5.04 RETAINING WALL, PATH AND SITE GRADING

- A. After removal of the existing structure, excavate behind the retaining wall as necessary to install timber laggings. Properly dispose of all excavation materials and impacted trees.
- B. Vibrate or drive reused timber piles to refusal, install new lagging and wingwall.
- C. Set subbase, compact and pave the new path.
- D. Regrade the site and place stone for erosion control.
- E. Seed all disturbed areas.

5.05 TRASH RECEPTACLE

- A. Pour a concrete pad, 27"x27"x6" tall, on a base of 4" of compacted crushed stone, near the entrance to the new fishing pier. The exact location of the new pad will be determined in consultation with SRDC after rough grading is completed.
- B. Retrieve the owner-supplied trash receptacle from the owner's maintenance building, approximately 1,000 feet from the installation site.
- C. Install the owner-supplied trash receptacle onto the pad, anchoring it with two steel L-brackets. The brackets shall be embedded in the pad or anchored with epoxy adhesive.

5.06 CLOSEOUT

- A. Regrade, pave and seed any disturbed areas, as necessary to restore original conditions.
 - 1. Seeded grass areas that are not thriving during the plant establishment period must be replaced at the Contractor's sole cost

SECTION 011100 – SUMMARY OF WORK

and expense. Towards the end of the 12 month establishment period, SRDC perform a plant inspection to ascertain whether any plants need to be replaced.

- B. Clean work site, remove E&S and wildlife protection devices, debris, etc.

- END OF SECTION -

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

PART 1 : GENERAL

1.01 REFERENCE

- A. The provisions of this section are applicable to the Bid Items as listed within the Schedule of Quantities, Prices, and Total Bid form.
- B. The cost of all elements as described under each Bid Item shall be included within the price proposed for that Item.
- C. The total of all items in Section 2 shall comprise the Total Value of the Contract. The Total Value of the Contract may be amended using these unit prices for additions or deletions in the scope of work.
- D. The amount(s) bid on the supplementary item(s) in Section 3 shall only be paid if the indicated modifications to the work become necessary. The Total Value of the Contract will be amended using these rates for additions or deletions in the scope of work.

1.02 INCIDENTAL ITEMS

- A. The scope of work for each pay item shall include providing all associated equipment, materials, labor, utilities, transportation, taxes and all other services and expenses as may be necessary to complete the work described.
- B. Each bid item, where applicable, shall include the procurement, storage, handling, and installation of all materials described within the item.
- C. Tasks that are incidental to the completion of the payment items shall be included in the cost of the associated item, unless specifically identified under another payment item(s).
- D. The description of work in this section may not be exhaustive of all tasks necessary for completion of the overall payment item, and the omission of such tasks does not indicate that they are extra to the contract.
- E. Where the Contractor deems that items in the scope of work are not incidental to the payment items, or additional work is required to complete the project scope, a request for clarification must be submitted with the Bid.

1.03 UNIT ABBREVIATIONS

- A. CY = Cubic Yard
- B. EA = Each
- C. LF = Linear Feet
- D. LS = Lump Sum

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

E. SF = Square Feet

PART 2 : BID ITEM DESCRIPTION

2.01 MOBILIZATION / DEMOBILIZATION

- A. The amount of this item shall be limited to ten percent (10%) of the total lump sum price of the Contract Bid.
- B. The Contractor shall mobilize all equipment, personnel, materials and supplies necessary for completing the work to the project site.
- C. Notify the state One Call Center.
- D. Obtain necessary permits. The contract includes an allowance of \$15,000 to cover the cost of the building permit fee, as detailed in Item 12. SRDC will reimburse the contractor for fees paid to obtain the permit but not for the contractor's effort in completing and filing the application which effort should be included in the lump sum fee in the mobilization item.
- E. Coordinate with the Owner to allow for a preconstruction turtle screening by a qualified herpetologist in the area around Bent 3. The Owner will not be responsible for any Contractor delays surrounding this requirement. It is the Contractor's responsibility to provide a schedule to the Owner well in advance of the work and to confirm that the herpetologist will be able to perform the survey before beginning the work.
- F. Comply with the Owner's site safety and security requirements.
- G. Prepare and transmit submittals to the Engineer and/or Owner as required.
- H. Attend meetings as required.
- I. Provide, setup and supply office trailers as required on site,
- J. Transport material, equipment and tools to accommodate the Owner's operations when provided with at least 18 hours of notice.
- K. Install environmental protections, booms and barriers.
- L. Provide the Owner and Engineer access to the construction site during the work.
- M. Prepare and submit As-Built Drawings.
- N. Cleanup and dispose of material off-site.
- O. Address items on project closeout punch list.
- P. Demobilize.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

2.02 EROSION & SEDIMENT CONTROL

- A. Install and maintain floating booms, turtle barriers, silt fence, rock construction entrance and any other Erosion and Sediment Control BMPs around the project site as required.

2.03 FLOATING BOOMS

- A. Install and maintain floating booms and associated materials around the work area to contain materials in the immediate vicinity of the work and prevent them from entering the waterways.

2.04 DEMOLITION

A. DEMOLITION INCLUDING TWO EXISTING TIMBER PILE CLUSTERS

1. Demolish and dispose of all materials as indicated within the Contract Drawings.
2. Include any falsework or temporary supports as may be required.
3. Salvage long sections of existing round timber piles to be reused.
4. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.

a. 024000 Demolition

B. DEMOLITION EXCLUDING TWO EXISTING TIMBER PILE CLUSTERS

1. Demolish and dispose of all materials as indicated within the Contract Drawings, except for the two existing timber pile clusters.
2. Include any falsework or temporary supports as may be required.
3. Salvage long sections of existing round timber piles to be reused.
4. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.

a. 024000 Demolition

NOTE: Only 4.A or 4.B shall be part of the contract, and the selection shall be at the owner's discretion.

2.05 DOCK PIPE PILES/ROCK SOCKET

- A. Furnish piles, reinforcement, concrete, and necessary materials.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

- B. Development of drilling plan
- C. Provide coatings, as required.
- D. Survey, layout and Falsework.
- E. Pile Drilling / Auguring / Driving / Vibrating / Installation.
- F. Cutting and splicing of piles, as required.
- G. Continuous capture and offsite disposal of spoils and cuttings
- H. Steel reinforcement and tremie-poured concrete.
- I. Trimming of the pile top.
- J. Touch up painting.
- K. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.
 - 1. 032000 Concrete Reinforcement
 - 2. 033000 Cast-In-Place Concrete
 - 3. 316329 Drilled Shafts
 - 4. 099626 Coating of Steel Waterfront Structures
 - 5. 051200 Structural Steel Framing

2.06 TIMBER PILES (REUSE)

- A. Hammer Selection.
- B. Falsework.
- C. Driving shoes / tips, as required.
- D. Pile Driving / Installation.
- E. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.
 - 1. 316219 Timber Piles

2.07 NEW DOCK PLATFORM

- A. Furnish steel sections, hardware, deck grating, and necessary materials.
- B. Provide galvanizing and/or coatings, as required, including cleaning and preparation of surfaces and field touch-up.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

- C. Survey, layout members, trim as necessary, adjust connections as necessary.
- D. Install stringers, cross beams, joists, decking, handrail and gate posts.
- E. Cutting and splicing of materials.
- F. Perform all connections, including materials, hardware, surface preparation, bolting and welding.
- G. Touch up painting.
- H. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.
 - 1. 051200 Structural Steel Framing
 - 2. 099626 Coating of Steel Waterfront Structures
 - 3. 099700 Hot Dip Galvanizing

2.08 RAILINGS AND LADDERS

- A. Furnish steel sections, hardware, grout, and necessary materials.
- B. Provide coatings, as required.
- C. Layout members, trim as necessary, adjust connections as necessary.
- D. Install grouted anchors to the existing seawall and mount the ladder.
- E. Touch up painting.
- F. Furnish and install the mooring cleat shown in the contract drawings.
- G. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.
 - 1. 051200 Structural Steel Framing
 - 2. 099000 Paint & Coating

2.09 EXISTING PIPELINES

- A. SALVAGE AND REUSE EXISTING PIPELINES
 - 1. Careful removal of the existing pipelines and temporary staging on land or barge.
 - 2. Trimming and capping the pipelines for reuse.
 - 3. Remounting the pipelines on the finished dock.
 - 4. Properly disposing of trimmed sections offsite.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

5. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.

- a. 024000 Demolition
- b. 051200 Structural Steel Framing

B. DEMOLISH AND DISPOSE OF EXISTING PIPELINES

1. Careful removal and offsite disposal of existing pipelines.

2. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.

- a. 024000 Demolition

NOTE: Only 9.A or 9.B shall be part of the contract, and the selection shall be at the owner's discretion. The owner may choose to remove this pay item from the contract.

2.10 RETAINING WALL EXTENSION,

- A. Furnish, trim and install new timber lagging and wing wall, after piles are driven.
- B. Installation of geotextile and stone, as shown.
- C. Provide temporary support (if needed) to replace and install new timber lagging for the retaining wall and wing wall.
- D. The work shall include all excavation and disposal or reuse of existing bank material, as required, to achieve the grades shown in the contract drawings.

- 1. 061333 Timber Pier Framing
- 2. 310000 Earthwork

2.11 ASPHALT PATH, SITE GRADING & ROCK SLOPE STABILIZATION

- A. Furnish, install and compact stone subbase and asphalt path for the new path.
- B. Furnish place and grade rock for slope stabilization in the areas shown on the contract drawings.
- C. The work shall include all excavation and disposal or reuse of existing bank material and impacted trees, as required, to achieve the grades shown in the contract drawings.
- D. Removal and disposal of all surplus materials from the excavations in the manner specified by the Owner.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

- E. Seeding of all disturbed areas.
- F. Replanting, if required, based on the Owner's inspection after the 12-month establishment period.
- G. All work included within the following Technical Specifications sections shall be included, unless specifically included within another pay item.
 - 1. 310000 Earthwork
 - 2. 313700 Riprap
 - 3. 321216 Asphalt Paving

2.12 BUILDING PERMIT FEE ALLOWANCE

- A. This allowance shall be used to reimburse the contractor, at cost, for the building permit fee paid to the City of Philadelphia.
- B. This item shall not include the necessary administrative labor and coordination to obtain the building permit.
- C. The contractor must supply SRDC with receipts for the permit fees which are to be reimbursed without any mark-up. Should the permit fees be waived by the City (as the dock will be city-owned), no reimbursement shall be made.

2.13 TRASH RECEPTACLE

- A. Furnish and compact crushed stone subbase.
- B. Furnish concrete for pad, form and cure.
- C. Furnish and install steel L-brackets. Mount brackets to the pad and connect to the trash receptacle.
- D. Retrieve the owner-supplied trash receptacle from the Owner.
- E. Coordinate with the Owner to determine the location of the pad.

PART 3 : ADDITIONS AND DELETIONS ITEM DESCRIPTION

3.01 HOURLY STANDBY RATE

- A. The hourly rate the Contractor be compensated at in the event that work is temporarily suspended by an unscheduled directive by the Owner.
- B. The Contractor will only be compensated when directed so by the Owner.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

- C. The rate shall include all expenses, including labor, equipment, tools, utilities and taxes. No additional payment will be made in supplement to this rate.

3.02 DAILY STANDBY RATE

- A. The daily rate the Contractor be compensated at in the event that work is temporarily suspended for an entire work day(s) by an unscheduled directive by the Owner.
- B. The Contractor will only be compensated when directed so by the Owner.
- C. The rate shall include all expenses, including labor, equipment, tools, utilities and taxes. No additional payment will be made in supplement to this rate.

3.03 PILE EXTENSIONS – ROCK SOCKETS

- A. The unit price will be paid when as-installed pile depths exceed the design tip elevation of the Contract.
- B. The Contractor will only be compensated when directed by the Inspector to continue pile advancement when a pile does not reach the design capacities at the design tip elevation.
- C. The work shall include attaching / splicing an additional shaft section onto the pile up to 5 feet (5 ft) in length and advancing the pile that distance.
- D. This work shall include the additional reinforcement, concrete fill, and cuttings disposal, in accordance with the associated base bid item.
- E. Each occurrence shall be paid at the unit price for any additional length required in increments of five feet (5 ft).

3.04 SPECIAL BACKFILL

- A. The unit price shall be applicable to any special backfill required due contaminated soils or materials otherwise unsuitable for backfill that must be disposed of and replaced.
- B. The Contractor will only be compensated when directed so by the Inspector.
- C. Remove and dispose of all contaminated and/or unsuitable materials from the excavations in the manner specified by the Owner.
- D. The work shall include the refilling of excavation and trenches to grades shown on the Drawings, or as otherwise required to complete the Work, using suitable materials which have physical properties that match the requirements of this Specifications.

SECTION 012000 – PRICE AND PAYMENT PROCEDURES

- END OF SECTION -

SECTION 013300 – SUBMITTAL PROCEDURES

PART 1: GENERAL

1.01 SCOPE

- A. The provisions of this section apply to the submittal of all information by the Contractor to the Engineer / Owner.

PART 2: PRODUCTS

Not used.

PART 3: SUBMITTALS

As specified in related sections.

PART 4: QUALITY ASSURANCE

Not used.

PART 5: EXECUTION

5.01 SUBMITTAL PROCEDURES

- A. It is the Contractor's responsibility to make timely Submittals. The Contractor shall not initiate a construction activity prior to receiving ALL the submittals, reviewed by the Engineer, related to the construction activity, indicating an authorization to proceed with the construction activity. Any construction activity performed without this authorization shall be at Contractor's risk and cost. Delays arising due to the failure in making timely submittals shall be at Contractor's cost. The Contractor shall not be compensated for construction activities performed without the authorization of the Engineer.
- B. The Contractor shall submit a Submittal Log, documenting the list of submittals to be made during the project, prior to mobilization.
- C. Transmit each submittal with a letter of transmittal indicating the content of the submittal, quantity of submitted items and any special instructions.
- D. Submittals are to be sequentially numbered. Mark revised submittals with original number and sequential alphabetic suffix.

SECTION 013300 – SUBMITTAL PROCEDURES

- E. Identify Project, Contractor, Subcontractor and Supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
- F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
- G. Schedule submittals to expedite Project. All materials shall be submitted electronically either through email or other media. The Contractor shall coordinate with the Engineer and Owner as to the preferred submission procedures for the project. Physical media may be delivered to the Engineer's (Urban Engineers, Inc. (Urban)) Office at 530 Walnut Street, Philadelphia, PA 19106, Attn: Michael Wagner, P.E.
- I. For each submittal, allow for a 10-working-day review period excluding delivery time to and from Contractor.
- J. Identify with highlighter and/or red ink variations from Contract Documents and product or system limitations, which may alter or be detrimental to successful performance of completed Work. Contractor shall provide an estimated cost for any proposed alternates.
- K. Allow space on submittals for Contractor and Engineer review stamps.
- L. When revised for resubmission, identify changes made since previous submission.
- M. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- N. Submittals not requested will not be recognized or processed.
- O. No materials, supplies, equipment or labor shall be ordered for an item until the Engineer has reviewed the submittal.
- P. Contractor shall update the submittal log and submit to the Engineer every month at a minimum.

5.02. SUBMITTAL DATA

- A. Product Data: Submit to the Engineer, for the purpose of review and checking the conformance with information given and design concept expressed in Contract Documents. Provide appropriate number of copies and distribute in accordance with the section "Submittal Procedures".

SECTION 013300 – SUBMITTAL PROCEDURES

- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project. Record this information in the submittal matrix.

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1: GENERAL

1.1 SCOPE

- A. Quality control and control of installation.
- B. Tolerances.
- C. References.
- D. Examination.
- E. Operations.

PART 2: PRODUCTS

Not used.

PART 3: SUBMITTALS

The Contractor shall submit a quality assurance / quality control plan for the project.

PART 4: QUALITY ASSURANCE

As specified in related sections.

PART 5: EXECUTION

5.1. QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Prior to ordering any material, the Contractor is responsible to verify all material quantities and dimensions in the field.
- B. The contractor shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of Contract-specified quality.
- C. The Contractor shall comply with all manufacturers' instructions, including performing all tasks in the instructed sequence.
- D. When manufacturers' instructions conflict with Contract Documents, a

SECTION 014000 - QUALITY REQUIREMENTS

request of clarification shall be submitted to the Engineer 5 business days prior to the need.

- E. The Contractor shall have a minimum of five (5) years of experience in performing similar work. The Contractor shall use qualified employees to produce the Contract-specified quality.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

5.2. TOLERANCES

- A. Fabrication and installation tolerances shall be governed by the tolerances specified in applicable codes, standards, and the Contract Documents. Monitor fabrication and installation tolerance control of products to produce acceptable work. Tolerances are non-additive.
- B. When tolerances mentioned in the Contract Documents conflict with codes and standards, request a written clarification from the Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.
- D. For items found to be installed or manufactured out of tolerance, the Contractor shall remove and install an acceptable replacement at no additional cost to the Owner.

5.3. REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified by this Contract or are required by applicable codes.
- B. Obtain copies of standards where required by product and contract specification sections.
- C. When specified reference standards conflict with the Contract Documents, request clarification from the Engineer before proceeding.
- D. Neither the contractual relationships, duties, nor responsibilities of the parties to the Contract, shall be altered from the Contract Documents by mention or inference in reference documents. All changes, alterations and requirements of others shall be presented to the Engineer prior to initiation.

SECTION 014000 - QUALITY REQUIREMENTS

5.4. EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.

5.5. OPERATIONS

- A. The Contractor shall submit a schedule of work to the Owner as required by the Contract. Daily time sheets including men, equipment, and material received shall be presented at the conclusion of each working day.
- B. Construction and testing are to be scheduled to accommodate the Owner's vessel schedule. At no time shall the arrival/departure of an incoming vessel be delayed due to construction and testing. A safe berthing facility must be provided at all times.
- C. Weekly Construction Progress Update meetings will be held to discuss and document the status of the project. It is mandatory that the Contractor or Contractor's representative, empowered to engage in Contract binding decisions, attend each meeting.
- D. The Contractor shall submit to the Owner and the Engineer a copy of the updated work progress 1-week look-ahead schedule for review and comments 24 hours prior to each Construction Progress Update meeting.
- E. Continuous coordination with the Owner / Engineer / Project Construction Inspector and other Contractors is the responsibility of the Contractor. Failure to coordinate will not relieve the Contractor from his responsibilities.
- F. The Engineer will record and distribute meeting minutes for each Construction Progress Update meeting.

- END OF SECTION -

SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1: GENERAL

1.1 SCOPE

The work shall consist of the mobilization and demobilization of the Contractor's forces, equipment, and materials necessary for performing the work required under the contract.

PART 2: PRODUCTS

The Contractor shall provide all equipment, materials, and labor required for this item.

PART 3: SUBMITTALS

Not used.

PART 4: QUALITY ASSURANCE

As specified in related sections.

PART 5: EXECUTION

- 5.1 Mobilization shall include all activities and associated costs for transportation and assembly of the Contractor's personnel, equipment, and operating supplies to the site; establishment of offices and other necessary general facilities for the Contractor's operations at the site as may be required by the Specifications, as well as by Federal, State and/or local law and regulation. The determination of the adequacy of the Contractor's facilities, except for those required by government laws and regulations, shall be made by the Engineer. The cost of required bonds, insurance, permits and/or any other initial expenses required for the start of the work shall be included in this item.
- 5.2 Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the Contract from the site; including the disassembly, removal and site clean up of offices, buildings, and other facilities assembled on the site specifically for this contract. In addition, all storage areas and work areas shall be cleaned of all rubbish and discarded materials. Storage and work areas must be left in a manner satisfactory to the Owner & Engineer. Any damage to the Owner's property and/or any other property of the project site shall be repaired to the satisfaction of the Owner & Engineer at no additional cost to the Owner. The project will not be

SECTION 017000 – EXECUTION AND CLOSEOUT REQUIREMENTS

considered complete until the above work has been completed and accepted by the Owner & Engineer.

- 5.3 This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted, or added items of work for which the Contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

- END OF SECTION -

SECTION 024000 - DEMOLITION

PART 1: GENERAL

1.1. SCOPE

- A. This section includes the temporary removal and replacement of materials, demolition of materials, and extraction of piles required for the work shown on Contract drawings and described in the Summary of Work.

1.2 RELATED SECTIONS

- A. Quality requirements Section 01400

PART 2: PRODUCTS

Not used.

PART 3: SUBMITTALS

- A. Contractor shall submit a demolition plan describing the means and methods of demolition, and a protection plan describing the fencing, barriers, floating boom installation, and lighting 3 weeks prior to need.

PART 4: QUALITY ASSURANCE

Not used.

PART 5: EXECUTION

5.1. PROTECTION

- B. The Contractor shall contact the PA-One Call System 3 to 10 days before initiating work at 800-242-1776.
- C. Protect existing aboveground and underground utilities, structures, foundations, and equipment during excavation and other operations.
- D. Take all necessary precautions for the safety and protection of the terminal employees, construction crew, and other personnel. Install and maintain barriers, fences, planking, and warning signs at the demolition site, as necessary, during construction.

5.2. PERFORMING WORK

SECTION 024000 - DEMOLITION

- A. All work shall be performed in a manner that does not interfere with the terminal's daily operations. The Contractor shall notify the Owner of his schedule before beginning the demolition to allow the Owner to take appropriate measures.
- B. The Contractor shall field verify the location of any existing utilities and mark the deck surface in the appropriate utility color. If an interference with the existing utilities is expected during the demolition / excavation work, such interference shall be brought to the attention of the Owner and the Engineer before the commencement of the work.
- C. Interfering utilities shall be temporarily relocated by the Contractor. These utilities shall be installed at the original location after the completion of the construction work. Price to perform such work shall be included in the bid by the Contractor.
- D. Should any utility or service line be disrupted or otherwise damaged, arrange for the immediate restoration of service, or temporary service until substantial and proper corrective repairs and/or replacement can be made. Immediately inform the Owner, the Engineer, and the utility company. Provide a written statement of the occurrence within 24 hrs to the Owner and the Engineer.
- E. Where an existing utility, service, equipment, or facility is damaged, the same shall be repaired to its original condition at no cost to the Owner.
- F. The demolition shall be performed as shown on the construction drawings and in conformance with the Contractor's reviewed submittals.
- G. The Contractor shall keep a record of all demolished structures, including information on the location, quantity and state of all demolished material. Upon request, the Contractor shall submit drawings showing the location, orientation, condition, and method of extraction for all demolished piles.
- H. The Contractor shall exercise care when handling and storing existing materials which are called out for temporary removal for the purpose of conducting Contract work. Materials damaged by the Contractor's removal process shall be fixed or replaced at the Contractor's cost.
- I. The Contractor shall coordinate with the Engineer to identify materials to be removed from the project site and saved by the Owner. The contractor shall include the cost of this coordinating with the Owner for handling these materials in the base bid.

SECTION 024000 - DEMOLITION

- J. Dispose and record all extracted material, which is not to be reused or saved by the Owner, off the site in accordance with all Federal, State and local laws and regulations unless otherwise specified elsewhere in the Contract Documents or Plans.
- K. The Contractor is solely responsible for the safety of personnel and terminal property during demolition operations.

- END OF SECTION 024000 -

SECTION 032000 – CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 WORK SPECIFIED

- A. Provide all labor, materials, equipment, and services necessary for furnishing and installing all steel reinforcement, welded steel wire fabric, and accessories for concrete required for the completion of the Work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Reinforcing Steel:
 - a. General Applications: ASTM A615, 60 ksi yield grade billet-steel deformed bars, uncoated finish.
 - b. Welding Applications: ASTM A706, 60 ksi yield grade billet-steel deformed bars, uncoated finish,
- B. Welded Steel Wire Fabric: ASTM A185 plain type; in flat sheets, coiled rolls, uncoated finish.
- C. Stirrup Steel: ASTM A82.

2.02 ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during installation and placement of concrete, including load bearing pad on bottom to prevent vapor barrier puncture.
- C. Chairs, Bolsters, Bar Supports, Spacers Adjacent to Architectural Concrete Surfaces: Plastic tipped-type, sized and shaped as required.

2.03 FABRICATION

- A. Unless otherwise shown or directed, the following minimum concrete cover shall be provided for reinforcement.

