SECTION 01 71 13 - MOBILIZATION

PART 1. - GENERAL

1.1 GENERAL REQUIREMENTS

All work of this section shall be governed by the Contract Documents as defined in the General Conditions.

1.2 WORK INCLUDED

A. Set up of necessary general plant, including shops, storage areas, office and such sanitary and other facilities as are required by local or state law or regulation.

B. All work, incidentals, including survey, clean-up, restoration, and demobilization not paid for in other sections of the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

Such materials as required for mobilization and that are not part of the completed contract shall be determined by the Contractor, except that they shall conform to any pertinent local or State law, regulation or code.

PART 3 - EXECUTION

3.1 The work required to provide the above facilities and service for mobilization shall be done in a safe and workmanlike manner and shall conform with any pertinent local or State law, regulation or code.

PART 4 - PAYMENT

4.1 The amount bid for mobilization shall not exceed five percent of the total contract bid price.

4.2 The amount of bid shall include the furnishing and maintaining of services and facilities, to the extent and at the time the Contractor deems them necessary for his operations, consistent with the requirements of his work and the respective contract, and the costs of required insurance and bonds, and/or any initiation of the contract work.

4.3 The amount of bid for mobilization shall be payable to the Contractor whenever he shall have completed ten percent of the total contract work. Ten percent of the work shall be considered completed when the total of payments earned, as reflected by estimates of work done, shall exceed ten percent of the total amount of the Contractor's bid price.

END OF SECTION

SECTION 02 41 00 – DEMOLITION AND REMOVALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

A. Work of this Section includes all labor, materials, equipment, and services necessary to demolish and remove indicated structures and elements as shown on the Contract Drawings and/or specified herein, including but not necessarily limited to the following:

1. Partial demolition and removal at wharf as indicated:
   a. Remove loose, spalled, deteriorated, and disintegrated existing concrete at the Albany Wharf Sheds No. 1 to 3 adjacent to and within areas that are to receive new concrete or repairs or overlays. Include removal of marine growth and cleaning of existing concrete surfaces to remain that are to receive new concrete.
   b. Complete removal of existing concrete slabs and beams where being replaced with new slabs and beams.

2. Demolition and removal, by extraction, of any existing timber piles interfering with the installation of the proposed new piles, as approved by the Engineer.
3. Removal of any items which, in the judgment of the Engineer, are likely to become a drift source.
4. Removal of river bottom and underwater debris, materials, concrete, and timbers that may be lying on the river bottom that may be a result of demolition and removal operations of this Contract; and debris that interferes with new Contract related pile driving work.
5. Protection of existing elements and conditions to remain.
6. Legal disposal off site of all removed items and demolished construction materials, garbage, cuttings, and miscellaneous materials resulting from demolition and removal operations. Dispose of removed items and material.
7. Other work as and where indicated by the Contract Documents, as necessary and including any demolition to install the work of this Contract.

B. Related Sections include the following:

1. Division 3 Section 03311 “Marine Concrete” for placing concrete on/at prepared surfaces.

1.3 REGULATORY AND SAFETY REQUIREMENTS

A. Contractor, including Contractor’s employees and subcontractors, shall become familiar with and obey all governing regulations, including fire, traffic, environmental, and security regulations. All personnel employed on the Project shall keep within the limits of the work (and avenues of ingress and egress), and shall not enter other areas unless required to do so, and authorization is obtained for such entry. Contractor's equipment shall be conspicuously marked for identification.

B. Floating equipment, mooring conditions, and temporary anchorages of marine equipment and demolition transport barges shall comply with requirements and regulations of governing authorities..

1. Floating equipment shall be operated in compliance with U.S. Coast Guard Regulations and shall conform with the requirements of Navigation Rules, International-Inland.
2. Contractor shall maintain, protect, and not interfere with navigation at any time during the demolition and construction phases of Contract Work.

C. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the Contract, safety requirements shall conform to ANSI A10.6 "Demolition Operations - Safety Requirements" and ANSI A10.11 “Safety Nets Used During Construction, Repair, and Demolition Operations”.

D. Additional References:

1. OSHA.
2. New York State Departments of Environmental Conservation.
3. Department of the Army – U.S. Army Corps of Engineers.