	<u>Minimum Cover (inches)</u>
1. Concrete cast against and permanently exposed to earth	3

SECTION 032000 – CONCRETE REINFORCEMENT

- | | | |
|----|---|------|
| 2. | Concrete exposed to earth or weather: | |
| | No. 6 through No. 18 bar | 2 |
| | No. 5 bar and smaller | 1-1½ |
| 3. | Concrete not exposed to weather or in contact with ground | |
| | <u>Slabs, nails, joists:</u> | |
| | No. 14 and No. 18 bars | 1½ |
| | No. 11 and smaller | ¾ |
| | <u>Beams, columns:</u> | |
| | Primary reinforcement, ties, stirrups, spirals | 1½ |
| 4. | Concrete exposed to water or sewerage slabs, walls | 2 |
| 5. | Concrete hooks or development bars | 2½ |
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate the proposed location of splices on the Shop Drawings for approval. Splices shall be staggered such that adjacent bars located in the same plane of reinforcement are not lapped at the same location. The projecting ends of horizontal bars that extend across construction joints shall be furnished at different lengths, such that in no place will laps in adjoining bars occur in the same plane.
- C. Unless noted otherwise, longitudinal reinforcing shall be closed off at end faces and cold joints of all concrete elements by 90 degree bends, U-stirrups, or some other engineer-approved method such that the faces of the element normal to the longitudinal reinforcing are laterally reinforced against cracking. In all cases, the lateral reinforcement shall be adequately developed or lapped with the longitudinal reinforcement. This provision may not apply where longitudinal reinforcing is continued across the plane of construction joints.

PART 3: SUBMITTALS

3.01 GENERAL

The Contractor shall submit the following items, in accordance with Section 013300:

SECTION 032000 – CONCRETE REINFORCEMENT

- A. Shop Drawings that indicate sizes, spacings, locations, and quantities of reinforcing steel, wire fabric, bending and cutting schedules, splicing, stirrup spacing, supporting, and spacing devices.
- B. Mill test certificates of supplied concrete reinforcing indicating physical and chemical analysis.

3.02 WELDING

- A. Only AWS (American Welding Society) qualified welders shall be employed for welding. Submit a Welding Personnel Qualification Record (WPQR), containing all variables listed in AWS Table 6.2, to the Engineer for review at least three (3) weeks prior to using the welder. If the qualification test listed on the WPQR is more than six (6) months old, a detailed employment history and letter must accompany the WPQR to certify that the welder has been engaged in the welding process in question since the date of original qualification.
- B. For each anticipated class of weld, submit Weld Procedure Specifications, containing joint geometries and all variables listed in AWS Table 4.12, to the Engineer for review at least three (3) weeks prior to welding. In general, only Welding Procedures that are prequalified, or have been qualified in accordance with AWS, shall be used.

PART 4: QUALITY ASSURANCE

4.01 REFERENCES

- A. American Concrete Institute (ACI)
 - 1. 301 Specifications for Structural Concrete for Buildings.
 - 2. 315 Details and Detailing of Concrete Reinforcement.
 - 3. 315R Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
 - 4. 318 Building Code Requirements for Reinforced Concrete.
- B. American Society for Testing and Materials (ASTM)
 - 1. A185 Welded Steel Wire Fabric for Concrete Reinforcement.

SECTION 032000 – CONCRETE REINFORCEMENT

2. A615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
 3. A706 Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 3. E329 Recommended Practice for Inspection Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. Concrete Reinforcing Steel Institute (CRSI)
1. CRSI Manual of Practice.
 2. 63 Recommended Practice for Placing Reinforcing Bars.
 3. 65 Recommended Practice for Placing Bar Supports, Specifications and Nomenclature.
- D. American Welding Society (AWS)
1. D1.4 Reinforcing Steel Welding Code for Reinforcing Steel.

4.02 QUALITY CONTROL

- A. Perform concrete reinforcement Work in accordance with referenced Standards.
- B. Welders and Weld Procedure Specifications shall be qualified in accordance with AWS D1.4. Note that personnel qualification to AWS D1.1 alone does not satisfy this requirement.

PART 5: EXECUTION

5.01 INSTALLATION

- A. Before placing concrete, clean reinforcement of foreign particles or coatings.
- B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
- C. Do not displace or damage vapor barrier, if required.

SECTION 032000 – CONCRETE REINFORCEMENT

- D. The Contractor shall follow the requirements of ACI 306R “Cold Weather Concreting” when applicable.
- D. Do not flame-cut rebar.

5.02 WELDING

- A. All welds shall be performed in accordance with AWS D1.4 in accordance with a prequalified or approved qualified Weld Procedure Specification.
- B. Except for tack welding, GMAW shall not be used for welding. When GMAW is used for tack welding, the electrode shall not be deposited by short circuit transfer.
- C. All welding shall be in accordance with AWS D1.4, using low-hydrogen E80XX electrodes, unless noted otherwise on Contract Drawings or specifically approved by the Engineer.
- D. In general, electrodes shall be new, or reconditioned, at the start of each work shift. The Contractor shall strictly adhere to the atmospheric exposure and baking requirements of Table 5.3 of AWS D1.4, and shall provide suitable holding and conditioning ovens onsite, as necessary.
- E. Welds shall not be water quenched.
- F. Field welds shall be permitted only at air temperatures above zero (0) degrees F. When welding, surfaces of pile within 3 inches, laterally and in advance of weld shall be preheated and maintained to the temperature recommended by AWS D1.4. Welding shall not be permitted during rain or snow, or when surfaces are wet.
- G. The Contractor shall be responsible for the adequacy of welds in addition to the service life of the weld. The Contractor shall be responsible for visual inspection and necessary correction of all weld deficiencies in material and workmanship in conformance with AWS D1.4. The Contractor shall maintain records of these visual inspections and submit if requested by the Engineer.
- H. All connections shall be welded unless noted otherwise on the Contract Drawings. Field fabricated members shall be cut to within 1/4” of required dimensions, fitted and welded completely along the perimeter of intersecting members on both sides using a 3/8” fillet weld, unless shown otherwise on the Contract Drawings. No separate measurement or payment will be made for this work.

SECTION 032000 – CONCRETE REINFORCEMENT

- I. The Owner, at his own discretion, may perform visual and ultrasonic testing of up to 20 percent of the welds on the project, using an independent agency. The contractor shall not be compensated for any delays due to the testing of welds. Contractor shall cooperate and provide access to the welds to the testing agency. The Contractor shall correct the deficient welds at no cost to the Owner.

- END OF SECTION -

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SCOPE

- A. Provisions of this section apply to furnishing and placing all cast-in-place cement concrete indicated on the Drawings, described in these Specifications or otherwise required for proper completion of the Work.
- B. This section does not include pre-cast, post-tensioned or pre-stressed concrete work.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Cement & Cementitious Materials
 - 1. ASTM C 150, Portland Cement - Type II except as modified herein. The blended cement shall consist of a mixture of ASTM C 150, Type II, and ASTM C 618 Type F or C pozzolan or fly ash. The pozzolan or fly ash content shall not exceed 25% by weight of the total cementitious material. Use one manufacturer for each type of cement, fly ash, and pozzolan.
- B. Admixtures
 - 1. When required or permitted, use admixtures conforming to the following specifications:
 - a. Air Entertaining - ASTM C260
 - b. Water Reducing, Retarding and Accelerating - ASTM C494.
 - 2. When concrete is to be placed underwater, whether by tremie or another method, an anti-washout admixture shall be included in the concrete mix design to minimize material loss and segregation.
- C. Water
 - 1. Water used in the mix shall conform to the requirements specified in ASTM C1602.
- D. Aggregates

SECTION 033000 - CAST-IN-PLACE CONCRETE

1. Maximum nominal size of aggregate shall be $\frac{3}{4}$ inch, unless stated otherwise on the contract drawings, and shall conform to the requirements specified in ASTM C33. Regard fine and coarse aggregates as separate ingredients. Conform to the appropriate grading requirements for each size of coarse aggregate, as well as the combination of sizes when two or more are used.
- E. Curing Materials
1. Waterproof Sheets
 - a. Conform to the requirements specified in ASTM C171.
 2. Liquid Membrane Forming Compounds
 - a. Conform to the requirements specified in ASTM C309.
- F. Expansion Joint Filler
1. Conform to the requirements specified in ASTM D1751.

PART 3: SUBMITTALS

- 3.01 The Contractor shall submit the following for approval in accordance with the Contract:
- A. Submit shop drawings of proposed construction two (2) weeks prior to fabrication of reinforcement. Shop drawings shall contain the following:
1. Meet requirements of applicable portions of "Details and Detailing of Concrete Reinforcement" by ACI 315, latest edition.
 2. Show bending, assembly, splicing, sizes, bar lengths, and marking of bars. Indicate bar spacing by dimension.
 3. Show reinforcing with necessary details in elevations, sections and plans. Locate sleeves, holes, accessories, and anchors by dimensions.
 4. Furnish prints of approved shop drawings to trades that have items to be embedded in, or connected to concrete work.
- B. Submit a plan showing the location and details of proposed construction joints two (2) weeks prior to fabrication of reinforcement.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- C. Submit data on proposed concrete admixtures thirty (30) days before concrete placement.
- D. Submit Samples of materials as requested by the Engineer, including names, sources, and descriptions.
- E. Submit a brief plan stating the proposed method of pouring and testing concrete, providing details on site access for delivery trucks, staging area, means of conveyance, washout locations, testing and cylinder curing locations, and proposed curing procedures thirty (30) days before concrete placement.
- F. Submit proposed concrete mix design and supporting laboratory test reports for concrete materials and mix design test for approval thirty (30) days before concrete placement. Provide materials certificates in lieu of materials laboratory test reports. Materials certificates shall be signed by the manufacturer and contractor, certifying that each material item complies with, or exceeds specified requirements.
- G. Submit results of strength tests for samples taken at site within ten (10) days after test is completed

PART 4: QUALITY ASSURANCE

4.01 CODES, STANDARDS & PROVISIONS

- A. Comply with the provisions specified in the latest revision of the following ASTM standards, including all supplements and addenda:
 - 1. C31 - Standard Method of Making and Curing Concrete Test Specimens in the Field
 - 2. C33 - Standard Specification for Concrete Aggregates.
 - 3. C39 - Standard Method of Test for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. C94 - Standard Specification for Ready-Mixed Concrete
 - 5. C138 - Standard Method of Test for Unit Weight, Yield, and Air Content (Gravi-metric) of Concrete.
 - 6. C143 - Standard Method of Test for Slump of Portland Cement Concrete.
 - 7. C150 – Portland Cement.

SECTION 033000 - CAST-IN-PLACE CONCRETE

8. C171 - Standard Specification for Sheet Materials for Curing Concrete.
9. C172 - Standard Method of Sampling Fresh Concrete.
10. C173 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method.
11. C192 - Standard Method of Making and Curing Concrete Test Specimens in the Laboratory.
12. C231 - Standard Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
13. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
14. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
15. C494 - Standard Specification for Chemical Admixtures for Concrete.
16. C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolans for Use in Portland Cement Concrete.
17. C685 - Specifications for Concrete Made by Volumetric Batching and Continuous Mixing.
18. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
19. C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
20. D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
21. E329 - Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.

- B. Comply with the provisions specified in the latest revision of the following publications of the American Concrete Institute (ACI):

SECTION 033000 - CAST-IN-PLACE CONCRETE

1. Committee 212 Report - Guide for Use of Admixtures in Concrete.
 2. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
 3. ACI 301 - Specifications for Structural Concrete for Buildings.
 4. ACI 302 - Recommended Practice for Concrete Floor and Slab Construction.
 5. Committee 303 Report - Guide to Cast-In-Place Architectural Concrete Practice, 1974.
 6. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
 7. Committee 304 Report - Placing Concrete by Pumping Methods.
 8. Committee 305 Report - Hot Weather Concreting.
 9. Committee 306 Report - Cold Weather Concreting.
 10. ACI 308 - Recommended Practice for Curing Concrete.
 11. ACI 309 - Recommended Practice for Consolidation of Concrete
 12. ACI 318 - Building Code Requirements for Reinforced Concrete.
 13. ACI 347 - Guide to Formwork for Concrete.
 14. ACI 357R - Design and Construction of Fixed Offshore Concrete Structures
 15. ACI 546.2R - Guide to Underwater Repair of Concrete
 16. SP-19 - Cement and Concrete Terminology (Report of ACI Committee 116).
- C. Comply with the provisions specified in the following:
1. Concrete Plant Manufacturers Bureau: "Concrete Plant Mixer Standards of the Plant Mixer Manufacturers Division", 1970.
 2. National Ready Mixed Concrete Association: Check List for Certification of Ready Mixed Concrete Production Facilities, 1967.

SECTION 033000 - CAST-IN-PLACE CONCRETE

3. American Association of State Highway and Transportation Officials, "Standard Specification for Transportation Materials and Methods of Sampling and Testing". (AASHTO T260-78).

PART 5: EXECUTION

5.01 HANDLING

A. Storage

1. Store cement in weathertight buildings, bins or silos which will exclude moisture and contaminants.
2. Arrange and utilize aggregate stockpiles in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates. To insure that this condition is met, perform any test for determining conformance to requirements for cleanness and grading on samples taken from the aggregates at the point of batching. Do not use frozen or partially frozen aggregates.
3. Allow stockpiles of natural or manufactured sand to drain to ensure a relatively uniform moisture content throughout the stockpile.
4. To prevent excessive variations in moisture content, allow predampened aggregates to remain in the stockpiles for a minimum of 12 hours before use.
5. Store admixtures in such a manner as to avoid contamination, evaporation or damage. For those used in the form of suspensions or non-stable solutions, provide agitating equipment to assure thorough distribution of the ingredients. Protect liquid admixtures from freezing and from temperature changes which would adversely affect their characteristics.

5.02 CONCRETE MIX

A. General

1. Concrete for all parts of the work shall be of the specified quality capable of being placed without excessive segregation and, when hardened, of developing all characteristics required by these specifications.

SECTION 033000 - CAST-IN-PLACE CONCRETE

B. Strength

1. The minimum compressive strength of the concrete shall be as indicated on the drawings.

C. Durability

1. Concrete shall be air-entrained and shall conform to the air content limits of the following table as measured by ASTM C 138 or ASTM C 173 or ASTM C231.

Nominal maximum size of coarse aggregate, in	Size number	Total air content percent by volume
3/8	8	6 - 10
1/2	7	5.5 - 7.5
3/4	67	5 - 7
1	57	4.5 - 6.5
Nominal maximum size of coarse aggregate, in	Size number	Total air content percent by volume
1-1/2	467	4.5 - 6
2	357	4 - 5.5
3	-	3.5 - 4.5

2. Concrete of normal weight shall have a water-cement ratio not exceeding 0.40.
3. For all concrete in which aluminum or galvanized metal is to be embedded, demonstrate by tests that the mixing water of the concrete, including that contributed by the aggregates and admixture used, will not contain a deleterious amount of chloride ion.

D. Slump

1. Except as specified for floors, proportion and produce concrete to have a slump of 4 in. or less if consolidation is to be by vibration, and 5 in. or less if consolidation is to be by methods other than vibration. A tolerance of up to 1 in. above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated. The slump shall be determined by ASTM C 143.

SECTION 033000 - CAST-IN-PLACE CONCRETE

2. If concrete slabs are used, proportion and produce concrete to have a slump of 3 inches or less.
3. A slump of 6 to 9 inches is typically used for concrete that will be pumped or tremie-poured.

E. Aggregate Size

1. The nominal maximum size of the aggregate shall be $\frac{3}{4}$ inch, but shall not exceed one-fifth of the narrowest dimension between sides of forms, one-third of the depth of slabs, or three-fourths of the minimum clear spacing between reinforcing bars.

F. Admixtures

1. Except for air-entraining admixtures, or anti-washout admixtures for underwater placement, do not use admixtures unless specifically approved by the Engineer.
2. When its use is allowed by the Engineer, the amount of calcium chloride shall not exceed 2 percent by weight of cement. Determine the amount of calcium chloride by the method described in AASHTO T260-78.
3. When their use is permitted, use all admixtures in accordance with the manufacturer's instructions except as otherwise specified herein.

G. Proportions

1. Proportion the ingredients so as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the work, but without permitting the materials to segregate or excessive free water to collect on the surface.
2. Use of the proposed mixture proportions shall be subject to approval by the Engineer based on their demonstrated ability to produce concrete meeting all requirements of the specifications. Determine ability to produce the required average strength on the basis of the strength test record of 30 or more tests made during the past 24 months from a similar mix, representing similar materials and conditions to those expected, in accordance with section 5.3 of ACI 318.

SECTION 033000 - CAST-IN-PLACE CONCRETE

The strength test history used to determine standard deviation will be considered to comply with the above requirement for 30 consecutive strength tests if the tests represent either a group of 30 consecutive batches of the same class of concrete or the statistical average for two groups totaling 30 or more batches. The tests used in establishing the standard deviation shall represent concrete produced for a specified strength or strengths within 1000 psi of that required for the proposed work; changes in materials and proportions within the population of background tests shall not have been more closely restricted than will be the case for the proposed work.

H. Temperature

1. The temperature of concrete to be placed shall not exceed 90 degrees F.
2. The temperature of concrete to be placed in cold weather shall conform to the requirements of the following table.

Nominal Section Size, in	Minimum Concrete Temperature, as placed, F
<12	55
12-36	50
36-72	45
>72	40

3. The temperature of ready-mix concrete shall be determined in accordance with ASTM C 1064.

5.03 PRODUCTION OF CONCRETE

- A. Batch, mix and transport ready-mixed concrete in accordance with ASTM C94, except as otherwise specified herein. Plant equipment and facilities shall conform the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.
- B. Batch and mix concrete produced by on-site volumetric batching and continuous mixing in accordance with and conforming to all requirements of ASTM C 685.
- C. Charge air-entraining admixtures, calcium chloride, and other chemical admixtures into the mixer as solutions and measure by means of an approved mechanical dispensing device. Consider the liquid a part of the mixing water. Admixtures that cannot be added in solution may be

SECTION 033000 - CAST-IN-PLACE CONCRETE

weighed or may be measured by volume if so recommended by the manufacturer.

- D. If two or more admixtures are used in the concrete, add them separately to avoid possible interaction that might interfere with the efficiency of either admixture or adversely affect the concrete.
- E. Complete the addition of retarding admixtures within 1 minute after addition of water to the cement has been completed, or prior to the beginning of the last three-quarters of the required mixing, whichever occurs first.
- F. Mix concrete only in quantities for immediate use. Do not re-tamper concrete which has partially set.
- G. When concrete arrives at the project with slump below that suitable for placing, as indicated by the specifications, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. Incorporate the water by additional mixing equal to thirty revolutions or more, if necessary, at mixing speed. Water shall not be added to the batch at any later time.
- H. Cold Weather
 - 1. Comply with the applicable requirements of "Cold Weather Concreting", ACI 306.
 - 2. Do not place concrete if temperature is below 40 degrees F, except with specific approval. For concrete placed or cured below 40 degrees F, provide heat, insulation and moisture to maintain concrete temperature and curing conditions as recommended by ACI 306.
 - 3. Do not use frozen materials, or materials containing ice. Do not allow concrete to come into contact with frost.
- I. Hot Weather
 - 1. Comply with the applicable requirements of "Hot Weather Concreting", ACI 305.
 - 2. Cool the ingredients before mixing.
 - 3. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water

SECTION 033000 - CAST-IN-PLACE CONCRETE

if, due to high temperature, low slump, flash set or cold joints are encountered.

4. Reduce concrete temperatures to prevent rapid evaporation of water in hot weather.

5.04 PREPARATION BEFORE PLACING

- A. Remove hardened concrete and foreign materials from the inner surfaces of the conveying equipment.
- B. Complete the formwork and remove snow, ice, frost, water, dirt or other foreign materials.
- C. All material that is to come in contact with the fresh concrete, including formwork, reinforcement and inserts, must be at a temperature above 32 Degrees Fahrenheit at the time the concrete is poured, in accordance with ACI 306 "Cold Weather Concreting".
- D. Place all sleeves, inserts, anchors and embedded items including reinforcing bars. Approved bar chairs shall be used where required to vertically position reinforcing bars. The use of large aggregate or brick will not be permitted to provide clearance between the formwork and reinforcing steel.
- E. Give ample notice and opportunity to Engineer before starting to place concrete in any unit of the structure to permit proper inspection of forms and reinforcement by the Engineer.
- F. Give ample notice and opportunity to all other contractors whose work is related to or supported by the concrete to furnish embedded items before the concrete is placed.
- G. Sprinkle semiporous subgrades sufficiently to eliminate suction, and seal porous subgrades in a manner approved by the Engineer.
- H. Do not place concrete on frozen ground or fill material, or on subgrades containing frost.

5.05 CONVEYING

- A. Convey concrete from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- B. Use conveying equipment which is approved by the Engineer and of a size and design such that detectable setting of the concrete does not occur before adjacent concrete is placed.
- C. Clean conveying equipment at the end of each operation or work day.
- D. For truck mixers, agitators and non agitating units, conform to the applicable requirements of ASTM C94.
- E. For belt conveyors, use units which are horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Protect concrete against undue drying or rise in temperature. Use an arrangement approved by the Engineer at the discharge end to prevent apparent segregations. Do not allow mortar to adhere to the return length of the belt. Discharge long runs into a hopper or through a baffle.
- F. For chutes, use metal or metal lined equipment having a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 ft. long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
- G. For pumping or pneumatic conveying, use equipment of suitable kind with adequate pumping capacity, and pump the concrete directly to the structure with no intermediate transfer points.
 - 1. Do not convey concrete through pipe made of aluminum or aluminum alloy.
 - 2. Control pneumatic placement so that segregation is not apparent in the discharged concrete.
 - 3. When concrete is being conveyed to the pump by delivery trucks, the Contractor shall test the slump and entrained air of the first batch of concrete on each shift in which concrete will be poured. Tests will be conducted on the concrete being discharged from the truck into the pump, and on the concrete being discharged from the end of the pumping line at the point of final placement. These tests shall be performed at no additional cost to the Owner.
 - a. The loss of slump due to the pumping or pneumatic conveying of concrete shall not exceed 3 inches. Concrete exhibiting larger slump losses, or a resulting slump outside the specified range shall not be accepted.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- b. The loss of entrained air due to the pumping or pneumatic conveying of concrete shall not exceed 5%. Concrete with a resulting air entrainment below the specified range shall not be accepted.
- 4. The Contractor shall ensure that pump and pipeline washout-blowout procedures are performed safely and cleanly to prevent personnel injury and to prevent concrete contact with river water or other natural environments.

5.06 PLACING CONCRETE

- A. Deposit concrete continuously, or in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, locate construction joints as shown on the drawings or as approved by the Engineer.
- B. Deposit concrete at such a rate that the concrete which is being integrated with fresh concrete is still plastic.
- C. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
- D. Remove temporary spreaders in forms when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete, and if prior approval has been obtained from the Engineer.
- E. Do not begin placing of concrete in supported elements until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.
- F. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Do not subject the concrete to any procedure which will cause segregation.
 - 1. Do not allow concrete to drop free more than four feet. Where greater drops are required use a tremie or "elephant's trunk". Control the discharge of such devices so that the concrete can effectively be compacted in horizontal layers not more than 12 inches thick. Space the devices such that excessive segregation does not occur.
- G. Consolidate all concrete by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around

SECTION 033000 - CAST-IN-PLACE CONCRETE

embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Use international vibrators of the largest size and the most powerful that can be properly used in the work, as described in Table 5.1.4 of ACI 309. They shall be operated by competent workmen. Do not use vibrators to transport concrete within forms. Insert vibrators and withdraw at points approximately 18 in. apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 seconds. Keep a spare vibrator on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, bring a full surface of mortar against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

- H. Unless adequate protection is provided, do not place concrete during rain, sleet or snow.
- I. Do not allow rainwater to increase the mixing water or damage the surface finish.
- J. The temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90F. When the temperature of the concrete exceeds 90 F, use precautionary measures approved by the Engineer. When the temperature of steel forms is greater than 120 F, spray steel forms and reinforcement with water just prior to placing the concrete.
- K. When required or permitted, deposit concrete underwater by an approved method in such a way that the fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at the surface of the concrete.

A tremie pipe (8 to 12 inches in diameter) shall be used to deposit the concrete. The tremie pipe shall be water tight. No water shall be allowed to enter the tremie pipe. The tremie pipe shall be sealed and lowered into the base of the formwork and filled with concrete. The tremie shall be raised no more than 6 inches off the bottom to break the seal and initiate the flow of concrete. The end of the tremie pipe shall remain embedded in the fresh concrete from 3 to 5 feet after pouring is started. The tremie pipe shall be lifted slowly to avoid disturbance to the concrete. Concrete placement shall be as continuous as possible through each tremie.