1.4 SUBMITTALS

A. Qualifications: For firms and persons specified in Article “Quality Assurance” to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, and other information specified.

B. Work Plans and Schedules:

1. Procedures and Operations: Submit for approval prior to start of any removal or demolition work to show coordination and conditions with respect to each site area of the work. Contractor shall not proceed with the demolition and removal work until the Engineer has given written approval of the following submittals:

   a. Demolition and Protection Plan: Submit work plans to indicate areas of demolition and removal related to locations and details of proposed protections and controls and with descriptions of the various equipment types and construction aids to be used for work and disposal of debris.

      1) Submit a method of control and recovery of drift in the event items or material travel beyond the boundaries of the debris control boom or turbidity curtains.
      2) Show the protection of existing structures and utilities that are to remain including piping and conduits. This plan shall include a written description supported by sketches, drawings, and specific materials and equipment to be used for protection.
      3) Submit sedimentation and dust control plan covering all demolition and removal work.
      4) Submit planned methods and sequences for controlled demolition, including the locations of proposed saw cutting and schedules indicating proposed sequence of operations for selective demolition.

C. Product Data: Include with Work Plans a description and manufacturer’s Product Data (catalogue cuts) of proposed silt and debris control booms.

D. Data Submitted for Information and Reference:

1. Copies of permits necessary to transport materials for disposal off site.
2. Permits for and location of legal disposal sites for waste materials of this Project with documentation of legal status for type of disposal material.

1.5 QUALITY ASSURANCE

A. Qualifications: Work of this Section shall be by an experienced firm that has specialized in demolition work similar in conditions, material, and extent to that indicated for this Project.

1. Demolition and removal work shall be performed by competent workmen experienced in this kind of work, and shall be carried through to completion with due regard to the safety of the public, the Owner, the Engineer, any visitors, and the employees of the Contractor and subcontractors, and with as little nuisance as possible.
2. All members of the Project team including all subcontractors shall have a minimum of 5 years of previous experience in heavy demolition and construction at a marine environment.

B. Damage or loss, whether by reasons of fire, theft, or other casualty, or any other occurrence to the various items required to be demolished or salvaged, shall be at the risk of the Contractor from and after the date of the Contract, and no such damage or loss shall relieve the Contractor from any obligation under the Contract to complete all demolition and salvage work as specified herein.

C. Damage to Existing Work Not to be Removed: Existing items that are not to be removed shall not be disturbed or damaged in any way except where specifically required by the Contract in order to accomplish the removals. If any such disturbance or damage occurs to the existing work, which is to remain, or which is to be salvaged, the Contractor shall promptly repair the damage and restore or replace the damaged items at no additional cost to the Owner.

1.6 PROJECT / SITE CONDITIONS

A. Materials Ownership:

1. General: Except for materials indicated to be salvaged and/or otherwise indicated to remain Owner's property, all demolished and removed materials shall become property of Contractor and shall be removed from the site in a legal manner.

B. Existing Conditions, General:

1. The locations of existing timber piles shown on the Contract Drawings are based on available information and are schematic. There may be additional timber piles, debris, and timbers not shown on the Contract Drawings or lying on the bottom which may require cutting and/or removal. Contractor shall be held to have field verified existing conditions prior to bid.
2. Contractor shall assess actual dimensions, conditions, and materials for demolition and disposal.

C. Existing Utilities and Services:

1. Should uncharted, or incorrectly charted, piping or other active utilities be encountered during the work, consult the Engineer immediately for directions. Cooperate in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of the Engineer.
2. Where inactive surface or subsurface piping, conduit, or other items are encountered during operations, properly remove and dispose of items and to suit item as approved.

1.7 SEQUENCING AND SCHEDULING (NOT USED)

PART 2 - PRODUCTS

2.1 MATERIALS

(NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions and correlate with requirements indicated to determine the extent of site preparation, demolition, removals, and other related work required.

3.2 PREPARATION

A. Contractor shall furnish all services, labor, equipment, and materials required to perform demolition and removal work of this Section and to prepare pier and bulkhead areas for subsequent Contract work. Accept actual conditions existing and as found at site.