The tremie pipe must remain fixed horizontally while concrete is flowing. Horizontal movement of the pipe will damage the surface of concrete already in place. Horizontal distribution of the concrete is accomplished by halting placement, moving the pipe, reestablishing the seal and

SECTION 033000 - CAST-IN-PLACE CONCRETE

resuming placement. A tremie pipe injection point spacing of 2 to 3 times the depth of concrete shall be used.

- L. After the introduction of the mixing water to the cement and aggregates, each batch of concrete will be discharged within 1.5 hours, or before the mixing drum has completed 300 revolutions, whichever comes first.
 - 1. These limitations may be waived by the Owner, or Engineer, if, after the limits stated above, the concrete slump remains sufficient to allow it to be placed without the addition of water to the batch.
 - 2. These limitations may reduced by the Owner, or Engineer, if hot weather, or other conditions that may contribute to rapid stiffening of the concrete mix, are present.
- M. Provide all material, manpower and equipment necessary for the safe washout and cleaning of all concrete-related equipment, including trucks, pumps, pipes, and forming tools. Dispose of all hardened washout concrete. Rivers and other aquatic environments shall not be used for washout or cleaning.

5.07 CONSTRUCTION JOINTS

- A. Make construction joints only as shown on the Drawings, or as approved by the Engineer.
- B. Locate joints not shown on the Drawings only as approved by the Engineer. Locate those joints as least to impair the strength of the structure. In general, locate construction joints near the middle of the spans of slabs, beams and girders. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs. Place beams, girders, brackets, column capitals, haunches and drop panels at the same time as slabs. Make joints perpendicular to the main reinforcement.
- C. Continue reinforcement across joints unless shown otherwise on the drawings.
- D. Provide keys and inclined dowels as directed by the Engineer.
- E. For all transverse and longitudinal construction joints, provide a keyway 2 inches deep by 4 inches wide with a rubber dumbbell-type waterstop.
- F. Clean the surface of concrete at all joints and remove all laitance before placing adjoining concrete.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- G. Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.
- H. Obtain bond by one of the following methods:
 - 1. The use of an approved adhesive. Prepare and apply adhesive to joints receiving an adhesive in accordance with the manufacturer's recommendations.
 - 2. The use of an approved chemical retarder which delays but does not prevent setting of the surface mortar. Remove mortar within 24 hours after placing to produce a clean exposed aggregate bonding surface. Prepare surfaces of joints to be treated in accordance with the manufacturer's recommendations.
 - 3. Roughening the surface of the concrete in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.
 - 4. Dampen (but do not saturate) the hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below immediately prior to placing of fresh concrete.
 - 5. For horizontal construction joints in exposed work; horizontal construction joints in the middle of beams, girders, joists and slabs; and horizontal construction joints in work designed to contain liquids, dampen (but do not saturate) the hardened concrete and thoroughly cover the joint with a coat of cement grout of similar proportions to the mortar in the concrete. Place the fresh concrete before the grout has attained its initial set.

5.08 EMBEDDED ITEMS

- A. Expansion Joints - Do not extend reinforcement or other embedded metal items bonded to the concrete (except dowels in slabs bonded on only one side of joints) continuously through any expansion joint.
- B. Position expansion joint material, waterstops and other embedded items accurately, and support them against displacement. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent the entry of concrete into the voids.

5.09 SLABS

SECTION 033000 - CAST-IN-PLACE CONCRETE

- A. Set edge forms and intermediate screed strips accurately to produce the designated elevations and contours of the finished surface, and construct them sufficiently strong to support vibrating screeds or roller pipe screeds if the nature of the finish specified requires the use of such equipment. Align the concrete surface to the contours of screed strips by the use of strike-off templates or approved compacting type screeds.
- B. Carefully coordinate mixing and placing with finishing. Do not place concrete on the subgrade or forms more rapidly than it can be spread, straightened, and darried or bull floated. These operations must be performed before bleeding water has an opportunity to collect on the surface.
- C. To obtain good surfaces and avoid cold joints, plan the size of finishing crews with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete.
- D. If saw-cut joints are required or permitted, time cutting properly with the set of the concrete: start cutting as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and complete before shrinkage stresses become sufficient to produce cracking.
- E. Thoroughly consolidate concrete in slabs. Use internal vibration in beams and girders of framed slabs and along the bulkheads of slabs on grade. Obtain consolidation of slabs with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

5.10 FINISHES

- A. Provide the following finishes as applicable and in accordance with ACI 301 unless specified otherwise herein or shown otherwise on the Drawings:
 - 1. Smooth Form Finish - for all formed concrete surfaces.
 - 2. Broom or Belt Finish - for sidewalks, driveways, ramps and exterior platforms.
 - 3. Provide smooth form finish where type of finish is not certain from above.
- B. Smooth Form Finish - Use form facing materials which produce a smooth, hard, uniform texture on the concrete. it may be plywood, tempered

SECTION 033000 - CAST-IN-PLACE CONCRETE

concrete-form-grade hardboard, metal, plastic, paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. Support it with studs or other backing capable of preventing excessive deflection. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface. Patch tie holes and defects. Completely remove all fins.

- C. Broom or Belt Finish - First, float finish the surface as described above. Do not trowel. Give the surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

5.11 TOLERANCES

- A. Tolerance in finished elevation shall be $\frac{1}{4}$ inch per 100 feet of length. This tolerance is non additive.
- B. Produce formed surfaces which result in concrete outlines within the tolerances of applicable standards.
- C. Depressions in slabs between high spots shall not be greater than $\frac{3}{16}$ in. below a 10 ft. long straightedge.

5.12 CURING

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury, and maintain the concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete.
- B. For concrete surfaces not in contact with forms, apply one of the following procedures immediately after completion of placement and finishing:
 - 1. Ponding or continuous sprinkling.
 - 2. Application of absorptive mats or fabric kept continuously wet.
 - 3. Application of sand kept continuously wet.
 - 4. Continuous application of steam (not exceeding 150F) or mist spray.
 - 5. Application of waterproof sheet materials conforming to ASTM C171.

SECTION 033000 - CAST-IN-PLACE CONCRETE

6. River water and other non-potable water sources shall not be acceptable for use in curing.
 7. Application of a curing compound conforming to ASTM C309. Apply the compound in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications. Minimize moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun by keeping the forms wet until they can be safely removed. After form removal, cure the concrete for at least seven days.
- C. Cold Weather - When the mean daily outdoor temperature is less than 40 F, maintain the temperature of the concrete between 50 and 70 F for seven days. When necessary, make arrangements for heating, covering, insulating, or housing the concrete work in advance of placement and maintain the required temperature without injury due to concentration of heat. Do not use combustion heaters during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.
- D. Hot Weather - When necessary, make provision for windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material in advance of placement, and take such protective measures as quickly as concrete hardening and finishing operations will allow.
- E. Rate of Temperature Change - Keep changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period as uniform as possible and do not exceed 5 F in any 1 hour or 50 F in any 24 hour period.
- F. During the curing period, protect the concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. Protect all finished concrete surfaces from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Do not load self-supporting structures in such a way as to overstress the concrete.
- G. Proper curing methods shall be maintained, including curing methods for side faces once forms are stripped, for a minimum of seven (7) days.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- H. No external loads shall be applied to the concrete until seven (7) days after concrete is cast.
- I. No piles shall be driven or vibrated within fifty feet (50 ft) of new concrete until seven (7) days after concrete is cast.

5.13 REPAIR OF SURFACE DEFECTS

- A. Repair surface defects, including tie holes immediately after form removal.
- B. Remove all honeycombed and other defective concrete down to sound concrete. If chipping is necessary, form the edges perpendicular to the surface or slightly undercut. No feathered edges will be permitted. Dampen the area to be patched and an area at least 6 in. wide surrounding it to prevent absorption of water from the patching mortar. Prepare a bonding grout using a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface.
- C. Make the patching mixture of the same materials and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2 1/2 parts sand by damp loose volume. Substitute white portland cement for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete as determined by a trial patch. Use no more mixing water than necessary for handling and placing. Mix the patching mortar in advance and allow it to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.
- D. After surface water has evaporated from the area to be patched, brush the bond coat well into the surface. When the bond coat begins to lose the water sheen, apply the premixed patching mortar. Consolidate the mortar.
- E. After cleaning and thoroughly dampening the tie holes, fill them solid with patching mortar.
- F. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Use such compounds in accordance with the manufacturer's recommendations.

5.14 TESTING

SECTION 033000 - CAST-IN-PLACE CONCRETE

- A. Concrete materials and operations will be tested and inspected as the work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered, nor shall it obligate the Engineer for final acceptance.
- B. Additional testing and inspection required by failure to meet specification requirements or by changes in materials or proportions requested by the Contractor shall be paid for by the Contractor.
- C. Testing of concrete for mix design purposes shall be paid for by the Contractor.
- D. All testing agencies shall meet the requirements of ASTM E 329.
- E. Contractor shall engage an independent field and laboratory testing agency to perform all test required by the Contract Documents.
- F. To facilitate testing and inspection,
 - 1. Furnish any necessary labor to assist the designated testing agency in obtaining and handling samples at the project or other sources of materials.
 - 2. Advise the designated testing agency sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.
 - 3. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test cylinders on the project site for the first 24 hours as required by ASTM C 31.
- G. The first batch of concrete to be poured during a shift shall have its air content, slump and temperature tested, prior to initiating a pour, and will be rejected if values outside accepted ranges are obtained.
- H. One strength test sampling shall be randomly taken from each 50 cu. yds. of concrete poured in a given shift. A minimum of five (5) strength test samplings shall be performed on randomly selected batches for each class of concrete on the project. If fewer than five (5) batches of concrete are used, strength test sampling shall be performed on each batch. If the total quantity of a given class of concrete is less than 50 cu. yds., strength tests may be waived at the engineer's discretion.
- I. A strength test sampling shall consist of enough cylinders to perform a minimum of two strength tests, as defined below in 5.14.I.1. All strength

SECTION 033000 - CAST-IN-PLACE CONCRETE

test sampling shall be performed in accordance with ASTM C-172. Cylinders will be made and cured in accordance with ASTM C-31 and tested in accordance with ASTM C-39.

1. A valid strength test shall consist of the breaking of a minimum of two (2) 6"x12" concrete cylinders, or three (3) 4"x8" concrete cylinders. At a minimum, strength tests shall be performed after seven (7) days and twenty-eight (28) days.
2. Additional test cylinders may be taken at the time of sampling, at the Engineer's or Contractor's discretion, in order to:
 - a. Perform an additional strength test after less than seven (7) days for consideration of form removal.
 - i. Forms shall not be removed until the concrete has achieved at least 70% of the design strength.
 - b. Perform an additional strength test after fourteen (14) days for evaluation of strength gain.
 - c. Perform an additional strength test after either seven (7) days or twenty-eight (28) days to confirm those strength tests results.
 - d. Perform an additional strength test after forty-five (45) days should the twenty-eight (28) day strength test results be below the specified strength.
 - e. Allow for the discarding of outlying strength results for any strength test, in accordance with ACE 214R.
 - f. Perform strength tests of cylinders cured under field conditions to demonstrate the adequacy of the curing and protection undertaken in the field.
 - i. The strength test results of field-cured cylinders will not be used for evaluation and acceptance of the concrete strength. However, a field-cured strength test that results in less than 85% of the strength of companion laboratory-cured cylinders will necessitate the improvement of field protection and curing procedures. This 85% limitation will not apply if the field-cure strength exceeds the specified compressive strength by more than 500 psi.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- ii. No additional compensation will be allowed to accommodate the requirement to perform the additional sampling and testing under this provision, and to improve field curing and protection procedures as necessary.

- J. The air content, temperature, and slump of the concrete shall be measured for each strength test sampling performed. All sampling shall be performed in accordance with ASTM C 172.
 - 1. These properties tests may be conducted more frequently than the test strength sampling, and may be performed on every arriving batch prior to its placement, at the Engineers discretion.
 - 2. If the measured slump, or air content, or both are found to be *above* the specified upper limit, a check test shall be immediately performed on a fresh sample. If the check test fails, the concrete shall be considered to have failed the requirements of this specification, and shall be rejected.
 - 3. If the measured slump, or air content, or both are found to be *below* the specified upper limit, adjustments shall be permitted in accordance with ASTM C 94. If the adjusted concrete subsequently fails, a check test shall be immediately performed on a fresh sample. If the check test fails, the concrete shall be considered to have failed the requirements of this specification, and shall be rejected.

- K. All concrete testing, whether properties testing or strength test sampling, shall be conducted on concrete at the point of placement. The Contractor shall take all necessary measures to efficiently and safely allow the representative of the testing agency to take samples at the point of placement. No additional compensation will be allowed to accommodate this requirement.

- L. Representatives of the testing agency will inspect, sample and test the materials and the production of concrete as required by the Engineer. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Engineer and the Contractor.

- M. The testing agency will report all test and inspection results to the Engineer and Contractor immediately after they are performed. All test reports will include the exact location in the work at which the batch represented by a test was deposited. Reports of strength tests will

SECTION 033000 - CAST-IN-PLACE CONCRETE

include detailed information on storage and curing of specimens prior to testing.

- N. The testing agency and its representatives are not authorized to revoke, alter, relax, enlarge or release any requirement of the contract documents, nor to approve or accept any portion of the work.

5.15 EVALUATION AND ACCEPTANCE

- A. Test results for standard molded and standard cured test cylinders will be evaluated separately for each portion of the structure.
- B. The strength level of the concrete will be considered satisfactory so long as the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi, or one tenth the specified strength, whichever is greater.
- C. Completed concrete work which meets all applicable requirements will be accepted without qualification.
- D. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring into compliance will be accepted without qualification.
- E. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance as determined by the Engineer may be accepted or rejected. Remove and replace (at Contractor's expense) all concrete work rejected by the Engineer.
- F. Formed surfaces resulting in concrete outlines smaller than permitted by the allowable tolerances shall be considered potentially deficient in strength and subject to the requirements stated below for concrete of deficient strength.
- G. Formed surfaces resulting in concrete outlines larger than permitted by the allowable tolerances may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance.
- H. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or misplaced items interfere with other construction.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- I. Inaccurately formed concrete surfaces exceeding the limits of applicable standards and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.
- J. Finished slabs exceeding the tolerances of this section may be repaired provided that strength, durability or appearance is not adversely affected. High spots may be removed with a terrazzo grinder, low spots filled with a patching compound or other remedial measures performed as permitted.
- K. Concrete with defects which adversely affect the appearance of the specified finish may be repaired, if possible. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete may be either accepted or rejected.
- L. Concrete not exposed to view is not subject to rejection for defective appearance, except in those cases where concrete finish is specified.
- M. The strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions.
 - 1. Low concrete strength.
 - 2. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements of the contract drawings.
 - 3. Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.
 - 4. Curing less than that specified.
 - 5. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - 6. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
 - 7. Poor workmanship likely to result in deficient strength.
- N. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.
- O. Core tests may be required when the strength of the concrete in place is considered potentially deficient.

SECTION 033000 - CAST-IN-PLACE CONCRETE

- P. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with Chapter 20 of ACI 318.

- Q. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction if so directed by the Engineer, or shall be replaced at the Contractor's expense.

- END OF SECTION -

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1: GENERAL

1.01 SCOPE

- A. The provisions of this section are applicable to all the structural steel, miscellaneous metal work, and steel items required to complete the work as shown and specified in the contract documents.
- B. The provisions of this section shall not apply to stainless steel pipe and tube railings.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Plates, Shapes and Bars
 - 1. All structural steel shapes and bars, except wide flange and HP shapes, shall be purchased under the requirements of ASTM A36 "Standard Specification for Structural Steel," unless noted otherwise. Wide flange shapes shall conform to ASTM A992, GR-50. HP shapes shall conform to ASTM A572, GR-50.
 - 2. Plates shall be produced from cut lengths of flat product. Plates produced from coil are specifically disallowed. Plates shall be purchased oversized and cut to fabricated dimensions or purchased with sheared, gas, or plasma cut edges in exact sizes. Mill edge plates are not to be used in fabrication. Plates, shapes, and bars shall meet the dimensional requirement of ASTM A6.
- B. Structural Steel Tubing
 - 1. Structural Steel tubing shall be purchased under the requirement of ASTM A 500. Tensile requirements for square and rectangular tubing shall meet the requirements of Grade B (46 ksi minimum yield).
- C. Pipe
 - 1. Structural steel pipe shall be purchased under the requirements of ASTM A 53 Grade B, unless otherwise noted on the drawings.
- D. Grating.
 - 1. Bar Grating

SECTION 051200 - STRUCTURAL STEEL FRAMING

- a. Grating shall be as noted on Contract Drawings. Grating shall be ADA compliant and finished with a non-skid surface.
- b. Banding of grating edges not required, unless noted on Contract Drawings. However, provide load-carrying bands at all openings through grating. Grating panels shall be attached to the supporting structure by welding or using anchor and/or clamp assemblies. If welded, use 2 in. of 3/16-in. fillet weld at maximum 12 in. on centers. If using clips, the spacing of attachment clips shall not exceed two (2) feet and there shall be no less than six (6) clip assemblies in any one piece of grating.

E. Ladders

1. Unless otherwise noted on Contract Drawings, vertical ladders shall be fabricated using 3 1/2"x 1/2" side rails (with eased edges) spaced on eighteen (18) inch centers with 1" round bar rungs spaced on twelve (12) inch centers. Vertical ladders of more than twenty-four (24) feet in height shall have back cages installed beginning between seven and eight feet above the walkway or base elevation and extending to the upper extent of the vertical ladder stringers. The back cages shall be of form and construction to meet applicable OSHA requirements. Stringers shall extend above the top rung of the vertical ladders at least forty-two (42) inches to provide an adequate hand hold for entry and exit from the ladder, unless noted otherwise. Where required for safety, additional 1" square bar grip rungs shall be provided on adjacent structure to facilitate safe and convenient access to the vertical ladder. Support each ladder at top and bottom and at intermediate points where shown by means of welded or bolted steel brackets clear of the wall surface by not less than seven (7) inches.

F. Handrails

1. Handrails are to be formed of round HSS with mesh infill panels, in the style and position shown on the drawings.
2. Portable safety chain type rails are to be installed at all openings in the handrail perimeter. The chain rails are to be fabricated of 1/4" hot dipped galvanized chain. Attachments are to be welded 1/4" round bar eyelets at one end, and fitted with chain hooks with spring loaded safety clasp at the other end. The chain hooks are to attach to 1/4" round bar eyelets welded to the handrail stanchion.

SECTION 051200 - STRUCTURAL STEEL FRAMING

3. All handrail material shall be SS 316.

G. Bolts, Threaded Rods, Nuts, and Washers

1. All bolts, anchors, and threaded rods that are not a portion of vendor-furnished equipment packages shall be purchased under the following ASTM Designations, as indicated in the design drawings: ASTM A307, ASTM A325, ASTM A449, ASTM A490, ASTM A193, or ASTM F1554. Nuts shall conform to ASTM A563, and washers shall conform to ASTM F436, unless the grade of bolt, anchor or threaded rod calls for matching nuts and washers from another specification. Where necessary, bolts may be purchased under the equivalent SAE specification of grade eight (8) if mechanical properties are shown to be equivalent. Bolts that are a part and/or accessory to vendor-purchased items shall meet the manufacturer's requirements as modified by special protective coating stipulations in this specification.
2. All bolts shall be of the size indicated on the contract and detail drawings and shall be UNC coarse thread series. Nuts shall be heavy hex series and fitted with hardened washers, lock washers, and/or other washers as indicated on the drawings.
3. All bolts nuts, and threaded holes in structural steel shall be thoroughly cleaned of any foreign matter including machining chips and oil before the bolts are installed. The threaded portion of the bolt to engage with the nut and/or the threaded steel shall be coated with a thread locking compound suitable for disassembly with hand tools
4. All bolts in slip-critical connections shall be tensioned to seventy (70) percent of the minimum tensile strength of the bolts using the turn of the nut method, or an accurately calibrated torque wrench. Torque shall be applied to the bolts immediately after the application of the thread-locking compound. Bolts that are found to be under the required torque value shall be removed, thoroughly cleaned, and reinstalled with another application of thread locking compound.
5. Impact wrenches, or other tools whose torque is not easily controlled, shall not be used without the written permission of the engineer.
6. Bolts that have been torqued with a calibrated wrench shall be marked with a semi-permanent marker to indicate that they have been tightened to specified value.

SECTION 051200 - STRUCTURAL STEEL FRAMING

7. The bolts, nuts, and washers are to receive the same surface preparation and protective coating systems as the surrounding steel unless otherwise noted on the drawings or in the specification. Note that hot dipped galvanized bolts, nuts, washers, screws, and other similar items are to be used in conjunction with grating, and sheet metal that is specified to be hot dipped galvanized.

PART 3: SUBMITTALS

3.01 The Contractor shall submit the following items in accordance with Section 013300, Submittal Procedures.

A. SUBMITTALS FOR REVIEW

1. Shop Drawings: Submit shop drawings for review prior to fabrication. Do not start fabrication until review of shop drawings by the engineer is complete. Prepare drawings in accordance with the latest edition of the AISC manual "Structural Steel Detailing" and including complete details, sections, materials, fabrication, assembly, and erection requirements, procedures and diagrams.
 - a. Indicate welds by standard AWS A2.1 and A2.4 symbols, and show size, length and type of each weld.
 - b. Provide setting drawings, templates and directions for installation of anchor bolts or other anchorages.
 - c. Include diameters of bolt holes, types, sizes and strengths of bolts; yield strength of steel; shop and field welding details; arc-welding electrode designation; and manufacturer's name, color, and number of coats of shop paint.
 - d. Include erection diagrams showing elevations and cross sections which will locate all members by piece mark and provide essential dimensions and necessary erection information.
 - e. Design all connections not shown on the contract drawings as per the AISC manual. Account for eccentricity in all connection designs.
 - f. Prohibit direct reproduction of the Contract Drawings for use as Shop drawings.

SECTION 051200 - STRUCTURAL STEEL FRAMING

2. Test Reports: Assist independent testing agency in submitting reports of inspections and testing of structural steel.
 - a. Furnish the testing agency with the fabrication plant's schedule, in order for appropriate inspections to be accomplished.
 - b. Request the testing agency to conduct both visual inspections and torque sampling of mill-fabricated connections, at the rate of one test and sampling for each 50 tons of steel fabricated.
3. Manufacturer's Mill Certificate: The Fabricator is required to obtain mill certificates from the supplier for all structural steel and furnish copies of the certificates to the Construction Manager and/or Engineer prior to fabrication. Mill Certificates shall properly account for all project steel, and shall be accompanied by an inventory list that provides the quantities and lengths of the steel in each supplied heat.
4. Weld & Welder Qualification Documents (See Section 5.06 of this specification for more details):
 - a. Only AWS (American Welding Society) qualified welders shall be employed for welding. Submit a Welding Personnel Qualification Record (WPQR), to the Engineer for review at least three (3) weeks prior to using the welder.
 - c. For each anticipated class of weld, submit Weld Procedure Specifications (WPS) to the Engineer for review at least three (3) weeks prior to welding.
5. Bolt tensioning procedures for snug, pretensioned, and slip-critical bolts, including methods, equipment, and torque values.
6. Submit samples of materials as requested by the engineer, including names, sources, and description.

PART 4: QUALITY ASSURANCE

4.01 REFERENCE

SECTION 051200 - STRUCTURAL STEEL FRAMING

- A. Comply with the requirements of the latest edition of the following standards (including all supplements and addenda), unless noted otherwise:
1. AISC (American Institute of Steel Construction):
"Steel Construction Manual"
"Specification for Structural Joints Using High-Strength Bolts"
"Code of Standard Practice for Steel Buildings and Bridges".
 2. AWS (American Welding Society):
"Structural Welding Code-Steel" (AWS D1.1)
"Welding Zinc-Coated Steel" (AWS D19.0)
Other Applicable Standards
 3. BOCA (Basic Building Code)
 4. ASTM (American Society for Testing and Materials):
Applicable Referenced Specifications.
 5. OSHA (Occupational Safety and Health Administration):
As required by State and Federal Regulations.
- B. Where provisions of pertinent codes and standards conflict with these specifications, more stringent provisions shall govern.

4.02 QUALIFICATIONS

- A. Steel Fabricator shall be a member of the American Institute of Steel Construction or can further demonstrate at least ten (10) years of qualified experience, subject to the approval of the Engineer.
- B. Qualify welding procedures, welders and welding operators in accordance with AWS D1.1. See Section 5.06 of this specification for further details.
- C. Fabricate structural steel members in accordance with AISC Code of Standard Practice.
- D. Maintain one copy of each document on site.
- E. Erector: Company specializing in performing the work of this section with a minimum of 5 years documented experience.

SECTION 051200 - STRUCTURAL STEEL FRAMING

- F. Design connections not detailed on the drawings under direct supervision of a professional structural engineer experienced in design of this work and licensed in the State of **Pennsylvania**.
- G. An independent testing laboratory may be employed by the Owner for the final detailed inspection of the work under this section. The Engineer may also elect to undertake this work. In either case, the following items apply:
1. The testing agency (or Engineer) will inspect materials, workmanship, field welds, bolts and bolt tension and projection of bolt threads. The testing agency will follow specified and applicable AISC criteria and the inspection procedures specified in the "Specifications For Structural Joints Using ASTM A-325 or A-490 Bolts" for checking Hi-Tensile Bolt installation. Materials and workmanship not conforming to drawings and established standards of these specifications and/or references will be rejected by the Owner and shall be corrected at Contractor's expense.
 2. The Contractor shall allow access for such testing at all times.
 3. Testing on behalf of the Owner shall not relieve the Contractor of responsibility to comply with the provisions of these specifications.
- H. Inspection of material and workmanship in mill and shop, if required, will be performed by the Owner without expense to the Contractor, except as otherwise described in these Specifications. Contractor shall provide access to all areas of work to allow inspection as may be determined necessary by the Owner and Engineer. In either case, whether the Owner decides to require or omit Laboratory inspection in the shop, this shall not relieve the Contractor of the responsibility of providing and erecting steel in full accordance with the Specifications. Any steel not conforming may be rejected by the Engineer at any stage of construction, and shall be repaired or replaced by the Contractor, as required to satisfy all Contract requirements, all without additional cost to the Owner.

PART 5: EXECUTION

5.01 FABRICATION

- A. Fabricate items of structural steel in accordance with AISC Specifications and as indicated on the approved Shop Drawings. Provide camber in structural members as shown.

SECTION 051200 - STRUCTURAL STEEL FRAMING

- B. Properly mark and match-mark materials for field assembly and for identification as to structure and site for which intended. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.
- C. All fabricated members shall have shop marks matching the member designations on the approved shop drawings. Any finished members arriving onsite that are unlabeled, or do not match the approved shop drawings, shall be rejected.
- D. Furnish main steel members in one piece without splicing, unless otherwise noted on Contract Drawings or approved by the Construction Manager.
- E. Exclude bolt threads from shear planes in bearing type connections using high-strength bolts.
- F. Provide either welded or bolted shop connections, except as noted on Contract Drawings. Provide bolted or welded field connections at contractor's option, except as noted on Contract Drawings.
- G. Remove all cracks, porosities, spatter, slag inclusions, incomplete fusions, and incomplete penetrations over ½ in. long in any 12 in. length of weld, and reweld as required.
- H. Mill ends of columns and other members in direct bearing.
- I. Contractor to verify all existing dimensions and elevations before fabrication. The completed structure shall be dimensionally accurate to the extent that parts shall move and function freely without unnecessary strain, wear, vibration or deflections.
- J. In regard to items not indicated on the drawings or referenced in the specifications or contract, the requirements of the Code of Standard Practice for Steel Buildings and Bridges as contained in the AISC Manual of Steel Construction – Thirteenth Edition shall be applicable.
- K. General dimensional tolerances not specified on the drawings shall meet the requirements of the Code of Standard Practice referenced above. Dimensional tolerances for fitting at joints to be welded shall meet the requirements of AWS D1.1 for pre-qualified and/or Fabricator-qualified welding procedures.
- L. All workmanship must be first-class in all respects, and any exposed members not presenting a finished and workmanlike appearance will be

SECTION 051200 - STRUCTURAL STEEL FRAMING

rejected. All finished members shall be free from twist, bends or open joints.

- M. All members shall be true to length so that assembling may be done without fillers, except where same are required as detailed. There shall be no projecting edges or corners where different members are assembled.
- N. All coping, blocking and mitering shall be done with care.
- O. All welds on exposed surfaces shall be ground smooth and flush with the adjacent surfaces.
- P. All details and connections shall be carefully made and fitted and special care shall be exercised to produce a thoroughly neat and workmanlike appearance. All detail pieces shall be made in exact accordance with detail drawings and all projecting corners clipped and all filler pieces made flush.
- Q. Provide all lugs, clips, connections, bolts and the like, necessary for complete fabrication and erection, and to engage with the adjacent construction. Provide setting diagrams for loose items to be built into concrete work indicating location, elevation and projection of loose items. All bolts remaining in the finished, exposed work shall be hexagon head bolts with hexagon nuts. Bolts shall be of proper length to permit full thread in the nut, but shall not project more than ¼" beyond the face of the nut.
- R. Burning shapes to length in the shop with a standard flamecutting machine will be permitted. There shall be no burning in the field without the consent of the Owner. If consent is given, burned members shall be finished to an acceptable appearance which shall be the equal of a sheared finish. Burning of holes will not be permitted in the shop or in the field.
- S. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

5.02 MATERIAL HANDLING

- A. Where possible, material shall be handled with slings, straps, and/or plate clamps to minimize the attachment of welded plate clips and lifting lugs to the structure. Where necessary, lifting clips, eyes, and lugs may be fitted on a temporary basis and removed after member erection. Where this course is followed, the base material shall be refinished to

SECTION 051200 - STRUCTURAL STEEL FRAMING

original surface condition by welding gouges and grinding surface irregularities to a flush finished condition.

- B. In areas where lifting lugs may be left on the structure without detriment to the function or appearance to the structure, the Fabricator shall be permitted to leave the lifting attachments permanently in place. Where this course is followed, the lugs shall be fabricated using optical or numerically controlled burning equipment and shall have smooth finishes on all cut surfaces. In addition, the attachments shall be welded continuously and shall receive surface preparation and protective coating systems identical to the surrounding structure to which they are attached.
- C. Material shall be stored so as to avoid contact with the ground, and shall be protected against weathering. Material shall be stored in a manner to insure that no members, protruding flanges, stiffeners, gussets plates, and other attachments are bent or otherwise damaged during storage. During transport, material shall be similarly secured so as to protect it from excessive vibration, abrasion, impact, weather, and anything else which could damage the material or coating.
- D. If such defects or damage in material cannot be corrected in the field to the entire satisfaction of the Engineer, the material shall be returned to the shop, or new parts furnished, as the Engineer will direct. The Contractor shall pay all expenses for such actions.
- E. Material determined unacceptable by the Engineer shall be corrected or replaced as required, all at Contractor's expense.

5.03 MATERIAL PREPARATION

- A. Material shall be carefully cut to length and dimensioned using optical or numerical burning equipment, saws, shears, etc. where possible. Material that is cut using hand torches shall be carefully ground to finished dimensions and to remove any edge irregularities prior to fabrication.
- B. Holes for bolts, pins, and miscellaneous attachments shall be drilled or bored. Flame burning is not allowed to prepare holes in structural steel with the exception of using flame burning to remove excessive material prior to finishing the parts with machine tools.
- C. Where special grades of steel are required, those being steel grades other than ASTM A 36, the individual parts are to be clearly marked with semi-permanent markers to indicate the steel grade from which the part has been fabricated.

SECTION 051200 - STRUCTURAL STEEL FRAMING

- D. The Fabricator shall protect all material from extended ground contact, exposure to corrosive environment, weld spatter, or other conditions that will adversely affect the milled surface finish on the material to be used in fabrication.

5.04 CLEANING AND PAINTING

- A. Clean and paint all structural steel as outlined in Sections 09900 and 09967, unless noted otherwise. If a structural steel section is designated to be hot-dip galvanized, galvanize in accordance with Section 09911.
- B. Do not shop coat:
 - 1. Surfaces within 2 in. of field welds.
 - 2. Contact surfaces of slip-critical high-strength bolted connections.
- C. After erection and inspection, erection contractor shall field paint all unpainted surfaces and abraded spots with primer and finish coats as outlined the appropriate Section.
- D. For galvanized steel that will be welded after galvanizing, refer to Section 05120.5.06.

5.05 ERECTION

- A. Brace and maintain all steel in alignment until other parts of construction necessary for permanent bracing or support are completed.
- B. Install temporary guys and bracing to safely resist wind loading designated in applicable building code.
- C. Set threads of machine bolts to prevent loosening.
- D. Tighten bolts in slip-critical connections by the “turn-of-nut” or calibrated wrench methods as specified in the Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- E. Contact surfaces of slip-critical connections shall be free of oil, grease, rust, mill scale, etc.
- F. After erection and inspection, paint with shop paint all unpainted surfaces, abraded spots, and bolt heads and nuts.

SECTION 051200 - STRUCTURAL STEEL FRAMING

- G. Base plates, complete with anchor bolts shall be accurately located and leveled with instruments. When leveling bolts are not required by the drawings, proper steel shims shall be provided for leveling the base plates. Wood shims will not be permitted to be used for leveling steel base plates or masonry plates. Provide grout holes in base plates as shown on drawings.
- H. No shims will be allowed between compression/tension members and base plates.
- I. Compression members shall not be spliced except as shown on drawings or as authorized in writing by Engineer.
- J. Erect compression and tension members plumb and true, in positions indicated. All work shall be formed, fabricated and erected or installed true to lines, levels, and dimensions, plumb and square. Level and plumb individual members of the structure within specified AISC tolerances.
- K. All beams shall be fabricated with crown of mill camber at top.
- L. Do cutting, punching, drilling and tapping as required for attachment of other work coming in contact with miscellaneous metal work where so indicated or where directions for same are given prior to or with approval of shop drawings. Do necessary cutting, drilling and fitting required for installation of miscellaneous metal work. Execute drilling, cutting, fitting carefully and where required, fit work at job before finishing. Flame cutting or hole burning will not be accepted, unless specifically approved.
- M. Form all work true to detail, with clean, straight, sharply defined profiles. Metals shall have smooth finish surfaces except where otherwise specified. Finish curved work to true radii, using easy curves.
- N. Wherever exposed, welds shall be ground smooth and polished to match finish to adjacent metals using filler metal compatible with base metal.
- O. Install all supporting members, fastenings, framing, hangers, bracing brackets, straps, bolts, angles as required to set, connect work rigidly and properly to steel, masonry or other construction.
- P. Finished work shall be free from warp, twists, bends or open joints and shall present a clean and workmanlike appearance.
- Q. Faulty work shall be immediately corrected at no additional expense to the Owner.

SECTION 051200 - STRUCTURAL STEEL FRAMING

- R. Unless shown on drawings, Anchorage to concrete shall be accomplished by use of built-in anchors or expansion bolts. Expansion bolts or cartridge driven stud anchorage will be allowed only for fastening to concrete, but will not be permitted for fastening to masonry. Wood plugs will not be permitted for fastening in any walls.

5.06 WELDING

A. General

1. Welding details shall conform to the size and configurations indicated on the contract and Fabricator-prepared detail drawings. Unless otherwise noted and approved by the Engineer, all exterior welding shall be continuous.
2. All welding shall fully comply with the requirements of AWS D1.1 Structural Welding Code – Steel. Other welding procedures may be considered by the Engineer on a per case basis; however, requests for variance from AWS code requirements will normally be denied.
3. Welds shall not be water quenched. For field welding to be performed in the tidal zone, the base metal within 3” of the proposed weld shall be preheated to fully dry the material prior to welding.
4. In general, electrodes shall be new, or reconditioned, at the start of each work shift. The Contractor shall strictly adhere to the atmospheric exposure and baking requirements of Clause 5 of AWS D1.1, and shall provide suitable holding and conditioning ovens onsite, as necessary.

B. Welding Procedures

1. Formal written welding procedure specifications (WPS) shall be prepared by the Contractor and submitted to the Engineer for review prior to the commencement of fabrication. All WPS shall be either prequalified in accordance with AWS, or qualified by the Fabricator on a case-by-case basis.
2. The formal WPS shall contain all variables listed in AWS Table 3.8, including: sketches indicating joint geometry and access or backing holes; welding process; base material specification and thickness limits; backing material specification and dimensions; groove preparation dimensions and tolerances, permitted welding positions; electrode rod, wire, flux and gas shield information; current type, range and polarity; and preheat and interpass temperature ranges.

SECTION 051200 - STRUCTURAL STEEL FRAMING

3. Welding procedures that are not pre-qualified by AWS D1.1, and are to be qualified by the Fabricator, shall be qualified in accordance with AWS D1.1 in the presence of the Engineer and/or his designated representative.
4. Allowable welding processes are shielded metal arc welding (SMAW), gas metal arc welding (GMAW), flux core arc welding (FCAW), and submerged arc welding (SAW). As such, the following filler material requirements are to be used on all grades of steel used on this project:

SMAW	E70X5(-X), E70X6(-X), E70X8(-X)
SAW	F7X-EXXX-X
GMAW	ER70S-X
FCAW	E7XTX-X (Except -2, -3, -1-, -GS)

Higher filler metal strengths may be required when welding materials in groups III and IV of AWS D1.1 Table 3.1.

5. Submerged arc welding, while being very efficient on thick material, sometimes produces excessive distortion on light gauge materials. Where the Fabricator desires to use submerged arc welding on material of less than one-half (1/2) inch in thickness, it shall be demonstrated to the Engineer that excessive distortion of the material can be effectively controlled.
6. Short circuiting transfer (short arc) welding produces low heat input into parent material and is useful for preventing excessive distortion when welding relatively thin steel shapes and plate. Penetration produced by short arc welding is minimal and often times insufficient for highly stressed parts. Short arc welding will only be considered on certain thin plate structures where stress levels are relatively low. Specific written approval of the engineer is required for the use of short arc welding.
7. All bevel welds shown without penetration size shall be complete joint penetration welds.
8. Backing bars shall be removed from all accessible complete joint penetration welds.
9. When the 'all-around' welding symbol is used at an end connection of a rolled shape, the Contractor shall terminate the weld at each of the flange edges, and one weld thickness away from each intersection of the web and flange, unless noted otherwise.

SECTION 051200 - STRUCTURAL STEEL FRAMING

10. Parts to be joined by fillet welds shall be brought into close contact, and the root opening shall not be permitted to exceed 3/16 in, unless written permission is granted by the Engineer. If the root opening separation is greater than 1/16 in, the legs of the fillet weld shall be increased by the size of the root opening.

C. Welders and Welding Operator Qualifications

1. Each welder or welding operator shall be qualified in accordance with AWS D1.1. Welding Personnel Qualification Records shall be submitted to the Engineer for review.
2. WPQRs shall contain all of the variables listed in AWS Table 4.12, and shall be applicable to the welds that a given welder proposes to perform on the project.
3. If the qualification test listed on the WPQR is more than six (6) months old, a detailed employment history and letter must accompany the WPQR to certify that the welder has been engaged in the welding process in question since the date of original qualification.

D. Welding Galvanized Steel

1. Prior to welding surfaces that have been previously hot dip galvanized, all zinc coating must be removed from either side of the intended weld zone, and on both sides of the piece.
2. Zinc coating may be removed by grinding or burning. If the coating is removed by burning, the surface shall be further ground or cleaned to remove combustion byproducts and other impurities.
3. Welding shall be performed in Accordance with AWS D19.0.
4. In order to prevent excessive heat that could damage the adjacent galvanized coating, weave beads shall not be permitted.
5. Recoat areas after the completion of welding in accordance with the Contract Drawings and Section 09911.

5.07 REWORK AND FAIRING

- A. Fabricated steel that is out of dimensional tolerances and/or not fair to the eye may be replaced and/or repaired by the Fabricator. If heat

SECTION 051200 - STRUCTURAL STEEL FRAMING

fairing is to be used, the material shall not be heated to more than twelve hundred (1200) degrees Fahrenheit. During heat fairing procedures, the Fabricator shall monitor the material temperature with temp sticks or lacquer, surface applied thermocouple gauges, or some other suitable form of temperature measuring system.

5.08 WELD INSPECTION

- A. Inspection of welded splices of main material and all complete penetration welds selected by the Engineer shall be by a testing laboratory selected by the Engineer and paid by the Owner, unless noted otherwise. All weld testing shall be in accordance with the AWS, unless otherwise modified hereinafter.
- B. The Contractor shall cooperate with and assist the Owner with the inspection of welds.
- C. Unless noted otherwise, visual inspection of all welds will be made by the Contractor. A record of this inspection shall be maintained by the Contractor.
- D. The Contractor shall correct improper workmanship and remove, replace or correct as instructed all welds found unacceptable or deficient by the Engineer. The Contractor shall pay for all corrections.
- E. Send five copies of reports on all required testing directly to the Engineer.

5.09 COMPLETION

- A. Upon Completion or when directed, conduct careful inspection and correct all defective work.
- B. Remove scrap, litter and debris resulting from operations specified herein, and leave work and the premises in clean satisfactory condition, ready to receive subsequent work.

- END OF SECTION -

SECTION 055213 – PIPE AND TUBE RAILINGS

PART 1: GENERAL

1.1 SCOPE

- A. Provisions of this section apply to furnishing stainless steel pipe and tube railings indicated on the Drawings, described in these Specifications, or otherwise required for proper completion of the Work

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Where the drawings call for delegated design, or where member sizes, wall thicknesses, and connection details are not provided, design railings, including comprehensive engineering analysis by a qualified professional engineer, using the performance requirements and design criteria indicated on the Drawings and in this Section.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
 - 2. Stainless Steel: 60 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill Panels:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

SECTION 055213 – PIPE AND TUBE RAILINGS

PART 2: PRODUCTS

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Pipe and Tube Railings:

- a. Pisor Industries, Inc.
- b. Wagner, R & B, Inc.; a division of the Wagner Companies; or
- c. Approved Equal.

2. Stainless-Steel Pipe and Tube Railings:

- a. Blum, Julius & Co., Inc.
- b. Paragon Aquatics; Division of Pentair, Inc.
- c. Pisor Industries, Inc.
- d. Stainless Fabricators, Inc.
- e. Sterling Dula Architectural Products, Inc.; Div. of Kane Manufacturing.
- f. Tri Tech, Inc.
- g. Tubular Specialties Manufacturing, Inc.
- h. Tuttle Railing Systems; Div. of Tuttle Aluminum & Bronze, Inc.
- i. Wagner, R & B, Inc.; a division of the Wagner Companies; or
- j. Approved Equal.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 PLAIN STEEL AND IRON

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

SECTION 055213 – PIPE AND TUBE RAILINGS

- C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.5 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 316L.
- B. Pipe: ASTM A 312/A 312M, Grade TP 316L.
- C. Castings: ASTM A 743/A 743M, Grade CF 8M or CF 3M.
- D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316L.
- E. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 580/A 580M, Type 316.

2.5 FASTENERS

- A. General: Provide the following:
 - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
 - 3. Stainless-Steel Railings: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicate and capable of withstanding design loads.
- C. Fasteners for Interconnecting Railing Components:
 - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

SECTION 055213 – PIPE AND TUBE RAILINGS

2. Provide tamper-resistant machine screws for exposed fasteners unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible material.
- F. Intermediate Coats and Topcoats: Provide products that comply with Division 09 painting Sections.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- I. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

PART 3: SUBMITTALS

SECTION 055213 – PIPE AND TUBE RAILINGS

3.1 MANUFACTURERS

- A. Product Data: For the following:
 - 1. Manufacturer's product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: Submit certification that the delegated design products have been designed in accordance with the specified design criteria and meet the performance requirements. Include calculations signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Qualification Data: For qualified professional engineer or testing agency.
- E. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- F. Welding certificates.
- G. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 4: QUALITY ASSURANCE

4.1 MANUFACTURERS

- I. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- J. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.6, "Structural Welding Code - Stainless Steel."

PART 5: EXECUTION

SECTION 055213 – PIPE AND TUBE RAILINGS

5.1 PROJECT CONDITIONS

- E. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

5.2 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical

SECTION 055213 – PIPE AND TUBE RAILINGS

fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

- J. Form changes in direction as follows:
 - 1. As detailed.
 - 2. By flush bends or by inserting prefabricated flush-elbow fittings.
- K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
- N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1- by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.
 - 1. Orient wire mesh with wires horizontal and vertical.

5.3 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

5.4 STEEL AND IRON FINISHES

- A. As indicated on plans, provide hot-dip galvanized fittings, brackets, fasteners,

SECTION 055213 – PIPE AND TUBE RAILINGS

sleeves, and other ferrous components.

5.5 STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.
- B. Dull Satin Finish: No. 6.
- C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

5.6 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

5.7 RAILING CONNECTIONS

- F. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

SECTION 055213 – PIPE AND TUBE RAILINGS

- G. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- H. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

5.8 ANCHORING POSTS

- I. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with [nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- J. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- K. Anchor posts to metal surfaces with plates as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For stainless-steel pipe railings, weld plate to post and bolt to supporting surfaces.

5.9 ADJUSTING AND CLEANING

- L. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.
- M. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- N. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

SECTION 055213 – PIPE AND TUBE RAILINGS

5.10 PROTECTION

- O. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

SECTION 061333 – TIMBER PIER FRAMING

PART 1 : GENERAL

1.1 SCOPE

- A. The work shall consist of the installation of timber pier framing and associated hardware.

PART 2 : PRODUCTS

2.1 MATERIALS

A. Timber

- 1. Timber shall be Select Structural Grade Southern Pine unless otherwise indicated in the Contract Documents.
- 2. Timber shall be graded in accordance with ASTM D1990 and/or ASTM D245.

B. Treatment

- 2. Where treated timber is required by the Contract Documents, the timber shall be treated in accordance with this section.
- 3. Timber shall be pressure treated in accordance with AWPA C3, C18, M4 and UC4C.
- 4. Timber shall be treated with either Chromated Copper Arsenate (CCA) or Ammoniacal Copper Zinc Arsenate (ACZA).
- 5. Timber shall have a preservative retention in accordance with AWPA.
- 6. Piles shall not be treated with Creosote or other carcinogenic materials.

C. Hardware

- 1. Hardware shall include bolts with necessary nuts and washers, connectors, drift pins, dowels, nails, screws, spikes, and other metal fastenings.
- 2. Provide bolts with washers under nut and head.

SECTION 061333 – TIMBER PIER FRAMING

3. All hardware shall be in accordance with ASTM A490 or A449 unless otherwise indicated in the Contract Documents.
4. All hardware shall be galvanized in accordance with ASTM A123 and/or A153 unless otherwise indicated in the Contract Documents.

PART 3 : SUBMITTALS

3.1 GENERAL

- A. The Contractor shall submit the items contained in this section for review and acceptance, in accordance with the Contract.

3.2 SUBMITTAL ITEMS

- A. The Contractor shall submit material certificates for all timber that include grade, dimension and treatment, if applicable.
- B. The Contractor shall submit as-built drawings showing the installed timber locations to the Owner and Engineer upon completion of the work.

PART 4 : QUALITY ASSURANCE

4.1 REFERENCES

- A. The International Building Code (IBC).
- B. ASTM D245 - Method for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber.
- C. ASTM D4945 – Standard Test Method for High-Strain Dynamic Testing of Deep Foundations.
- D. AWPA American Wood Preserver's Association.

PART 5 : CONTRACTOR'S QUALITY CONTROL REQUIREMENTS

5.1 HANDLING

- A. Inspect timber upon delivery prior to installation. Defective and/or damaged materials will be rejected.

SECTION 061333 – TIMBER PIER FRAMING

- B. Handle materials in a manner to avoid damage. Handle treated lumber with nylon or other non-damaging rope slings.

5.2 FIELD TREATMENT

- A. Where treated timber is specified, field treat all abrasions, holes, cuts and other penetrations in accordance with AWWA M4.

5.3 INSTALLATION

- A. Cut all timber accurately and frame to a close fit to provide for even bearing of joints over the entire contact surface. Make joints without shimming. Field drill only as indicated or allowed.
- B. Bore holes for bolts or rods with a bit diameter 1/16 inch larger than the bolt diameter. Counterbore for counter-sinking wherever smooth faces are specified or required.
- C. Bolt the ends of bracing through the pile, post or cap.
- D. Furnish bracing of sufficient length to provide a minimum distance of 8 inches between bolts and the end of the brace.
- E. Provide washers under all bolt heads and nuts. After final tightening lock the nuts of all bolts.