B. Protection: Protective measures shall include the following:

1. Protect construction indicated to remain against damage and soiling during work operations including:

    a. Protect existing drainage systems to remain functioning from intrusion of debris and clogging.
    b. Protect adjacent surfaces and finishes.
    c. Protect other existing structures, in areas adjacent to demolition locations, as well as, any equipment, piping, conduits, etc. in the work area as well as in the adjoining areas, and leave the same in a safe and satisfactory condition as approved by the Engineer.

2. Contractor shall take actions and provide temporary installations necessary, subject to concurrence of Engineer, to allow the progress of the Work to continue and to make the work accessible to construction equipment and working persons.
3. Use suitable methods to limit spread of dust and dirt. Comply with governing environmental protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and/or pollution.
4. Take precautions to guard against movement, settlement, or collapse of any adjacent conditions, sidewalks or street passages, adjoining property, and adjacent structures. Provide temporary shoring, bracing and supports as necessary. Be liable for any such movement, settlement, or collapse. If such damage does accidentally occur, safeguard the public and repair promptly.
5. Protection of Persons:

    a. Provide temporary facilities including barricades and fencing to prevent entry to demolition areas by unauthorized persons. Access to demolition areas shall be prevented by temporary facilities such that the facilities cannot be circumvented or thwarted.
    b. The necessary temporary closures, guardrails, barricades, and other devices shall be provided so as to adequately protect workmen and employees, visitors, public, and others from possible injury.

6. Dust and Debris Control:

    a. Contractor shall be responsible for any and all dust, debris, sedimentation, and any other controls required by the work permits granted by the regulatory agencies having jurisdiction. Submit proposed spill, dust, debris, and sedimentation control methods and procedures to Engineer for review and acceptance prior to use.
    b. The discarding of any material into the waterway is prohibited. No river drift is allowed Appropriate measures shall be taken to prevent drift including:

        1) Providing adequate protection to carefully preclude any possibility of materials being dropped into the water.
        2) Installing and maintain floating booms to prevent the escape of floating materials from the site and netting, float stages with curbs and any other temporary structures used to prevent soil, stone, concrete, metals and other non-floating debris from entering the waterway and required to provide such protection. Indicate all such items on submitted demolition plan.
        3) The boom system shall be designed for the wave height and currents anticipated in the work area. Submit a plan and details with the manufacturer's literature for the selected boom system.

    c. A stand-by "chase boat" shall be provided by Contractor to retrieve and recover drift materials associated with demolition and construction operations. When not actually retrieving drift, this boat and operator shall be available for use by Engineer for observation of the work.

7. Noise Control: Comply with governing regulations pertaining to noise levels during demolition procedures.

C. Layout and Field Survey Work:

1. Establish benchmarks and survey control points and protect from disturbance during work operations.

3.3 DEMOLITION AND REMOVAL OPERATIONS

A. General:

1. Barges and other floating equipment shall not be moored to the adjacent wharf without written permission from their Owners. Mooring and berthing against the existing bulkhead is strictly prohibited.
2. Remove existing structures to the extent indicated by the Contract Documents and otherwise as required for new work preparation as approved by Engineer. All locations and areas of removals indicated on the Contract Drawings or specified herein are approximate only and are not guaranteed to represent all conditions. Contractor shall be responsible to verify all actual field conditions. Variations from conditions indicated shall in no case constitute a claim for additional compensation.
3. Blasting or other explosive demolition will not be permitted.
4. Equipment, fixtures, and miscellaneous articles not designated for salvage, as well as debris which is found on the premises and which has been abandoned by the Owner, shall be removed from the Project site by Contractor.
5. If demolition debris falls into the water, the debris shall not be allowed to accumulate and shall be removed immediately. In addition, conditions that allowed this occurrence shall be corrected immediately.

B. Surface, Structure, and Sub-structure Removals:

1. Demolition includes the cutting out, destruction, and complete removal of the item or portion of item so designated.
2. Where portions of items or exposed surfaces are to be removed, cutting and removal shall result in neat, plumb, and square edges. Use power saw equipment for pavements, concrete slabs, and other solid materials with saw cuts along straight lines to a depth of approximately two (2") inches unless otherwise noted. Protect remaining portions from damage.
3. Demolition of existing site elements, surface finishes, and structural components shall be to level and extent indicated and required to complete the removal of system or item and the pier deck structure. Include removal of timbers and other items below indicated elevation that become or are found to be loose or dislodged.