5.4 TOLERANCES

- A. The maximum deviation from the required framing locations shall be two inches (2 in).

- END OF SECTION -

SECTION 099000 - PAINTING & COATING

PART 1: GENERAL

1.01 SCOPE

A. Work Included

Paint and finish all surfaces not specified in the drawings and specifications to receive other coating systems. Provide all touch up and remedial painting as required until the work is accepted by the Engineer.

B. Work Not Included

1. Painting specified under other sections.
2. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas.
3. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting under this Section except as may be specified herein.
4. Do not paint any moving parts of operating units; mechanical or electrical parts such as valve operators, linkages, sensing devices, and motor shafts, unless otherwise indicated.
5. Do not paint over any required labels or equipment identification, performance rating, name, or nomenclature plates.

C. Definitions

The term "paint", as used herein, means all coating systems materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

PART 2: PRODUCTS

2.01 MATERIAL

A. Design

Design is based on use of paint products manufactured by Glidden or Rustoleum, and the materials of those manufacturers are named in the Painting Schedule. Equal products of Sherwin-Williams or other manufacturers may be used if approved by Engineer.

SECTION 099000 - PAINTING & COATING

B. General

Provide the best quality grade of the various types of coatings as regularly manufactured by paint materials manufacturers approved by Engineer. Materials not displaying the manufacturer's identification as a standard best-grade product will not be acceptable.

C. Durability

Provide paints of durable and washable quality. Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, ordinary soil, and similar material without showing discoloration, loss of gloss, staining, or other damage.

D. Colors and Glosses

Paint colors shall be as specified below, or Owner approved equal, unless noted otherwise on the Contract Drawings:

- Cleats - Sherwin Williams Safety Yellow (SW 4084)
- Walkway Stringers- Sherwin Williams Blueprint (SW 4056)
- All other structural steel - Primer only.

The Construction Manager will be the sole judge of acceptability of the various glosses obtained from the materials supposed to be used in the Work.

E. Undercoats and Thinners

Provide undercoat paint produced by the same manufacturer as the finish coat. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits. Insofar as practicable, use undercoat, finish coat, and thinner material as parts of a unified system of paint finish.

F. Standards

Provide paint materials, which meet or exceed the standards listed for each application in the Painting Schedule in Part Five of this Section.

2.02 APPLICATION EQUIPMENT

A. General

SECTION 099000 - PAINTING & COATING

For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint, and as approved by Engineer.

B. Compatibility

Prior to actual use of application equipment, use all means necessary to verify that the proposed equipment is actually compatible with the material to be applied and that the integrity of the finish will not be jeopardized by use of the proposed application equipment.

2.03 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installation of the work of this Section, shall be new, first-quality of their respective kinds, and as selected by the Contractor subject to the approval of the Engineer.

PART 3: SUBMITTALS

3.01 Contractor shall submit the following in accordance with Section 013300, Submittal Procedures:

- A. Submit recommended color, paint specifications, proposed application procedure, and manufacturer contact number three weeks prior to painting.

PART 4: QUALITY ASSURANCE

4.01 QUALIFICATIONS

- A. Qualification of Manufacturer
Products used in the work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Engineer.
- B. Qualifications of Workmen
1. Provide and identify by name, at least one person who shall be present at all times during execution of the work of this Section, who shall be thoroughly familiar with the specified requirements and the materials and methods needed for their execution, and who shall direct all work performed under this Section.

SECTION 099000 - PAINTING & COATING

2. Provide adequate numbers of workmen skilled in the necessary crafts and properly informed of the methods and materials to be used.
3. In acceptance or rejection of the work of this Section, the Engineer will make no allowance for lack of skill on the part of workmen.

C. Paint Coordination

1. Provide finish coats, which are compatible with the prime coats used.
2. Review other Sections of these Specifications as required, verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrata.
3. Upon request, furnish information on the characteristics of the specific finish materials to ensure that compatible prime coats are used.
4. Provide barrier coats over non-compatible primers, or remove the primer and reprime as required.
5. Notify the Engineer in writing of anticipated problems in using the specified coating systems over prime coating supplied under other Sections.

D. In addition to complying with all pertinent codes and regulations, comply with all pertinent recommendations contained in the latest revision of the following publications of the Steel Structures Painting Council:

1. SSPC-SP-1 Solvent Cleaning
2. SSPC-SP-2 Hand Tool Cleaning
3. SSPC-SP-3 Power Tool Cleaning
4. SSPC-SP-4 Flame Cleaning
5. SSPC-SP-5 White Metal Blast Cleaning
6. SSPC-SP-6 Commercial Blast Cleaning
7. SSPC-SP-7 Brush Off Blast Cleaning

SECTION 099000 - PAINTING & COATING

8. SSPC-SP-8 Pickling
9. SSPC-SP-9 Weathering Blast Cleaning
10. SSPC-SP-10 Near White Metal Cleaning

PART 5: EXECUTION

5.01 PRODUCT HANDLING

A. Delivery of Materials

Deliver all materials to the painting site in original, new, and unopened containers bearing the manufacturer's name and label showing at least the following information:

1. Name or title of the material
2. Fed. Spec. number, if applicable
3. Manufacturer's stock number
4. Manufacturer's name
5. Contents by volume for major constituents
6. Thinning instructions
7. Application instructions

B. Do not bring to the job site any paint or solvent containers bearing the name of a material that has not been specified.

C. Storage of Materials

Provide proper storage to prevent damage to and deterioration of, paint materials in accordance with manufacturer recommendations.

D. Protection

Use all means necessary to protect the materials of this Section before, during, and after installation and to protect the work and materials of all other trades.

E. Replacements

SECTION 099000 - PAINTING & COATING

In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer and at no additional cost to the Owner.

5.02 JOB CONDITIONS

A. Surface Temperatures

Do not apply any paints when the temperature of surfaces to be painted or the surrounding air temperature are below 45 degrees F, unless otherwise permitted by the manufacturer's printed instructions as approved by the Engineer. Do not apply any paints when the temperature of the surfaces to be painted or the surrounding air temperature is above 99 degrees F.

B. Weather Conditions

Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or to damp or wet surfaces; unless otherwise permitted by the manufacturer's printed instructions as approved by the Engineer. Applications may be continued during inclement weather within the temperature limits specified by the paint manufacturer during application and drying periods.

5.03 SURFACE CONDITIONS

A. Inspection

Prior to installation of the work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Verify that painting may be completed in strict accordance with the original design and with the manufacturer's recommendations as approved by the Engineer.

B. Discrepancies

Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

5.04 MATERIALS PREPARATION

A. General

SECTION 099000 - PAINTING & COATING

1. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations as approved by the Engineer.
2. Store materials not in actual use in tightly covered containers.
3. Maintain containers used in storage, mixing, and application of paint in a clean condition, free from foreign materials and residue.

B. Stirring

Stir all materials before application to produce a mixture of uniform density, and as required during the application of materials. Do not stir into the material any film, which may form on the surface. Remove the film and, if necessary, strain the material before using.

5.05 SURFACE PREPARATION

A. General

1. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's recommendations, federal, state, local environmental regulations and as approved by the Engineer.
2. Remove all removable items, which are in place and not scheduled to receive paint finish, or provide surface-applied protection prior to surface preparation and painting operations.
3. Following completion of painting in each space or area, reinstall the removed items by using workmen skilled in the necessary trades.
4. Clean each surface to be painted prior to applying paint or surface treatment.
5. Remove oil and grease with clean cloths and cleaning solvents. Change rags as they become dirty. Unless otherwise specified, the general purpose solvent to be used for cleaning under normal conditions shall be aliphatic or aromatic solvents, alcohol esters, chlorinated hydrocarbons, or mixtures of these substances, with a minimum flash point of 100 F. In hot weather (temperatures between 80 and 95 F) a solvent that has a minimum flash point of 120 F shall be used. In very hot weather (temperatures over 95 F) solvent with a flash point over 140 F shall be used.

SECTION 099000 - PAINTING & COATING

6. Schedule the cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet newly painted surfaces.

B. Preparation of Wood Surfaces

Not applicable

C. Preparation of Metal Surfaces

1. Thoroughly clean all surfaces until they are completely free from dirt, oil, and grease.
2. On galvanized surfaces, use solvent for the initial cleaning and then treat the surface thoroughly with phosphoric acid etch. Remove all etching solution before proceeding.
3. Allow to dry thoroughly before the application of paint.
4. Before sandblasting, remove all deposits of oil and grease by the methods described in SSPC-SP-1.
5. Clean in compliance with the provisions of SSPC-SP-10.

5.06 PAINT APPLICATION

A. General

1. Slightly vary the color of succeeding coats. Do not apply additional coats until the completed coat has been inspected and approved. Only the inspected and approved coats of paint will be considered in determining the number of coats applied.
2. Sand and dust between enamel coats to remove all defects visible to the unaided eye from a distance of five feet.
3. On all removable panels and all hinged panels, paint the back sides to match the exposed sides.
4. Prime all blasted surfaces as soon as possible within the same working day and before any visual rusting, blushing, or blooming occurs. Should any of these conditions develop before the paint is applied, these areas must be reblasted.

B. Drying

SECTION 099000 - PAINTING & COATING

1. Allow sufficient drying time between coats. Modify the period as recommended by the material manufacturer to suit adverse weather conditions.
2. Oil-base and oleo-resinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Brush Application

Brush out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, laps, brush marks, runs, sags, and other surface imperfections will not be acceptable.

D. Spray Application

1. Confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
2. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass.

E. Completed Work

Shall match the approved Samples for color, texture, and coverage. Remove, refinish, or repaint all work not in compliance with specified requirements.

F. Finish Paint

Finish paint on all structural steel shall be accomplished in the shop prior to shipment to the job site. Touch up all abrasions, welds, connections and other bare metals with primer and finish coats after erection.

G. Overspray

Overspray will not be permitted. Should overspray occur, remove the overspray with a stiff wire brush or by sanding. Air-blow the affected area to remove all traces of overspray and repaint as necessary.

5.07 PAINTING SCHEDULE

SECTION 099000 - PAINTING & COATING

- A. Provide a three coat system, prime coat of compatible Zinc Primer, 3 to 5 mils total dry thickness.
- B. Provide an Intermediate epoxy coat of 3 to 5 mils total dry thickness.
- C. Provide a finish coat of acrylic urethane with a minimum total dry film thickness of 2 to 4 mils.
- D. Color Chart

The color of the coatings shall be per Owner's requirements. The contractor shall obtain Owner's approval of the color two weeks prior to the purchase of the coatings. The handrail and guardrail shall be painted safety yellow.

5.08 PAINTED PRODUCT HANDLING

- A. After a product is painted, the Contractor and painting Subcontractor shall protect the coating from chipping, abrasion, or other damage during storage, transport, placement, and subsequent construction. Any damage to the coating system shall be repaired at the Contractor's expense.

- END OF SECTION -

SECTION 099626 – COATING OF STEEL WATERFRONT STRUCTURES

PART 1: GENERAL

1.1 SCOPE

This section covers the coating requirements for steel waterfront structures.

A. Work Included

All hot rolled steel piles as shown and specified in the contract documents are included under this section. In general, this section covers material that will be immersed, in the splash zone, or immediately above the splash zone.

B. Work not included

Do not include items that are specified under other sections to be painted or coated.

PART 2: PRODUCTS

2.1 COATING SYSTEM

A. Shop Coat - Coal Tar Epoxy

1. Provide SSPC Paint 16 Coal Tar Epoxy in prime coat and top coat, in accordance with the SSPC Painting System Specification 11.01.

B. Field Touch-Up

1. Provide Carboline Carbomastic 615, or an Engineer-approved equivalent, for field coating and touch up. Follow the manufacturer's recommendations and all applicable sections of this specification.

PART 3: SUBMITTALS

3.1 The Contractor shall submit the following in accordance with Section 013300, Submittal Procedures:

- A. The Contractor shall submit a description of the coating system to the Engineer for review. Authorization to proceed shall be obtained at least two weeks prior to coating steel structures.
- B. The Contractor shall submit the qualifications of proposed coating shops, in accordance with SSPC-QP 3. Records of relevant experience in

SECTION 099626 – COATING OF STEEL WATERFRONT STRUCTURES

applying coatings used in marine/splash zone environments shall be included with the qualifications.

- C. The coating shop shall submit affidavits that all coating was performed in accordance with relevant SSPC practices and guidelines, as well as quality control shop records indicating the time of blast cleaning; results of surface profile testing; environmental conditions and time of each coating application; and holiday spot testing.

PART 4: QUALITY ASSURANCE

4.1 REFERENCE

- A. All specifications, standards, and codes referred to in this specification shall be the latest revision of the same and considered a part of this specification to the extent referenced.

4.2 QUALITY CERTIFICATION

- A. The Coating shop shall have a SSPC QP 3 certification, at a minimum.

4.3 RESPONSIBLE PARTY

- A. All specifications, standards, and codes referred to in this specification shall be the latest revision of the same and considered a part of this specification to the extent referenced.

Affidavits and test records submitted by the coating shop shall be signed by the responsible quality assurance representative, indicating that all applicable SSPC and coating manufacturer guidelines have been followed.

4.4 OWNER'S RIGHT TO INSPECT

- A. The Owner reserves the right to have the Engineer, or a third party inspection agency, present to observe some or all of the coating process. The coating shop shall notify the Engineer of planned coating activities at least seven (7) days ahead of time to allow for the scheduling of these inspections, and shall allow access to the Owner's designated representative.

PART 5: EXECUTION

5.1 ENVIRONMENTAL CONDITIONS

SECTION 099626 – COATING OF STEEL WATERFRONT STRUCTURES

- A. Start work only when ambient and curing temperatures are within limits of coating manufacturer's recommendations and SSPC guidelines. All coating shall be accomplished in accordance with federal, state, and local codes and regulations.

5.2 SAFETY AND HEALTH PRECAUTIONS

- A. Materials listed in this section contain coal tar pitch volatiles, which are toxic. Follow safety procedures as recommended by manufacturer. Work in a well ventilated area. Provide, and require workers to use, impervious clothing, gloves, face shields (8-inch minimum), and other appropriate protective clothing necessary to prevent eye and skin contact with coating materials. Keep coatings away from heat, sparks and flame.

5.3 CLEANING AND PREPARATION OF SURFACES

5.3.1 Solvent Cleaning

SSPC SP 1. Remove visible oil, grease, and drawing and cutting compounds by solvent cleaning.

5.3.2 Blast Cleaning

SSPC SP 10. After solvent cleaning, complete surface preparation by near-white blast cleaning. Remove residual dust from blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping. Provide surface profile of at least 2 ½ -mils.

5.3.3 Bare Metal Power Tool Cleaning

SSPC SP 11. After solvent cleaning, complete surface preparation by cleaning and roughening with a bristle blaster. Remove residual dust from blasted surface by blowing with dry, oil-free air, vacuuming, or sweeping. Provide surface profile of at least 2 mils.

5.4 PROPORTIONING AND MIXING OF COATING SYSTEM

5.4.1 Proportioning of Coal Tar Epoxy System

Proportion components as dictated by the product manufacturer. Do not split kits.

5.4.2 Mixing of Epoxy-Polyamide System

SECTION 099626 – COATING OF STEEL WATERFRONT STRUCTURES

Mix components of coating by power stirring until a smooth, uniform consistency results, or as dictated by the product manufacturer. Stir coating periodically during its induction period. Follow Table 1 for induction time and pot life of mixed batches.

5.4.3 Temperatures

Follow all manufacturer guidelines for allowable application temperatures and induction times.

5.5 COATING APPLICATION

5.5.1 General

Apply primer coating to dry surfaces not more than 4 hours after near-white blast cleaning. Never apply coating over mill scale or smooth steel; any areas exhibiting mill scale or excessive smoothness must be blast cleaned again prior to coating application. Apply coats of each system so that finished surfaces are free from runs, sags, brush marks and variations in color.

5.5.2 Application Method for Coal Tar Epoxy System

Allow previous coat to dry to tack-free condition but not more than 72 hours before applying next coat. If more than 72 hours elapses between coats, clean surface, apply a 2 mil wet film thickness of previous coat, allow to cure to a tacky film, and apply a full thickness of next coat.

5.5.3 Repair of Defects

Repair detected coating holidays, thin areas, and exposed areas damaged prior to or during installation by surface treatment and application of additional coating or by manufacturer's recommendations. Allow a period of at least 72 hours to pass following final coat before placing in immersion service.

5.5.4 Two-Coat Coal Tar Epoxy System

Apply each coat at a dry film thickness of between 8 mils and 10 mils. Where product manufacturer recommends that the product be applied in three coats, apply each coat at a dry film thickness of between 5 mils and 8 mils.

5.5.5 Dry Film Thickness

SECTION 099626 – COATING OF STEEL WATERFRONT STRUCTURES

Provide total system minimum dry film thickness of 16 mils to 20 mils. Measure using a magnetic gage.

- 5.5.6 For HP or pipe piles, leave 6 inches of one end of each pile section uncoated for field splices. Further leave the top 2 feet of each pile uncoated for vibratory hammer grip.

5.6 FIELD TESTS

Conduct testing in presence of the Engineer.

5.6.1 Holiday Testing

Prior to installation, test for holidays in total coating system. Use a low-voltage holiday detector of less than 90 volts in accordance with manufacturer's instructions. After repair of holidays by surface treatment and application of additional coating or by manufacturer's recommendation, retest with a low-voltage holiday detector.

5.6.2 Dry Film Thickness

After repair of holidays, measure dry film thickness using a magnetic dry film thickness gage in accordance with ASTM D 1186 and ASTM E 376. Re-measure after an additional coat is applied, and add it to meet minimum thickness requirements.

5.7 FIELD COATING

5.7.1 General Provisions

Field coating shall only be allowed for touch-up purposes, or where explicitly allowed by the Engineer. Field coating shall follow the requirements of this specification and SSPC-PA 1, except as detailed in article 5.7.2.

5.7.2 Specific Conditions

Where blast cleaning surfaces to an SSPC SP 10 is not practical, surfaces to receive touch-up painting shall be thoroughly mechanically cleaned and roughened to an SSPC SP 11 with a bristle blaster, creating a minimum surface profile of 2 mils. Surfaces must be protected from rain, tidewater or other moisture between cleaning and coating, and must be coated on the same day that they are cleaned.

5.7.3 Field Welds

SECTION 099626 – COATING OF STEEL WATERFRONT STRUCTURES

Areas within 4 inches of field welds must be mechanically cleaned to SSPC SP 11 and touched up.

- END OF SECTION -

SECTION 099700 – HOT DIP GALVANIZING

PART 1: GENERAL

1.1 SCOPE

This specification covers iron and steel materials to be hot dip galvanized after manufacturing or fabrication.

A. Work Included

All structural steel members and miscellaneous metal work including bolts, washers, nuts, angles, inserts, plates, and other fabrications shall be hot-dip galvanized.

B. Work not included

Do not hot-dip galvanize items which are specified under other sections to be painted or coated. Do not hot-dip galvanize any series of stainless steel or quenched and tempered steel.

PART 2: PRODUCTS

2.1 STEEL MATERIALS

A. Material for galvanizing to be geometrically suitable for galvanizing as described in ASTM A384 and A385. Steel materials suitable for galvanizing include structural shapes, pipes, sheet, fabrications, and assemblies.

B. Material to be chemically suitable for galvanizing.

PART 3: SUBMITTALS

3.1 The Contractor shall submit the following in accordance with Section 01330, Submittal Procedures:

A. The Contractor shall submit the coating applicator's notarized Certificate of Compliance that the hot dip galvanized coating meets or exceeds the specified requirements of ASTM A123, A767 or A153 (as applicable).

PART 4: QUALITY ASSURANCE

4.1 REFERENCES

SECTION 099700 – HOT DIP GALVANIZING

- A. Publications
 - 1. American Galvanizers Association (AGA)
 - a. Inspections of Products Hot Dip Galvanized After Fabrication
 - b. The Design of Products to be Hot Dip Galvanized After Fabrication
 - c. Recommended Details for Hot Dip Galvanized Structures
 - 2. Research Council on Structural Connections of the Engineering Foundation:
 - a. Specification for Structural Joints Using ASTM A325 or A490 bolts.
- B. Reference Standards
 - 1. American Society for Testing and Materials (ASTM):
 - a. A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. A143 Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
 - c. A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - d. A384 Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Articles
 - e. A385 Providing High-Quality Zinc Coatings (Hot-Dip)
 - f. A767 Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
 - g. A780 Repair of Damaged Hot-Dip Galvanized Coatings
 - 2. Federal Specifications
 - a. DOD-P-21035, Paint, High Zinc Dust Content, Galvanizing Repair
 - b. MIL-P-26915, Primer Coating, Zinc Dust Pigmented

SECTION 099700 – HOT DIP GALVANIZING

4.2 QUALIFICATIONS

A. Acceptable Coating Applicators

1. Coating Applicator: Company specializing in hot dip galvanizing after fabrication and following the procedures of the Quality Assurance Manual of the American Galvanizers Association.

PART 5: EXECUTION

5.1 FABRICATION REQUIREMENTS

- A. Fabricate structural steel in accordance with Class (I), (II), or (III) guidelines, as described in the American Galvanizers Association (AGA) *Recommended Details for Hot Dip Galvanized Structures*.
- B. Fabrication practices for products shall be in accordance with the applicable portions of ASTM A143, A384, and A385, except as specified herein. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
- C. The Fabricator shall consult with the Engineer and hot dip galvanizer regarding potential problems or potential handling problems during the galvanizing process which may require modification of design before fabrication proceeds.
- D. Remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing.
- E. Provide holes and / or lifting lugs to facilitate handling during the galvanizing.
- F. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication.
- G. Remove by blast cleaning or other methods surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation.

5.2 APPLICATION OF COATING

SECTION 099700 – HOT DIP GALVANIZING

- A. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A123.
- B. Galvanize bolts, nuts and washers, and iron and steel hardware components in accordance with ASTM A153.
- C. Safeguard products against steel embrittlement in conformance with ASTM A143.
- D. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

5.3 COATING REQUIREMENTS

- A. Coating Weight: Conform to paragraph 5.1 of ASTM A123, Table 1 of A767, or Table 1 of ASTM A153, as appropriate.
- B. Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
- C. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

5.4 TESTS

- A. Inspection and testing of the hot dip galvanized coatings shall be done under the guidelines provided in the AGA publication *Inspection of Products Hot Dip Galvanized After Fabrication*.
- B. Include visual examination and tests in accordance with ASTM A123, A767 or A153 as applicable to determine the thickness of the zinc coating on the metal surface.
- C. Furnish Notarized Certificate of Compliance with ASTM Standards and Specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

5.5 REPAIR OF DAMAGED COATING

- A. The maximum area to be repaired is defined in accordance with ASTM A123 Section 4.6 current edition.

SECTION 099700 – HOT DIP GALVANIZING

1. The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.
- B. Repair areas where the coating has been damaged or removed by welding, flame cutting or during handling, transport or erection by one of the approved methods in accordance with ASTM A780 whenever damage exceeds 3/16" in width. Minimum thickness requirements for the repair are those described in the current edition of ASTM A123, section 4.6.

END OF SECTION

SECTION 310000 - EARTHWORK

PART 1 : GENERAL

1.1 WORK SPECIFIED

- A. Excavation, embankment, and backfilling, including the loosening, removing, refilling, transporting, storage, and disposal of all materials classified as “earth” necessary for the construction and completion of all waterfront work under the Contract.
- B. Excavation to the widths and depths shown on the Drawings or as specified.
- C. Dewatering excavation, removal, and discharge of water.

1.2 DEFINITIONS

- A. Excavation
 - 1. Removal of materials of whatever nature encountered, whether natural or manmade, wet, frozen, or otherwise, including dense tills, hardpan, cemented materials, concrete fragments, asphalt pavement, boulders or rock fragments, and weathered rock which can be removed by ripping or excavating with heavy-duty mechanical construction equipment without drilling and blasting.
 - 2. Grubbing, stripping, removing, storing and rehandling of all materials of every name and nature necessary to be removed for all purposes incidental to the construction and completion of all the Work under construction.
 - 3. All sheeting, sheet piling, bracing and shoring, and the placing, driving, cutting off, and removing of the same.
 - 4. All diking, ditching, fluming, cofferdamming, pumping, bailing, draining, well pointing, or otherwise disposing of water.
 - 5. The removing and disposing of all surplus materials from the excavations in the manner specified.
 - 6. The supporting and protecting of all tracks, rails, buildings, curbs, sidewalks, pavements, overhead wires, poles, trees, vines, shrubbery, pipes, sewers, conduits, or other structures or property in the vicinity of the Work, whether over or underground, or which appear within or adjacent to the excavations, and the restoration of the same in case of settlement or other injury.

SECTION 310000 - EARTHWORK

7. All temporary bridging and fencing and the removing of same.
- B. Earth
1. All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots, or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding all ledge or bedrock and individual boulders or masonry larger than ½ cubic yard (cy) in volume.
- C. Backfill
1. The refilling of excavation and trenches to grades shown on the Drawings, or as otherwise required to complete the Work, using suitable materials which have physical properties that match the requirements of this Specification for use in refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, or as may be required and approved by the Construction Manager.
- D. Spoil
1. Surplus excavated materials not required or excavated materials which have physical properties that limit their suitability for use as backfill or placement for embankments.
- E. Embankments
1. The placement of general fill material above the original grade or such other elevation as specified or directed.
- F. Limiting Subgrade
1. The underside of the pipe barrel for pipelines.
 2. The underside of footing lines for structures.
 3. The bottom of the lowest course for pavement sections.
- G. Excavation Below Subgrade
1. Excavation below the limiting subgrades of structures, pipelines, or pavements.
 2. Where materials encountered at the limiting subgrades are not suitable for proper support of structures, pipelines, or pavement the

SECTION 310000 - EARTHWORK

Contractor shall excavate to such new lines and grades as required.

PART 2 : PRODUCTS

2.1 MATERIALS

A. Wood Sheeting and Bracing

1. Shall be sound and straight; free from cracks, shakes, and large or loose knots; and shall have dressed edges where directed.
2. Shall conform to National Design Specifications for Stress Grade Lumber having a minimum fiber stress of 1,200 pounds per square inch (psi).
3. Sheeting and bracing shall be removed, except where specifically approved in writing by the Construction Manager to remain.

B. Steel Sheeting and Bracing

1. Shall be new or in excellent condition.
2. Shall conform to ASTM A328 with a minimum thickness of 3/8 inch.
3. Shall conform to OSHA Subpart P, Excavations Section 1926.652(C) Design of Support Systems, Shield Systems, and Other Protective Systems.
4. Sheeting and bracing shall be removed, except where specifically approved in writing by the Construction Manager to remain.

C. General Fill Material

1. Free of rocks or lumps larger than 3 inches, loam, organic matter, very soft clays, swelling clays, or fine uniform sands that may be difficult to compact.
2. General fill may be obtained from existing onsite areas designated for excavation or from an offsite source to be approved by the Construction Manager.
3. General fill may be composed of soils with any ASTM D2487 Group Symbol except CH, MH, OL, and OH.

SECTION 310000 - EARTHWORK

PART 3 : SUBMITTALS

- 3.1 The Contractor shall submit a plan, two (2) weeks prior to the start of the field operations, showing the safeguards, barriers, fences, bridges, planks, and warning signs required for a safe excavation.
- 3.2 All falsework, shoring and structural support plans and calculations shall be submitted to the Owner, for review, two (2) weeks prior to the use. Calculations shall be performed and sealed by a professional engineer registered in the Commonwealth of Pennsylvania.
- 3.3 The Contractors shall submit, at least two (2) weeks prior to the start of backfilling operations, lab test results for gradation and modified proctor density tests for all backfill material. If the contractor proposes to reuse excavated material as backfill, the lab tests shall be performed on the excavated material stockpile.
 - A. Moisture and Density relationships for the modified proctor density tests shall be determined in accordance with ASTM D 1557, Method C.
- 3.4 The Contractor shall submit reports of the field density testing of compacted backfill at the end of each work shift in which backfilling was performed.

PART 4 : QUALITY ASSURANCE

4.1 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. PennDOT Publication 408: Specifications
- C. Subpart P, "Excavations" of United States Department of Labor OSHA Regulations for Construction.
- D. Quality of Life Performance Standards (QoLPS).

PART 5 : EXECUTION

5.1 REMOVAL OF WATER

- A. General
 1. At all times, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations,

SECTION 310000 - EARTHWORK

and remove all such water as fast as it may collect, in such manner as to not interfere with the prosecution of the Work or the proper placing of pipes, structures, or other Work. Removal of water which enters excavations shall be coordinated with the Construction Manager.

2. Unless otherwise specified, all excavations which extend down to or below the static groundwater elevations shall be dewatered by lowering and maintaining the groundwater beneath such excavations at all times when Work thereon is in progress, during subgrade preparation, and placing of the structure or pipe thereon.
3. Water shall not be allowed to rise over or come in contact with any new masonry, concrete, or mortar until at least 48 hours after placement, and authorized by the Construction Manager.
4. Where the presence of fine-grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, install and operate an approved well point system designed by a licensed Professional Engineer (P.E.) registered in the Commonwealth of Pennsylvania to prevent the upward flow of water during construction. Services for the design of a dewatering system shall be obtained by the Contractor at no addition cost to the Owner.
5. Water pumped or drained from excavations, or any sewers, drains, or water courses encountered in the Work, shall be disposed of in a suitable manner without injury to adjacent property, the Work under construction or to pavement, roads, drives, and water courses. All water discharge points shall be approved by the Construction Manager. No water shall be discharged to sanitary sewers, waters or wetlands of the Commonwealth.
6. Provide filtration and erosion control at all water discharge points in accordance with all applicable environmental regulations.
7. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the Contractor and shall be repaired at no additional cost to the Owner.

B. Work Included

1. Construction and removal of cofferdams, sheeting, and bracing and the furnishing of materials and labor necessary therefore.
2. Excavation and maintenance of ditches and sluiceways.

SECTION 310000 - EARTHWORK

3. Furnishing and operation of pumps, well points, and appliances needed to maintain thorough drainage of the Work in a satisfactory manner.

C. Well Point Systems

1. Installation

- a. The well point system shall be designed and installed by or under the supervision of an organization whose principal business is well pointing, and which has at least five consecutive years of similar experience and can furnish a representative list of satisfactory similar operations.
- b. Well point headers, points, and other pertinent equipment shall not be placed within the limits of the excavation in such a manner or location as to interfere with the laying of pipe or trenching operations or with the excavation and construction of other structures.
- c. Detached observation wells of similar construction to the well points shall be installed at intervals of not less than 50 feet along the opposite side of the excavation from the header pipe and line of well points, to a depth of at least 5 feet below the proposed excavation. In addition, one well point in every 50 feet shall be fitted with a tee, plug, and valve so that the well point can be converted for use as an observation well. Observation wells shall be not less than 1½ inches in diameter.
- d. Standby gasoline or diesel-powered equipment shall be provided so that in the event of failure of the operating equipment, the standby equipment can be readily connected to the system. The standby equipment shall be maintained in good order and actuated regularly, not less than twice a week. Standby gasoline or diesel equipment selected shall comply with Noise QoLPS.

2. Operation

- a. Where well points are used, the groundwater shall be lowered and maintained continuously (day or night) at a level not less than 2 feet below the bottom of the excavation. Excavation will not be permitted at a level lower than 2 feet above the water level as indicated by the observation wells.

SECTION 310000 - EARTHWORK

- b. The effluent pumped from the well points shall be examined periodically by qualified personnel to determine if the system is operating satisfactorily without the removal of fines.
- c. The water level shall not be permitted to rise until construction in the immediate area is completed as determined by the Construction Manager, and the excavation backfilled.

5.2 EXAMINATION

- A. Verify that survey benchmarks and existing elevations are as shown on the Drawings.
- B. The Contractor shall locate and mark locations of monitoring wells requiring protection prior to commencement of excavation. Protect existing monitoring wells from damage during performance of the Work. Damage to existing monitoring wells resulting from Contractor activities shall be repaired by the Contractor, to the satisfaction of the Construction Manager, at no additional cost to the Owner.
- C. Existing installations: Installations that require protection shall be protected by the Contractor during the entire duration of the Project. Any damage to existing installations resulting from Contractor activities shall be repaired by the Contractor, to the satisfaction of the Construction Manager, at no additional cost to the Owner.
- D. For the purpose of obtaining detailed locations of underground obstruction, make excavations in advance of the Work. Advance the excavation sufficiently to allow re-alignment of the Work without impact to the schedule should obstructions be encountered. Consider such Work as incidental to the Work involved, and no separate payment will be made for such Work.

5.3 PREPARATION

- A. Site excavation permit must be completed and submitted to CM for approval prior to initiating excavation.
- B. Prepare Site for excavation Work including clearing and grubbing; inspection and sealing of permanent structures; and establishment of property boundaries, excavation limits, and pre-excavation elevations.

SECTION 310000 - EARTHWORK

- C. Demolish and dispose of all remaining non-permanent structures/items scheduled for removal or removal and replacement in-kind, as shown on the Drawings.
- D. Identify required lines, levels, contours, and datum locations.
- E. Locate, identify, and protect utilities from damage. Confirm locations of buried utilities and structures (if any) by suitable means.
- F. Arrange for Dig Safe to identify and stake out utilities prior to beginning Work.
- G. Protect plant life, trees, and other features not scheduled for removal. Trees must be approved by Construction Manager.
- H. Maintain and protect from damage benchmarks and survey control points, monitoring wells, utilities, buildings, building foundations, surface features, and any other structures encountered not designated for demolition or removal. In the event of disturbance of or damage to any such structures, immediately notify Construction Manager. Any damage or disturbance to such structures resulting from Contractor activities shall be repaired by the Contractor, to the satisfaction of the Construction Manager, at no additional cost to the Owner.
- I. Install sediment and erosion control devices.

5.4 SHEETING AND BRACING

- A. Installation
 - 1. Furnish, place, and maintain such sheeting, bracing, and shoring as may be required to support the side and ends of excavations in such manner as to prevent any movement which could, in any way, injure the pipe, structures, or other Work; diminish the width necessary for construction; otherwise damage or delay the Work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.
 - 2. In no case will bracing be permitted against pipes or structures in trenches or other excavations.
 - 3. Sheeting shall be driven as the excavation progresses and in such manner as to maintain pressure against the original ground at all times. The sheeting shall be driven vertically with the edges tight together, and all bracing shall be of such design and strength as to maintain the sheeting in its proper position.

SECTION 310000 - EARTHWORK

4. The Contractor shall be solely responsible for the adequacy of all sheeting and bracing. The Contractor shall hire a Professional Engineer licensed in the Commonwealth of Pennsylvania to design all excavation support.

B. Removal

1. In general, all sheeting and bracing, whether of steel, wood, or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or structural foundation shall not be withdrawn, unless otherwise directed, before more than 6 inches of earth is placed above the top of the pipe or structural foundation and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with equipment especially adapted for the purposes.
2. Do not remove sheeting and bracing until the Work has attained the necessary strength to permit placing of backfill.

C. Left in Place

1. If the Contractor files a written request for permission to leave sheeting or bracing in the trench or excavation, the Construction Manager may grant such permission, in writing, on condition that the cost of such sheeting and bracing be assumed and paid by the Contractor, at no additional cost to the Owner.
2. In case sheeting is left in place, it shall be cut off or driven down as directed so that no portion of the same shall remain within 12 inches of the street subgrade or finished ground surface. The locations and depth elevations of all sheeting left in place shall be marked on the Drawings and submitted to the Construction Manager at Project completion.

5.5 EXCAVATION

- A. **General Requirements:** Excavation shall include the removal of all types of materials encountered without exception. Excavated material approved for backfill may be stored at an approved convenient site for reuse. All excavation shall be made to the lines and grades indicated on the drawings or as specified herein.

SECTION 310000 - EARTHWORK

- B. Upon reaching the required subgrade, all loose dirt and debris shall be removed from the excavation.
- C. After completion of excavation work, and prior to commencement of work on the structures, fill or backfill, the excavation shall be inspected by the Contractor to ensure that suitable foundation elevations have been reached and the surfaces have been properly prepared. The excavation shall be protected from wash by tide, storm, and surface run-off.
- D. Shoring and Bracing: The Contractor shall provide all shoring, bracing, and sheeting of excavations required to properly and safely complete the work as shown on the drawings and in accordance with current OSHA guidelines. Shoring, bracing, and sheeting shall be removed as the excavations are backfilled in a manner to prevent caving. Dikes shall be employed to prevent surface run off from entering the excavation.
- E. Bailing and Pumping: The Contractor shall perform all bailing and pumping necessary to drain and keep all excavation, pits, trenches, foundations and the entire site free of water during the progress of the work. Proposed methods and equipment for dewatering shall be submitted to the Engineer, prior to use, and be suitable for the conditions.
- F. Over-Excavation: Over-excavation shall be corrected by placing and compacting suitable backfill material to a density of 95% Modified Standard Procedures for dry density as determined by ASTM 1557. Contractor shall perform field test using nuclear gauges to determine in-place density of moisture content (PA Test Method No. 402) and submit results to the Engineer.
- G. Make excavations to such angles of repose as may be required by OSHA guidelines and to keep the base area of excavations free from sliding or falling debris, as required for the safety of personnel working within the excavation as permitted by prior consent of the Owner.
- H. Dispose and record all excavated material not suited for backfill off the site. Suitable material for backfill may be retained and stockpiled adjacent to the excavation with prior approval of the Owner.
- I. Do not stockpile backfill in any area that can hinder dock operations or which shall prevent the free runoff of surface water, or slope excavation to prevent free runoff, and provide embankments, as shall be required to prevent the entry of surface water into any excavation.
- J. Keep the excavations free of standing or running water, and provide all equipment and perform all work to permit the work to be carried on

SECTION 310000 - EARTHWORK

therein. Take care that removed water does not cause washing or injury to the work.

5.6 STORAGE & DISPOSAL OF MATERIALS

A. Topsoil

1. Topsoil suitable for final grading shall be removed and stored for future reuse separately from other excavated material.
2. All topsoil which is planned to be stored for longer than 30 days shall be hydroseeded within 5 days of being stockpiled.

B. Excavated Materials

1. All excavated materials shall be stored in locations approved by the Construction Manager so as not to endanger the Work and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed.
2. Special precautions must be taken to permit and not restrict emergency services access to all areas of the Site and at all times.
3. Topsoil and excavated material shall not be removed from the Site unless otherwise directed by the Construction Manager.

C. Spoil Material

1. Spoil material shall be placed at pre-approved stockpile locations, as directed by the Construction Manager. Locating, maintaining, and transporting to the stockpiles shall be the responsibility of the Contractor at no additional cost to the Owner.
2. Unsuitable spoil material shall be disposed of at a location on site, identified by the Construction Manager. Locating, maintaining, and transporting to such Sites shall be the responsibility of the Contractor at no additional cost to the Owner.
3. When it is necessary to haul material over the streets or pavement, provide suitable tight vehicles so as to prevent deposits on the street or pavements. In all cases where any materials are dropped from the vehicles, clean same as often and as continuous as required to keep the crosswalks, streets, and pavements clean and free from dirt, mud, stone, and other hauled material.

5.7 BACKFILLING

SECTION 310000 - EARTHWORK

A. General

1. All excavations shall be backfilled to original grade or to such other grades as may be shown, specified, or directed.
2. Backfilling shall be done with suitable excavated materials which can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, the Owner will provide a stockpile of suitable material from off-site and provide to the Contractor at the site.
3. Backfilling around structures shall not be commenced before the structure has developed sufficient strength to withstand the loads applied. No backfill material shall be allowed to fall directly on a structure until at least 12 inches of material have been placed and compacted, nor shall any material be pushed directly against a structure in backfilling.
4. Backfill shall be deposited in loose horizontal layers not exceeding 8 inches in thickness and at no greater thickness than can be compacted to obtain the specified minimum densities.
5. Any settlement occurring in the backfilled excavations shall be refilled and compacted.
6. Backfilling operations shall not be permitted next to recently installed concrete until the concrete has cured for a minimum of seven (7) days.

B. Compaction and Density Control

1. The compaction shall be as specified for the type of earthwork (i.e., structural, trenching, or embankment).
 - a. Compact to achieve a 95% modified proctor density, in accordance with ASTM D1557.
 - b. The compaction specified shall be the percent of maximum dry density.
 - c. The compaction equipment shall be suitable for the material encountered.

SECTION 310000 - EARTHWORK

2. Where required to assure adequate compaction, in-place density test shall be made by an approved testing laboratory, at no additional cost to the Owner.
 - a. The moisture-density relationship of the backfill material shall be determined by ASTM D 1557, Method C.
 - 1) Compaction curves for the full range of materials used shall be developed.
 - b. In-place density shall be determined by the methods of ASTM D1556 or ASTM D2922 and shall be expressed as a percentage of maximum dry density.
3. Where required, to obtain the optimum moisture content, add, at no additional cost to the Owner, sufficient water during compaction to assure the specified maximum density of the backfill. If, due to rain or other causes, the material exceeds the optimum moisture content, it shall be allowed to dry, assisted if necessary to meet the schedule, at no additional cost to the Owner, before resuming compaction or filling efforts.
4. Compaction is not completed unless approved by the Construction Manager.

C. Unsuitable Materials

1. Stones, pieces of rock, or pieces of pavement greater than 1 cubic foot in volume or greater than 1½ feet in any single dimension shall not be used in any portion of the backfill.
2. All stones, pieces of rock, or pavement shall be distributed through the backfill and alternated with earth backfill in such a manner that all interstices between them shall be filled with earth.
3. Frozen earth shall not be used for backfilling.

5.8 PROTECTION

- A. Take all necessary precautions for the safety and protection of employees and the public, with specific consideration of neighbors.
- B. Provide and daily maintain all safeguards, barriers, fences, bridges, planking, shoring, danger and warning signs, flares, lights, and detours.

SECTION 310000 - EARTHWORK

- C. Prior to any excavation, backfilling or construction operations, adequately protect by shoring, sheet piling or other means all structures, paving, utilities, and other existing objects from damage.
- D. Should a utility or service line be disrupted or otherwise damaged, arrange for the immediate restoration of the temporary service until substantial and proper corrective repairs and/or replacement can be made. Immediately inform the Owner, the Engineer, and the utility company. Provide a written statement of the occurrence within 24 hrs to the Owner and the Engineer.
- E. When, for any reason, the Work is to be left unfinished, all trenches and excavations shall be filled and all roadways, sidewalks and watercourses left unobstructed with their surfaces in a safe and satisfactory condition. The surface of all roadways and sidewalks shall be restored with gravel until the final asphalt or concrete surface is installed.
- F. Where an existing utility, service, equipment, or facility is damaged, the same shall be repaired to its original condition at no cost to the Owner.
- G. The Contractor shall be responsible for all damage or injury done to pipes, structures, property or persons due to improper placing or compacting of backfill.
- H. It shall be the sole responsibility of the Contractor to control the dust created by any and all of his operations to such a degree that it will not endanger the safety and welfare of the general public.
- I. Dust control may require use of a water truck. When necessary, water trucks shall be supplied by the Contractor at no cost to the Owner.

5.9 UNAUTHORIZED EXCAVATION

- A. Description
 - 1. Whenever excavations are carried beyond or below the lines and grades shown on the Drawings, or as given or directed by the Construction Manager, all such excavated space shall be refilled with special granular materials, concrete, or other materials as the Construction Manager may direct. All refilling of unauthorized excavations shall be at no additional cost to the Owner.
 - 2. All material which slides, falls, or caves into the established limits of excavations due to any cause whatsoever, shall be removed and disposed of at no additional cost to the Owner and no extra compensation will be paid to the Contractor for any materials

SECTION 310000 - EARTHWORK

removed and disposed, and any materials required for refilling the void areas left by the slide, fall, or cave-in.

- END OF SECTION -

SECTION 313700 - RIPRAP

PART 1: GENERAL

1.1 SCOPE

- A. This section includes all work necessary for the placement of riprap stone and the underlying geotextile fabric as indicated on the contract drawings.

1.2 MEASUREMENT AND PAYMENT

- A. Riprap Stone

- 1. General

Measurement and payment for all stone materials shall be performed on a per ton basis as placed. No payment will be made for stone material which is placed in excess of the requirements shown on the plans. Tolerances provided in Section 5.6 are to be considered for re-work, but will not be considered for additional payment. Quantities will be computed to the nearest whole ton. For conversion purposes, cubic yards will be converted to tons according to the Table 1.2-A-4.

- 2. Truckload

- a. Each truckload will be weighed to the nearest 0.10 ton and the final quantity rounded to the nearest whole ton. Riprap stone will be measured for payment by weighing on approved scales before being placed in the work. Scales shall be of sufficient length to permit simultaneous weighing of all axle loads and shall have an accuracy within 0.2 percent (0.2%) throughout the range of the scales. The scale's accuracy shall conform to the applicable requirements of the *National Institute of Standards and Technology Handbook No. 44 for Specification Tolerances and Requirements for Commercial and Weighing Devices* (NIST HB 44) and shall be certified by an acceptable scale company representative and by an inspector of the State Inspection Bureau charged with scales inspection within the state in which the project is located prior to weighing any stone. A scale shall not be used for weighing a load totaling more than the nominal capacity marked on the scale by the manufacturer. If commercial scales are readily available in close proximity (within 10 miles) of the worksite, documentation shall be submitted certifying that the scales meet the requirements of the NIST HB 44 specification.

SECTION 313700 - RIPRAP

- b. Furnish the scales and weigh the stone in the presence of the Engineer. Scales will be checked and certified before hauling stone.
- c. The total weight of a single highway vehicle shall be weighed as a single draft and shall not be determined by adding together the results obtained by separately weighing each end of such vehicle, except that weighing of a coupled combination may be determined without uncoupling under the following conditions:
 - i. The brakes are released.
 - ii. There is no tension or compression on the drawbar.
 - iii. The approaches are straight and in the same level plane as the scale platform.
 - iv. The approaches are paved at least fifty feet (50') in each direction with a seal coat or higher type surfacing.
 - v. The approaches are of sufficient width and length to ensure level positioning of vehicles during the weighing operation.
- d. The print-out system shall print the following information on a triplicate ticket for each truckload:
 - i. Time
 - ii. Date
 - iii. Sequential ticket number (may be preprinted on ticket)
 - iv. Gross Weight
 - v. Tare Weight (trucks shall be tare weighed at least twice daily)
 - vi. Net Weight
 - vii. Net accumulated job daily total
 - viii. Truck identification number
 - ix. Project Number
 - x. Type of material
 - xi. Quarry location
 - xii. Contractor's name
 - xiii. Scale operator's stamp or number
 - xiv. Scale operator's signature or initials
- d. The system shall be so interlocked as to allow printing only when the scale has come to a complete rest. Ticket numbers do not have to be in sequential order; however,

SECTION 313700 - RIPRAP

they must appear in a reasonable sequence. The Engineer reserves the right to reject tickets grossly out of sequence.

- e. Weigh bills, including print-outs, shall be certified by the signature of the scale operator, which shall attest that the information shown on the weigh bill is correct and is the weight(s) observed on the scale at the time of weighing. Each weigh bill shall also be certified by the supplier attesting that the entire load was properly placed in the work, and shall show the time and date of weighing and the time and date of unloading. Each truck shall be plainly marked by a distinctive number, letter, or name, which shall not be changed or given to any other truck during the contract period. The Owner reserves the right to periodically inspect the weighing operations at the scales.

3. Barge or Vessel

A. Gauges

If stone is delivered by vessel or barge, the carrier shall, prior to use in connection with this work, be fitted by the Contractor at his own expense with gauges or such other facilities for determining displacement as may be required by, or be satisfactory to, the Engineer. Carriers which owing to their model or other cause cannot be accurately gauged for displacement shall not be used for this work. Gauges shall be graduated to the tenth of a foot, or to other suitable unit approved by the Engineer. They shall be six (6) in number and shall be located as follows: Two (2) near each end on opposite sides, and two (2) at midship on opposite sides. The gauges shall be attached solidly to the hull, and wherever practicable, shall be located inside the hull. If located inside the hull, provisions shall be made for the free passage of the outside water to a vertical tube and for the ready measurement of the depth of the water within the tube. If located outside on wood hulls, the gauges shall be protected by solid fenders or be recessed into the planking, or if on steel hulls, the gauge marks may be placed directly on the plates and identified by punch marks. Gauges shall be so placed that their zeros are below water when the carrier is in its normal trim, light and free from water. The installation of the gauges shall be subject to the approval of the Engineer. The Engineer shall be notified a minimum of five (5) work days prior to installation of gauges.

SECTION 313700 - RIPRAP

B. Gauging Tables

To facilitate the determination of the weight of each load, a gauging table for each carrier employed shall be prepared by an accredited agent satisfactory to the Engineer. The gauging table shall show the cargo weight, in tons of 2,000 pounds, for each unit of measurement of the draft. If the lines of the carrier are such that the cubic feet of displacement for each measured unit of draft can be accurately calculated, the gauging table shall be based upon the data, using 62.4 pounds as the weight of one cubic foot (1 CF) of water. If the lines of the carrier to be gauged are such as to render impracticable the preparation of the gauging table by the above described method, the weight for each unit of draft shall be determined by measurement of displacement by actually loading stone of known weight and the weight thus obtained shall be entered in the table for use in subsequent gaugings. If alterations are made in any carrier which will affect the accuracy of the gauging table after it has been prepared, or if otherwise deemed necessary at any time by the Engineer, the carrier shall be re-measured and a new gauging table prepared.

C. Reading of Draft Gauges

Readings to determine the draft will be taken before and after unloading, and the difference in tonnage thus found. The difference between loaded & unloaded displacements will be used to determine the net weight for payment. The mean draft of a barge shall be determined by the following equation:

$$\text{Mean draft} = (G1 + G2 + G3 + G4 + G5 + G6) / 6$$

where:

G1: Forward Starboard
G2: Forward Port
G3: Midship Starboard
G4: Midship Port
G5: Aft Starboard
G6: Aft Port

The Engineer shall be present at all draft gauge readings. Rejected stone and unacceptable material shall be left

SECTION 313700 - RIPRAP

aboard the barge until after the final readings have been taken.

D. Uniform Loading

The carrier shall be so loaded as to cause uniform submergence. The increase in draft on the middle gauges as a result of the load shall not differ by more than 0.5 feet from each side, and that between any bow gauges and any stern gauges shall not differ more than 1.5 feet from each other. If such is not the case, the Contractor shall trim the carrier by shifting the stone until this limit is reached, before the stone will be accepted. However, if the carriers proposed to be used by the Contractor are so built that they cannot be loaded as prescribed, and can be calibrated accurately for displacement under varying loads; another method of determination of displacement may be used if approved by the Engineer.

E. Readings in Still Water

All measurements for determining gauging table data and for load depths shall be made in still water as close to the work as is possible. The Contractor is required to place the carriers where such measurements can be accurately made.

F. Leaks

All carriers used in transporting stone shall be free of leaks such as would render accurate gauging difficult. Facilities for inspecting the hold of each carrier to determine whether leakage is occurring shall be provided. Each carrier shall also be provided with adequate pumping facilities, and the carrier shall be pumped dry before each gauging before unloading, and limbers shall be kept open so that any water in the vessel will flow freely to the pump suction.

G. Variations During Unloading Operations

Lightening by pumping or by transfer of crews or supplies will not be permitted while stone is being discharged. Should any lightening become necessary, the unloading of stone shall be suspended and the load marks shall be taken in such manner as to insure against loss from this cause.

H. Carrier Designations

SECTION 313700 - RIPRAP

Each carrier shall be plainly marked by a distinctive number, letter or name, which shall not be changed or given to any other carrier during the contract period.

I. Verification of Measurements

The readings, calculations and other data from which the gauging table and the tonnage are determined will be open to verification by the Contractor and shall be subject to the approval of the Engineer. The Contractor is invited to be present in person or to be represented by an authorized agent during the measuring of carriers. When the displacements of the carriers are determined or re-determined, a record of allowed displacement for quantity determination will be sent to the Contractor. If the Contractor protests within five (5) days, the carrier will be re-measured and the Contractor must be present in person or be represented by an accredited agent so that correct measurements can be agreed upon. The Contractor will be given the weight of each load as it is determined. Failure to protest within five (5) days will be taken as equivalent to expressing satisfaction with the measurements and weight of stone determined by the Engineer.

4. Determination of Excess Stone

All stone outside the limits and tolerances of the cross sections of the structure, except variations so minor as not to be measurable, will be deducted from the quantity of new stone for which payment is to be made. The weight of excess stone will be determined from the cross sections obtained by the method provided for in paragraph Section 1.2-A-6, on the basis that the cubic feet of volume (including voids) for each type of stone, as listed in Table 1.2-A-4 is equal to one ton for the bulk specific gravity and percentage of voids shown. If the bulk specific gravity of the stone furnished or the percentage of voids is other than as listed below, the cubic feet of volume equaling one ton shall be recomputed as described in paragraph Section 1.2-A-6.

Should any excess stone be disclosed above the tolerance line as defined in Section 5.5, its volume will be computed by the average end area method, based upon the cross section in the following manner. The average end area of excess stone above the tolerance line for two (2) successive cross sections, multiplied by the distance between the cross sections will be accepted as the

SECTION 313700 - RIPRAP

volume. The Contractor will not be required to remove such excess stone and deductions for the weights thereof will be made from contract payments for new stone. In addition to the above, stone which has been delivered to the site and has been lost, wasted or otherwise not properly incorporated into the final required work shall be deducted from the quantity for which payment is to be made.

TABLE 1.2-A-4 WEIGHT-TO-VOLUME CONVERSION PROPERTIES		
NCSA No.	Specific Gravity (SSD)*	% Voids
R-3	2.5	30 %
R-4	2.5	30 %
R-5	2.5	30 %
R-6	2.5	30 %
R-7	2.5	30 %
R-8	2.5	30 %
AASHTO No.	Specific Gravity (SSD)*	% Voids
3	2.5	30 %
57	2.5	30 %

*SSD = Saturated Surface Dry

5. Final Surveys

Survey work and measurements required for determination of excess volume computations for stone materials shall be performed in the presence of the Engineer. Notify the Engineer not less than three (3) days in advance of each survey. Determination of quantities will be made by the Engineer and having once been made, will not reopen, except on evidence of collusion, fraud or obvious error. Conduct Surveys in accordance with Section 5.5. Stone quantity computations shall be based entirely upon weights of new stone as determined from carrier displacement or certified scale weight tickets.

6. Revision of Bidding Schedule Quantities

The estimated quantities of stone listed in the Contract Drawings were computed on the basis of stone having a percentage of voids and a bulk specific gravity as listed in Table 1.2-A-4, based on

SECTION 313700 - RIPRAP

water having a unit weight of 62.4 pounds per cubic foot. When the bulk specific gravity (SSD) of the stone to be used in the work is other than that described above, the estimated quantities will be revised by multiplying them by the fraction which results when the bulk specific gravity (SSD) of the stone furnished is divided by the value described above for each respective stone gradation. Revision for the percentage of voids will likewise be made. The Engineer will issue a modification to the contract. The revised quantities will then be the quantities from which the allowable fifteen percent (15%) variation in estimated quantity, for payment purposes, will be determined as defined in the Contract.

B. Geotextile

1. Measurement and payment for geotextile fabric shall be performed on a per square-foot (SF) basis as installed. Payment will be made only for the net area of geotextile installed, and this quantity shall not include any additional material for overlap of the individual pieces.

PART 2: PRODUCTS

2.1 RIP-RAP STONE

- A. Rip-rap stone shall be sized and graded in accordance with National Crushed Stone Association (NCSA) regulations:

TABLE 2.1-A			
NCSA RIP-RAP PARTICLE SIZE DISTRIBUTION			
NCSA Size No.	Percent Passing (Square Openings)		
	100%	15-50%	0-15%
R-3	6 in	3 in	2 in
R-4	12 in	6 in	3 in
R-5	18 in	9 in	4 in
R-6	24 in	12 in	6 in
R-7	30 in	18 in	12 in
R-8	42 in	24 in	15 in
AASHTO CRUSHED STONE PARTICLE SIZE DISTRIBUTION			
AASHTO No.	Percent Passing (Square Openings)		
	100%	25-60%	0-15%
3	2.5 in	1.5 in	1.0 in
57	1.5 in	0.5 in	0.2 in

SECTION 313700 - RIPRAP

- B. The stone shall be free from structural defects. No shale seams.
- C. The stone shall be clean and free from any foreign substances such as soil, shale and organic materials.
- D. The stone shall be hard and angular shaped rock with neither width nor thickness less than one-third its length.
- E. The stone shall have a minimum bulk-saturated, but surface-dry specific gravity of 2.5 (unit weight of 155 PCF).
- F. The stone shall have an absorption of 2% or less in accordance with ASTM C127.

2.2 GEOTEXTILE FABRIC (IF REQUIRED BY PLANS)

- A. The fabric shall consist of long chain polymeric filaments or yarns such as polyethylene, polyamide, polyvinylidene-chloride, polypropylene or polyester formed into a stable network.
- B. The fabric shall be inert to commonly encountered construction chemicals and substances.
- C. The contractor is responsible for installing the fabric and keeping the fabric in place, above and below water, by using securing pins or other appropriate methods.
- D. The geotextile shall meet the requirements specified in PennDOT Publication 408, Section 735 for Class 4 Separation Geotextile as summarized in Table 2.2-D

TABLE 2.2-D GEOTEXTILE PHYSICAL REQUIREMENTS		
Property	Test Method	Requirements
Grab Tensile Strength	ASTM D4632	270 lbs
Grab Tensile Elongation	ASTM D4632	15-50%
Burst Strength	ASTM D3786	430 psi
Puncture	ASTM 4833	100 lbs
Trapezoid Tear Strength	ASTM D4533	100 lbs
Apparent Opening Size Sieve No.	ASTM D4751	> No. 50 sieve

SECTION 313700 - RIPRAP

Permeability, K	ASTM D4491	$K_{fabric} \geq 10 K_{soil}$
Seam Strength	ASTM D4632	240 lbs
Ultraviolet Resistance Strength Retention	ASTM 4355	70% @ 150 hrs

PART 3: SUBMITTALS

3.1 SUBMIT THE FOLLOWING FOR APPROVAL:

A. Stone Source

The Contractor shall submit the source for stone materials for approval prior to procurement of the materials. The right is reserved to reject materials from certain localized areas, zones, strata or channels when such materials are deemed unsuitable for use by the Engineer. The Engineer also reserves the right to reject individual units of produced specified materials in stockpiles at the quarry when such materials are determined to be unsuitable.

B. Testing Agency

The Contractor shall submit a copy of the documents, provided by the Materials Testing Center (MTC) at CEWES, that validates that the laboratory to be used for testing can perform the required tests. The individual tests shall be listed for which the validation covers along with the date of the inspection.

C. Stone Testing

The Contractor shall submit the results for testing of the stone materials as indicated in Table 3.1-C. Samples representative of the quarry shall be taken randomly by a quarry representative under the supervision of the Engineer.

TABLE 3.1-C TESTING OF STONE MATERIALS			
Description	Requirements	Designation	Frequency
Gradation Curves	Table 2.1-A	ASTM D5519	Prior to Delivery
Petrographic Examination	see stone description	ASTM C295	Prior to Delivery
Density	≥ 155 pcf (SSD)*	ASTM C127-88	Prior to Delivery

SECTION 313700 - RIPRAP

Absorption	≤ 2%	ASTM C127-88	Prior to Delivery
Soundness: (Sodium Sulfate)	≤ 5% (one cycle) ≤ 12% (five cycles)	ASTM C88-90	Prior to Delivery
Soundness: (Magnesium)	≤ 8% (one cycle) ≤ 18% (five cycles)	ASTM C88-90	Prior to Delivery
Abrasion	≤ 45%	ASTM C535	Prior to Delivery

*SSD = Saturated Surface Dry

D. Weigh Scale Certification

The Contractor shall submit a copy of the certification from the regulation agency attesting to the scale's accuracy.

E. Stone Shipment

1. Shipment by Truck

The Contractor shall submit a copy of each certified weight scale ticket within three (3) days after weighing.

2. Shipment by Barge or Vessel

The Contractor shall submit a freshwater displacement table for each barge/vessel to be used for transporting stone during the duration of the work not less than ten (10) days prior to unloading the stone from any barge/vessel. Each table submitted shall show the name and/or number of the barge/vessel, name of the owner, the name of the fabricator, and the certification and date of certification of the person or firm preparing the table. Furnish a drawing or sketch of each barge/vessel, including dimensions of sufficient detail to permit checking of the tables. The drawings shall show, as a minimum, the length, width, depth, and dimensions of the rake(s). Each such table shall have its accuracy certified by a person or firm, other than the Contractor, customarily performing this service. Each table submitted shall contain, in parallel columns, the freeboard of the barge/vessel in feet and inches from zero to the full depth of the barge/vessel and the corresponding gross displacement to the nearest ton.

F. Geotextile Material Data

SECTION 313700 - RIPRAP

The Contractor shall submit manufacturer's product and test data for the geotextile fabric prior to procurement.

G. Surveys

The Contractor shall submit all raw and processed survey data which has been obtained in accordance with Section 5.5.

PART 4: QUALITY ASSURANCE

4.1 REFERENCE

- A. Comply with the provisions specified in the latest revision of the following codes and standards and specifications, including all supplements and addenda:
1. International Building Code (IBC)
 2. City of Philadelphia Building Code
 3. Occupational Safety and Health Administration (OSHA) – As required by the state and federal regulations.
 4. National Crushed Stone Association (NCSA)
 5. Commonwealth of Pennsylvania Department of Transportation (PennDOT), Publication 408
- B. Comply with the provisions specified in the latest revision of the following ASTM standards, including all supplements and addenda:
1. ASTM D 4992 – Evaluation of Rock to Be Used For Erosion Control
 2. ASTM D 5312 – Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions.
 3. ASTM D 5313 – Evaluation of Durability of Rock for Erosion Control Under Wetting and Dryong Conditions.
 4. ASTM D 5519 – Particle Size Analysis of Natural and Man-Made Riprap Materials

SECTION 313700 - RIPRAP

- C. The more stringent provisions shall govern where provisions of pertinent codes and standards conflict with these specifications or conflict with one another.

PART 5: EXECUTION

5.1 PROTECTION

- A. Take all necessary precautions for the safety and protection of employees and the public, with specific consideration of neighbors.
- B. Provide and daily maintain all safeguards, barriers, fences, bridges, planking, shoring, danger and warning signs, flares, lights and detours.
- C. Prior to any stone placement or construction operations, adequately protect all structures, paving, utilities and other existing objects from damage. If any damage to existing structures occurs as a result of construction operations, it shall be repaired by the Contractor at no additional cost to the Owner.

5.2 RIP-RAP STONE

- A. Consider construction sequence prior to placing rip-rap; i.e. complete pile driving operations prior to placing stone.
- B. Stone shall be placed by equipment suitable for handling materials of the size specified.
- C. Do not damage or disturb any structures, underground piping, conduit and other facilities during construction operations. Any damage to existing structures shall be identified and corrected by the Contractor at no expense to the Owner.
- D. Do not place any stone material around any new concrete until fourteen (14) days after concrete is cast.
- E. Stone shall be placed from the toe upwards in a manner that minimizes voids within the placed material and provides an even distribution of pieces.
- F. Place the full course thickness in one operation in a manner to prevent segregation and to avoid displacement of the underlying material. Placing of rock in layers by dumping into chutes or by similar methods which are likely to cause segregation or geotextile damage will not be permitted.

SECTION 313700 - RIPRAP

- G. The stone shall be placed in the locations and thicknesses shown on the Contract Drawings. Rearrange individual stones, as necessary, to achieve the indicated grading and to insure uniform distribution.
- H. The Contractor shall place the stone using methods that do not damage or displace the underlying geotextile fabric.
- I. Above Water Placement
 - 1. No stones shall be dropped from a height of more than three feet (3 ft), and rocks larger than two feet (2 ft) in dimension shall not be dropped directly on the fabric from heights greater than one foot (1 ft).
- J. Under Water Placement
 - 1. Stones may be dropped from the surface of the water where water depths exceed five feet (5 ft).
- K. The Contractor must keep the waterway free of any surplus stone material and construction debris. The Contractor shall remove and dispose of offsite any said materials prior to demobilization.

5.3 GEOTEXTILE

- A. Geotextile fabric shall be placed in a manner as to avoid any wrinkles or folds within the material. Lay the fabric flat on the ground surface without stretching and to avoid puncturing or tearing the fabric.
- B. The end of the geotextile fabric shall be embedded within the toe and head of the stone material as indicated on the Contract Drawings.
- C. Adjacent pieces of geotextile fabric shall be overlapped with each other a minimum distance of three feet (3 ft). Offset adjacent roll ends a minimum of five feet (5 ft) when lapped. The Contractor may sew the fabric seams in lieu of overlapping.
- D. The Contractor shall be responsible to secure the geotextile in its proper location, both above and below water, by using securing pins, proper overlap directionality and any other methods as required. Any fabric that is displaced from its proper location and alignment shall be realigned or replaced.
- E. During shipment and storage, protect the fabric from direct sunlight, ultra-violet rays, temperatures greater than 140° F, mud, dust, dirt and debris.

SECTION 313700 - RIPRAP

- F. Geotextiles will be rejected at the time of installation if any defects, deterioration or damage is evident.
- G. No traffic or construction equipment will be permitted on the fabric.
- H. Do not allow the fabric to be exposed for more than two (2) weeks prior to covering with stone.

5.4 FINISH:

- A. All areas shall be finished to smooth compact surfaces to the lines and grades indicated on the drawings.
- B. All slopes shall be finished accurately to a uniform slope, free from humps and hollows and shall conform to the cross sections shown on the drawings. Care shall be exercised to avoid loosening of material beyond the required slopes.

5.5 HYDROGRAPHIC SURVEYS

- A. The Contractor shall conduct an initial hydrographic survey to determine quantities of stone. A final hydrographic survey (or multiple surveys) will be necessary to determine the finished profile of the rip-rap. Survey work and measurements required for determination of volume computations for stone materials shall be performed in the presence of the Engineer. Notify the Engineer not less than three (3) days in advance of each survey.
- B. Determination of quantities will be made by the Engineer and having once been made, will not be revised, except on evidence of collusion, fraud or obvious error. Prior to performing any work under this Section, coordinate all operations with the Engineer so that excess volume surveys will be made at the appropriate time. Stone quantity computations shall be based entirely upon weights of new stone as determined from carrier displacement or certified scale weight tickets.
- C. Hydrographic surveys to verify the thickness and limits of stone placed under this Contract will be accomplished with the use of a survey vessel having an automated acquisition system. Surveys shall be performed by a licensed surveyor hired by the Contractor. The horizontal location of survey lines and depth sounding points shall be determined by the use of an automated positioning system utilizing a differential global positioning system.

SECTION 313700 - RIPRAP

- D. All hydrographic surveys conducted shall follow the guidelines as referenced in the Corps of Engineers Hydrographic Survey Manual EM 1110-2-1003, dated 01 January 2002. Electronic single beam cross sections, on 50-foot station intervals, with the readings at one foot (1 ft) intervals and at breaks in the grade along the line, shall be utilized to compute the volume of material placed. All electronic echo sounders shall operate nominally at 200 khz, + 10% of the frequency. On automated surveys, position and depth data shall be collected, stored digitally, and subsequently submitted to the Engineer for review.
- E. All stone placed shall be measured for verification of stone layer thickness, by computing the difference in elevation between the bottom surface shown by the soundings of the initial survey performed by the Contractor immediately before placement and the bottom surface of an after-placement survey performed by the Contractor made as soon as practicable after placement.
- F. If the survey reveals grades that are out of tolerance or otherwise unacceptable, the Contractor shall perform the necessary grading adjustments and perform an additional hydrographic survey for the local areas of concern at no additional cost to the Owner. The Contractor shall be required to place additional stone to be compliant with the Contract Documents.

5.6 TOLERANCES:

- A. The range for tolerances for dimensions and slopes indicated for finished stone and excavation surfaces on the Contract Drawings shall be bounded on the top by a line that is parallel to the indicated slope and that is six inches (6 inches) above the slope measured perpendicularly and on the bottom by the stone slope as indicate don the Contract Drawings.
- B. The tolerance for all dimensions indicated in the contract drawings shall be +12/-0 inches.
- C. Tolerances are not additive.
- D. The contractor shall add/remove stone/earth as necessary such that final slopes and dimensions are within the tolerances specified above.

- END OF SECTION -

SECTION 316219 – TIMBER PILES

PART 1 : GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings, Contract Provisions, Special Provisions, Supplementary Conditions, and Division 01 Specification Sections apply to this Section.

1.2 SUMMARY

- A. The work shall consist of installing test piles, if required, and 25 ton timber production piles of such dimensions and at such locations as are shown on the drawings.

PART 2 : PRODUCTS

2.1 MATERIALS

- A. Timber Piles

- 1. Piles:

- a. ASTM D25, Southern Pine, clean peeled, one piece, non-spliced, friction type.

- 1. Treatment:

- a. Where treated piles are required by the Contract Documents, the piles shall be treated in accordance with this section.
 - b. Piles shall be pressure treated in accordance with AWPA C3, C18, M4 and UC4C.
 - c. Piles shall be treated with either Chromated Copper Arsenate (CCA) or Ammoniacal Copper Zinc Arsenate (ACZA).
 - d. Piles shall have a preservative retention in accordance with AWPA. Typical retention is 0.8 pcf for CCA and 1.0 pcf for ACZA.
 - e. Piles shall not be treated with Creosote or other carcinogenic materials.

- 2. Dimension:

SECTION 316219 – TIMBER PILES

- a. The minimum tip diameter shall be 8 inches, unless noted otherwise on the Contract Drawings.
 - b. The diameter located 3 feet below the butt shall be based on standard taper and the length of the pile.
3. Splices will not be permitted.
 4. Provide shop testing and inspection of wood piles under provisions of the applicable ASTM sections.

PART 3 : SUBMITTALS

3.1 GENERAL

- A. The Contractor shall submit the items contained in this section for review and acceptance, in accordance with the Contract.

3.2 SUBMITTAL ITEMS

- A. The Contractor shall submit detailed drawings, pile driving hammer and equipment specifications, and driving sequence of installing piles to the Engineer for review at least four (4) weeks prior to driving piles.
- B. The Contractor shall submit material certificates for all piles that include grade, size, length and treatment, if applicable, at least two (4) weeks prior to driving piles.
- C. The Contractor shall perform and submit the results of a wave equation analysis (WEAP Analysis) to determine the suitability of the hammer to be used to drive the piles to the capacities listed on the contract drawings, ensure that anticipated driving stresses will not exceed allowable driving stresses, and develop reasonable pile driving criteria, at least two (2) weeks prior to mobilization.
- D. If pile testing *is not* specified on the contract drawings, the Contractor shall submit proposed drive criteria to the Engineer for review at least two (2) weeks prior to driving the first pile. Drive criteria shall be developed from the WEAP Analysis, if available, or the FHWA-Modified Gates formula, with appropriate factors of safety.
- E. If pile testing *is* specified on the contract drawings, the Contractor shall submit the results of each dynamic or static test, including CAPWAP analyses and proposed drive criteria, to the Engineer for review within three

SECTION 316219 – TIMBER PILES

days of testing. Drive criteria for production piles shall be developed from the CAPWAP analyses of the lowest capacity test pile in the vicinity.

- F. The Inspecting Engineer or his representative shall be at the construction site when pile installation is in progress. The Inspecting Engineer shall issue reports as required by the Engineer and shall certify that the pile installation conforms to the IBC Code, accepted engineering practice and the design approved by the Agency issuing the Building Permit.
- G. Submit copies of the driving record of each pile to the Engineer not later than two (2) days after driving. Include project name and number, name of contractor, pile size, location and number, computed pile capacity, type and size of hammer used, type of pile driving cap used, rate of operation of pile driving equipment, pile dimensions, tip elevation, elevation of butt before and after cut-off, ground elevation, continuous record of number of blows for each foot of penetration, pile deviation, pile uplift and reaction, and any unusual occurrences during pile driving.
- H. The Contractor shall submit drawings showing the installed pile locations to the Owner and Engineer upon completion of the work.

PART 4 : QUALITY ASSURANCE

4.1 REFERENCES

- A. The International Building Code (IBC).
- B. ASTM D25 - Round Timber Piles.
- C. ASTM D245 - Method for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber.
- D. ASTM D4945 – Standard Test Method for High-Strain Dynamic Testing of Deep Foundations.
- E. AWPI Timber Pile Design and Construction Manual.
- F. AWPA American Wood Preserver's Association.

4.2 QUALIFICATIONS

- A. All piles shall be installed by a piling contractor qualified to install the type of piles as specified in these plans and specifications. The Contractor shall have a minimum of five (5) years pile driving experience and evidence of a

SECTION 316219 – TIMBER PILES

satisfactory completion of at least five pile installation contracts comparable to this project in scope and subsurface conditions.

- B. ASTM and similar specifications are to be followed where they are described within these specifications.

4.3 PRE-INSTALLATION CONFERENCE

- A. The Contractor, or appropriate representative of the Contractor, shall be required to attend a pre-installation conference with the Engineer one week prior to commencing work of this Section.

4.4 CONTRACTOR'S QUALITY CONTROL REQUIREMENTS

- A. Comply with applicable provisions of Division 01 Section "Quality Requirements."

PART 5 : CONTRACTOR'S QUALITY CONTROL REQUIREMENTS

5.1 HANDLING

- A. Inspect piles when delivered and when in the planned location immediately before driving.
- B. Piles shall be handled so as to protect piles from damage, and the Contractor shall take measures to prevent damage to the pile surface during placement and driving. Repair damage or defects in the pile prior to driving.
- C. Cut piles at cutoff grade by an approved method.

5.2 PILE TESTING AND DRIVE CRITERIA

- A. Where test piles are not required by the Contract, drive criteria required to achieve the allowable bearing capacity in compression shall be determined by testing, WEAP Analysis, or the FHWA-Modified Gates Formula, as required by the contract.
- B. Where test piles are required by the Contract, perform dynamic testing of piles, as indicated on the Contract Drawings, in accordance with ASTM D4945, restrike the piles after a 24 hour waiting period, and perform CAPWAP analyses.
 - 1. Do not perform pile re-strikes using a cold hammer.

SECTION 316219 – TIMBER PILES

2. A minimum of two CAPWAP analyses shall be performed on each dynamically tested pile. One CAPWAP shall be performed at the beginning of restrike, and the other shall be performed at a depth of the Engineer's choosing.
 3. Drive criteria for production piles shall be developed from the CAPWAP analyses of the lowest capacity test pile in the vicinity.
- C. Proposed drive criteria, along with test results and CAPWAP analyses (where required), shall be submitted to the Engineer for review in accordance with Part 3 of this specification. Production piles shall not be driven until the Engineer has reviewed the proposed drive criteria and test results, and the Engineer may revise the proposed driving criteria based on the test results. Piles driven prior to the Engineer's review of the proposed drive criteria shall be at the Contractor's risk.

5.3 INSTALLATION

- A. Piles shall be located as shown on the drawings or as otherwise directed by the Inspecting Engineer after conferring with the Engineer.
- B. Do not damage piles during driving operations.
- C. Protect pile head during driving using collar, with full bearing on pile butt for even distribution of hammer blow.
- D. Deliver hammer blows to central axis of pile.
- E. If driving is interrupted before refusal, drive an additional 12 inches before resuming recording of performance data.
- F. Re-drive piles which have lifted due to driving adjacent piles, or by soil uplift. Contractor shall re-tap all heaved piles at no additional cost to the Owner.
- G. Where boulders or other obstructions make it impossible to drive certain piles in the location shown and to the proper bearing strata, the Contractor shall resort to all usual methods to install piles as required, including spudding, or other feasible means. The granular fill material near the surface shall be removed by auger to avoid artificially increasing blow count. If, in the judgment of the Inspecting Engineer, the Contractor is unable to complete properly any pile by resorting to such methods, the Inspecting Engineer may order an additional pile or piles driven for which the Contractor will be paid in accordance with unit prices in the contract. Piles abandoned because of obstructions encountered before reaching the accepted bearing strata shall be left in place and be paid for as completed piles.

SECTION 316219 – TIMBER PILES

- H. Pre-drilling is not allowed.
- I. Jetting of piles is not allowed.
- J. The Contractor shall not drive piles until excavation is complete in the area the piles will occupy.
- K. Piles shall be considered to have reached hammer refusal if driving resistance exceeds fifteen (15) blows per inch, unless noted otherwise. Notify the Engineer immediately if such resistance is encountered, so that it can be evaluated whether the pile has reached practical refusal, or whether a larger hammer is required.
- L. Piles shall be driven until they develop the minimum allowable geotechnical and structural capacities indicated in the Contract.
- M. Where geotechnical capacity or practical refusal is reached prior to achieving the minimum embedment to develop full structural capacity, the Contractor shall immediately notify the Engineer. No piles shall be cut until the Engineer has reviewed the pile records and recommended a course of action to achieve full structural capacity.
- N. Cut off tops of piles to elevations indicated and prepare pile top to receive pile cap. Treat field cuts, holes and other penetrations in accordance with AWWA M4.
- O. All pile cutoffs shall be removed from the site and properly disposed of.
- P. The Contractor shall not drive piles within fifty feet (50 ft) of new concrete until fourteen (14) days after concrete is cast.
- Q. The Contractor shall not drive piles within three feet (3 ft) of existing piles, unless noted otherwise, without written approval of the Engineer.

5.4 TOLERANCES

- A. The maximum deviation from the required plan location the pile, at its top at cut-off, shall be six inches (6 in).
- B. The maximum deviation from the required axial alignment of the pile shall be ¼ inch within 1 foot of pile length (1 degree), and not greater than six inches overall.
- C. Piles shall not be pushed, pulled, jacked, or otherwise manipulated into position or alignment.

SECTION 316219 – TIMBER PILES

5.5 TEST BORINGS

- A. Available test borings and other geotechnical criteria are provided in the geotechnical report appended to this document. The Engineer does not guarantee and will not assume any liability for the accuracy of this boring information. It is made available for the Contractor's information only, and its availability does not relieve the Contractor from visiting the site or ascertaining the existing conditions at his own expense without impeding the project schedule.

- END OF SECTION 316219 -

SECTION 316329 – DRILLED CONCRETE SHAFT

PART 1: GENERAL

1.1 SCOPE

This specification covers the construction of reinforced concrete drilled shaft foundations consisting of shaft sections, with or without casings left in place, and with or without rock sockets formed within drilled excavations.

1.2 DEFINITIONS

- A. **Bearing Strata.** Layer(s) of soil or rock providing principal support at base of shaft.
- B. **Rock Stratum.** A stratum of geomaterial having an unconfined compressive strength equal to or greater than 250 pounds per square inch that cannot be drilled with conventional earth augers or underreaming tools, thus requiring the use of special rock augers, core barrels, air tools, blasting, or hand excavation.
- C. **Shaft Section in Soil.** Length of shaft from top of shaft to top of rock stratum.
- D. **Shaft Section in Rock.** Length of shaft from top of rock stratum to top of rock socket.
- E. **Rock Socket.** Length of shaft in rock stratum below the shaft, providing a fixed connection between the shaft and the rock stratum.
- F. **Permanent Casing.** Steel pipe, typically of cylindrical shape, installed by drilling, driving, or vibrating that when filled with concrete, becomes a permanent part of the drilled shaft.
- G. **Temporary Casing.** Protective steel pipe, typically of cylindrical shape, installed by drilling, driving, or vibrating, that provides lateral earth support during shaft excavation, cleaning, and inspection; controls groundwater infiltration; and is removed as part of the concrete placement operation.
- H. **Obstruction.** A natural or manmade object above designated rock socket elevation that cannot be drilled with conventional earth augers or underreaming tools, and that requires the use of special rock augers, core barrels, air tools, blasting, or hand excavation.

PART 2: PRODUCTS

2.1 MATERIAL

SECTION 316329 – DRILLED CONCRETE SHAFT

- A. Casing. Smooth, clean, rust-free metal casing of sufficient strength to withstand handling and installation stresses and the pressure of concrete, water, and the surrounding earth; and to prevent water seepage.
- B. Cast-In-Place Concrete. Section 033000.
- C. Concrete Reinforcement Bars. Section 032000. Use deformed bars.
- D. Bentonite Slurry. A mixture of fully hydrated bentonite and clean fresh water of adequate unit weight. Submit manufacturer's specifications, type, and properties of the slurry to the Representative for approval.

PART 3: SUBMITTALS

- 3.1 The Contractor shall submit the following in accordance with Section 013300, Submittal Procedures:
 - A. Project References: At least four weeks prior to the start of drilled shaft construction, the Contractor shall submit a project reference list to the Engineer for approval, verifying 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 difficulty to those shown in the Plans, and with similar subsurface geotechnical conditions. A brief description of each project and the owner's contact person's name and current phone number shall be included for each project listed.
 - B. Experience and Personnel: At least two weeks prior to the start of drilled shaft construction, the Contractor shall submit four copies of a list identifying the on-site supervisors and drill rig operators assigned to the project to the Engineer for approval. The list shall contain 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 shall 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 Plans, and similar geotechnical conditions to those described in the geotechnical report. The work experience shall 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 shall have a minimum one year experience in construction of drilled shaft foundations.

SECTION 316329 – DRILLED CONCRETE SHAFT

3. Provide documentation to satisfactorily demonstrate experience in the use of tremie or pumping procedures for placement of concrete for drilled shafts, and submit details of the placement method for review and acceptance.

The Engineer will approve or reject the Contractor's qualifications and field personnel within ten working days after receipt of the submission. Work shall not be started 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 shall be 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.

- C. Drilled Shaft and Reinforcement Installation Plan: At least four weeks prior to the start of drilled shaft construction the Contractor shall submit a Drilled Shaft Installation Plan narrative for acceptance by the Engineer. In preparing the narrative, the Contractor shall reference the available subsurface geotechnical data provided in the Contract boring logs and any geotechnical report(s) prepared for this project. This narrative shall 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 of proposed equipment, with detailed descriptions and capacities, including but not limited to cranes, drills, augers, bailing buckets, final cleaning equipment and drilling unit. As appropriate, the narrative shall describe why the equipment was selected, and describe equipment suitability to the anticipated site and subsurface conditions. The narrative shall 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 and drilling slurry (if applicable). If appropriate this shall 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,

SECTION 316329 – DRILLED CONCRETE SHAFT

slurry, or other means) during excavation and concrete placement. The details shall include a review of method suitability to the anticipated site and subsurface geotechnical conditions.

- Detailed procedures for mixing, using, maintaining, and disposing of the slurry shall be provided. 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, shall also be provided for the proposed slurry.

The submittal shall 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 which 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, the slurry quality control plan shall include the following tests:

Property	Test Method
Density	Mud Weight (Density), API 13B-1, Section 1
Viscosity	Marsh Funnel and Cup, API 13B-1, Section 2.2
pH	Glass Electrode, pH Meter, or pH Paper
Sand Content	Sand, API 13B-1, Section 5

- Reinforcing steel shop 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.
- When casings are proposed or required, casing dimensions and detailed procedures for permanent casing installation, temporary casing installation and removal, and methods of advancing the casing, along with the means to be utilized for excavating the drilled shaft hole in accordance with Part 5 of this Specification, shall be provided.
- 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.

SECTION 316329 – DRILLED CONCRETE SHAFT

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.
 10. Details of procedures to prevent loss of removed material or concrete into waterways, sewers and other areas to be protected.
 11. 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.
 12. The Engineer will evaluate the Drilled Shaft Installation Plan for conformance with the Contract Plans and Specifications within ten working days after receipt of the submission. At the option of the Owner, a Shaft Installation Plan Submittal Meeting may be scheduled after a review of the Contractor's initial submittal of the Plan. Those attending the Shaft Installation Plan Submittal Meeting, if held, shall include the following:
 - The superintendent, on-site supervisors, and other Contractor personnel involved in the preparation and execution of the Drilled Shaft Installation Plan.
 - The Project Engineer and Owner's personnel involved with the structural, geotechnical, and construction review of the Drilled Shaft Installation Plan together with Owner's personnel who will provide inspection and oversight during the drilled shaft construction phase of project.
 13. The Contractor shall 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 Plans and Specifications within ten working days after receipt of the submission.
- D. The Contractor shall submit full logs of shaft construction, as detailed in section 4.2 of this Section, on a continuous basis during construction. The logs for each shaft construction activity shall be submitted to the Engineer within 24 hours of the completion of that activity. A full set of shaft inspection logs for an individual drilled shaft shall be submitted to the Engineer within 48 hours of the completion of concrete placement at the shaft.

SECTION 316329 – DRILLED CONCRETE SHAFT

PART 4: QUALITY ASSURANCE

4.1 QUALIFICATIONS

- A. Refer to 3.1.A and 3.1.B of this Section for contractor qualification requirements.

4.2 LOGS OF SHAFT CONSTRUCTION

- A. The Contractor's Quality Control staff shall prepare inspection logs documenting each shaft construction activity, including casing installation, excavation, shaft bottom inspection, reinforcement installation and concrete placement. The logs shall fully document the work performed with frequent reference to the date, time and casing/excavation elevation. In addition, the Contractor shall prepare and submit the logs documenting any subsurface investigation borings or rock core holes performed for the Contract at drilled shaft foundation locations.

Records for temporary and permanent casing shall include at least the following information: identification number and location of the shaft; diameter and wall thickness of the casing; dimensions of any casing reinforcement; top and bottom elevations of the casing; method and equipment used for casing installation; any problems encountered during casing installation; and the name of the inspector.

The shaft excavation log shall contain at least the following information: identification number, location and surface elevation of the shaft; description and approximate top and bottom elevation of each soil or rock material encountered; seepage or groundwater conditions; type and dimensions of tools and equipment used, and any changes to the tools and equipment; type of drilling fluid used, if any, and the results of slurry tests; any problems encountered; elevation of any changes in the shaft diameter; method used for bottom cleaning; final bottom elevation of the shaft; and the name of the inspector and the date, time and name of any changes in the inspector.

Concrete placement records shall include at least the following information: concrete mix used; time of start and end of concrete placement; volume and start/end time for each truck load placed; concrete test results; concrete surface elevation and corresponding tremie tip elevation periodically during concrete placement; concrete yield curve (volume versus concrete elevation, actual and theoretical); and the name of the inspector.

SECTION 316329 – DRILLED CONCRETE SHAFT

- B. At a minimum, prepare and submit detailed inspection reports for each shaft, and include the following information:
1. Accurate location and dimensions of the excavation.
 2. Accurate top and bottom elevations.
 3. Measurement data for plumbness.
 4. Methods of excavation used.
 5. Description of materials encountered during excavation.
 6. Description of groundwater conditions encountered.
 7. Description of obstructions encountered and whether or not obstruction removal was achieved.
 8. Description of temporary or permanent casing placed including purpose, length, and wall thickness, and anchorage or sealing methods used, if any.
 9. Measurements of slurry quality including, as a minimum, density, viscosity, shear strength, and pH.
 10. Elevation at which bearing material was encountered. Description of bearing material. Probe holes made, along with method of probing, rate of drilling in rock, samples taken, tests made, and conclusions reached with regard to adequacy of bearing material.
 11. Shaft, bell footing, and rock socket measurements.
 12. Description of clean-out methods and adequacy of initial clean-out and final clean-out just before concrete placement.
 13. Record of depth of water in excavation and rate of water infiltration before concrete placement.
 14. Record of reinforcing steel inspection for position and adequacy.
 15. Method of concrete placement and casing removal, if any. Record of concrete head during removal of casing. Record of concrete elevation when vibration started.

SECTION 316329 – DRILLED CONCRETE SHAFT

16. Difficulties encountered including soil inclusion, voids, shaft squeeze-in, and casing collapse.
 17. Concreting curves showing actual versus theoretical volume of concrete required to fill shaft excavation.
 18. Condition of concrete delivered to site including record of slump, density, air content, and other tests. Record of cylinders made for compression testing.
 19. Any deviations from the specifications.
- C. Refer to sections 033000 and 032000 for further requirements on reinforcement and concrete quality and testing.

PART 5: EXECUTION

5.1 EXCAVATION

- A. Drilled shafts shall be excavated to the required depth and dimensions shown in the Plans or as directed by the Engineer. Once the excavation operation has been started, the excavation shall be conducted 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. Pauses during this excavation operation, except for casing splicing and removal of obstructions, will not be allowed. The Contractor shall provide temporary casing at the site in sufficient quantities to meet the needs of the anticipated construction method.
1. 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 shall be considered stops.
- B. All spoils must be collected within the casing pipe, so that they do not enter the water, and disposed of off site. Spoils are not to be dropped or placed on the river bottom.
- C. Unless otherwise indicated, bore excavations for vertical shafts plumb to within a tolerance equal to 2% of the shaft length. Contact the Engineer if shaft is out of tolerance and make needed corrections to the structure at no additional expense to the Owner. Do not place the top of a shaft out of the indicated position by more than 1/24 of the shaft diameter or 3 inches, whichever is less. Blasting is not allowed. Do not disturb formations below or outside the limits of the shaft under construction or any previously constructed shaft adjacent to the excavation.

SECTION 316329 – DRILLED CONCRETE SHAFT

- D. Do not excavate within three diameters of a shaft with new concrete until 24 hours after concrete placement. If satisfactory foundation materials are encountered at elevations other than those indicated on the Drawings, adjust drilling depths as directed.
- E. If a caving condition or excess groundwater is encountered, discontinue the drilling operation and employ a construction method that prevents caving and groundwater infiltration, such as the installation of casings.
- F. The Contractor bears full responsibility for selection and execution of the method(s) of stabilizing and maintaining the drilled shaft excavation. The walls and bottom of the drilled shaft excavation shall be protected so that side wall caving and bottom heave are prevented, and 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. An acceptable protection method includes the use of casing. Casing shall always be used above the mudline to collect the spoils and prevent them from spilling onto the river bottom.

5.2 OBSTRUCTIONS

- A. The Contractor shall immediately notify the Engineer upon encountering an obstruction. 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 which prevents or hinders the advance of the drilled shaft excavation. A change in geological strata does not constitute an obstruction. When it is not possible to advance past the obstruction with the drill equipment, the Contractor shall remove, bypass or break up the obstruction. 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 shall be promptly removed by the Contractor. All costs due to lost tool removal will be borne by the Contractor including, but not limited to, costs associated with the repair of hole degradation due to removal operations or an extended length of time that the hole remains open.

5.3 INSPECTION

- A. Do not place concrete until the foundation excavation has been inspected and accepted. If access to the bottom of the excavation for visual inspection cannot be provided because of inability to dewater the excavation using acceptable pumping methods, provide drilling logs and

SECTION 316329 – DRILLED CONCRETE SHAFT

core samples, or other acceptable data, for determining the condition of the excavation and the quality of the foundation material. At a minimum, inspect each shaft that cannot be dewatered with an underwater video camera. Contractor shall provide a video camera so that each hole can be adequately inspected.

- B. Follow all site safety practices, including, the following items specifically required for the inspection of drilled shaft excavations:
 - 1. Cover open excavations immediately upon completion or, if work is discontinued for any period of time, with a cover capable of preventing persons from falling into or entering the excavation without proper authorization. Secure the cover by approved methods.
 - 2. Provide casing through soil cavities and broken or unstable rock for inspection of the excavation.

5.4 REINFORCEMENT PLACEMENT

- A. Submit the method of reinforcement placement in accordance with 3.1.C.
- B. Reinforcement shall be placed into the drilled shaft prior to the tremie concrete placement to ensure accurate reinforcement location and plumbness.
- C. The reinforcement shall be carefully positioned and securely fastened to provide the minimum clearances specified or shown on the Plans, and to ensure that no displacement of the pin occurs during placement of the concrete.
- D. Concrete spacers or other approved non-corrosive spacing devices shall be used at sufficient intervals (near the bottom, the top and at intervals not exceeding 10 feet vertically) to ensure concentric spacing for the entire reinforcement in the shaft. The spacers shall be of adequate dimension to ensure an annular space between the outside of the reinforcement and the side of the casing or excavation along the entire length of the drilled shaft as shown in the Plans. Acceptable feet made of plastic, or concrete (bottom supports) shall be provided to ensure that the bottom of the pile is maintained at the proper distance above the base of the excavation.

5.5 CONCRETE PLACEMENT

- A. Submit the method of concrete placement according to 3.1.C. Do not start concrete placement without written acceptance. Mix, place, vibrate, and cure concrete as specified in Section 033000, except as modified herein.

SECTION 316329 – DRILLED CONCRETE SHAFT

Place concrete within 18 hours of the completion of excavation and within three hours of final inspection. Keep the excavation free from accumulated seepage water and loose material until concrete is placed. Place the concrete for each shaft in one continuous operation. Thoroughly work and vibrate the upper 5 feet of concrete. Do not allow concrete to come in contact with aluminum during placement.

1. Placement by Tremie Method.

Tremie concrete placement shall be done by pumping, as specified in Section 033000 through a ferrous metal, rubber, or plastic pipe with a minimum diameter of three times the size of the aggregate in the mix. Do not allow the concrete to segregate during pumping. Begin pumping with the pipe discharge positioned not more than 6 inches off of the bottom of the excavation and build a concrete head of at least 5 feet. Maintain a concrete head of not less than 5 feet above the discharge at all times. Keep the pump hopper continuously filled with concrete to prevent entrapment of excess air in the discharge.

5.6 CASING REMOVAL

- A. If temporary casing is used, withdraw each section, except the final section, in partial stages, as concrete is deposited, at a rate that keeps the bottom of the casing below the top of the fresh concrete. During removal, ensure that there is no reduction in shaft cross-section and that displacement of steel reinforcement is less than 2 inches upward and less than 2 inches downward per 20 feet of shaft length. Maintain the specified 3-inch reinforcement bar clearance at bearing level and on the sides during casing removal. If observations indicate otherwise, reduce the rate of casing removal and establish a head of concrete within the casing sufficient to offset the forces tending to cause concrete arching or displacement of the reinforcing cage. As concrete is deposited, withdraw the final section of casing to a point 2 feet below existing ground elevation and allow it to remain for approximately 2 hours, depending on the temperature. Then, completely withdraw the section or cut it off flush with existing ground. If cavities or unstable materials are encountered and the danger exists of losing concrete or of the concrete becoming mixed with extraneous material, cut off the casing at the top of shaft elevation and leave in place.

5.7 UNACCEPTABLE PILES

- A. Unacceptable Piles: Piles that do not meet the specified tip elevation requirements, are placed out of position, or are damaged.

SECTION 316329 – DRILLED CONCRETE SHAFT

- END OF SECTION -

SECTION 321216 – ASPHALT PAVING

PART 1: GENERAL

1.01 WORK SPECIFIED

- A. Construction of bituminous concrete pavement on a prepared base laid to the required grade, thickness, and cross-section as shown on the Drawings or as specified in this Section.
- B. The quality of materials and performance of the Work shall be in accordance with the Standard Specifications of the Pennsylvania Department of Transportation (PennDOT), unless otherwise specified in this Section.

1.02 SUBMITTALS

- A. Bituminous concrete mix designs shall be submitted and approved by the Construction Manager prior to the start of paving operations.

1.03 REFERENCES

- A. Comply with the most recent editions of the following:
 - 1. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
 - 2. Commonwealth of Pennsylvania Department of Transportation Publication 408 – Specifications

PART 2: PRODUCTS

2.01 MATERIALS

- A. Bituminous Concrete Products
 - 1. Base course shall be PennDOT Section 320 – Aggregate-Bituminous Base Course.
 - 2. Binder course shall be PennDOT Section 431 - Bituminous Binder Course FB-2.
 - 3. Top course shall be PennDOT Section 430 - Bituminous Wearing Course FB-2.
 - 4. Tack coats of asphalt emulsions, PennDOT Section 460.
 - 5. The subbase shall consist of PennDOT 2A aggregate as specified in Section 703 of Publication 408.

SECTION 321216 – ASPHALT PAVING

PART 3: EXECUTION

3.01 PAVEMENT INSTALLATION

A. Subgrade

1. The subgrade shall be shaped to line and grade and compacted with self-propelled rollers. Compaction of the subgrade shall be as required by Table 1 of Section 02200 – Earthwork.
2. All depressions which develop under rolling shall be filled with acceptable material and the area re-rolled with approval of the Construction Manager.
3. Soft areas shall be removed and filled with acceptable materials and the area re-rolled with approval of the Construction Manager.
4. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.

B. Subbase

1. The subbase shall be compacted in lifts not to exceed 6 inches, compacted thickness.
2. Provide subbase over excavated areas only and/or as directed by the Construction Manager.
3. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller. Compaction shall be to 98 percent compaction throughout the subbase as determined by ASTM D1557.
4. After completion of the subbase rolling, there shall be no hauling over the subbase other than the delivery of material for the overlying course.

C. Bituminous Material

1. Placement of bituminous mixtures shall be in accordance with PennDOT Publication 408, Section 409.3.
2. The thickness of the bituminous courses shall be as shown on the Drawings.

SECTION 321216 – ASPHALT PAVING

3. Prior to placing any bituminous wearing course, a tack coat of asphalt emulsions shall be furnished and applied to the bituminous binder course surface.

- END OF SECTION -