C. Pile Extraction, Loose Pile Removal, and Pile Removal by Cut Off:

1. Piles that are shown or otherwise indicated to be extracted shall be pulled out in their entirety. Make best effort to extract the piles intact in their full length. Contractor shall be responsible for clearing all broken piles that interfere with new work including but not limited to new pile installation.

    a. In the event that a pile breaks during extraction the remaining portion becomes an obstruction and must be cleared by the Contractor prior to pile driving.

2. Existing piles that are loose or become loose shall be documented and removed.
3. Where removed, piles shall be pulled out of the riverbed completely (extracted). Removal of piles shall be in a manner that does not result in substantial sediment resuspension. Pulling of piles will be permitted only for those piles so indicated on the Contract Drawings and for any piles found to interfere with proposed new piling as otherwise directed and/or approved by the Engineer.
4. Equipment Restrictions:

    a. Use of pavement breakers (hoe rams) to remove concrete is prohibited.
    b. Use of Jack Hammers on surfaces will be permitted where depth of removals exceeds 3 inches except use shall be discontinued when working in close proximity to sensitive structures.
    c. Hydrodemolition techniques may be employed subject to separate approval of the Engineer for each condition of proposed use.

5. Initial Preparation:

    a. Where existing surfaces will be exposed after completion of repairs, square up and provide a one (1”) inch minimum depth sawcut at indicated or designated limits of removals.
    b. Remove all loose, disintegrated, and friable concrete down to "sound" matrix or the minimum indicated depths, whichever is greater, using hand held chipping guns and jack hammers.

        1) Removals for conditions of existing concrete to receive new concrete facing or overlay shall be done in the presence of the Engineer. The Engineer will determine/approve the extent of concrete to be removed.
        2) Sound matrix shall be determined by observation of the concrete chipping operation, by sounding the concrete with a rod or hammer, or other device acceptable to the Engineer.
        3) Contractor shall afford and accommodate the Engineer access to the work in progress. Determination of "sound" matrix will be predicated on the general criterion that concrete, which is difficult to remove, is "sound".
        4) Where removals expose reinforcing bars, the concrete around the bar shall be removed to provide a 1 inch minimum space below the bar so that new concrete will completely encapsulate the reinforcing bar.

D. Underwater Removals:

1. Debris falling into the water shall not be allowed to accumulate and shall be removed immediately.

2. Removal and clearing shall be performed in a manner to minimize disturbance to the river bottom. The appropriate method shall be reviewed and approved by the Engineer.
3. Site areas of work may be subject to an underwater inspection of the area, at the Contractor's expense, to determine if any construction or garbage debris is present.
4. Material from demolition and removal operations, removal of pilings, removal of underwater debris, and other items or equipment shall be deposited directly into transport barges or other conveying equipment for removal and final deposit at a legally accredited disposal site.
5. Demolition or other removed materials shall not be stored on the upland portion of site unless otherwise approved for specific conditions by Engineer.
6. Burning of removed materials shall not be permitted on the Project site.
7. Contractor shall be responsible for the legal removal of all demolished materials and debris resulting from the work to locations outside the site property, which meet the requirements of all applicable laws and codes of regulatory agencies having jurisdiction over the work.

3.4 REPAIRS/RESTORATIONS

A. General: Promptly repair damage to adjacent construction caused by work operations.

B. Any damage caused to the structures, equipment, piping, conduits, and any other items that are to remain, shall be replaced or repaired by methods acceptable to the Engineer, at no additional cost to the Owner. Engineer will make the choice of replacement or repair as warranted by each condition.

C. Where repairs to existing surfaces are required, patch surfaces to produce surface suitable for new materials.

D. Repair or replace existing off-site and to remain on-site improvements damaged during the conduct of this work with material of same or better kind, quality, and size as approved by Engineer.

E. Provide repairs or, if required, replacement of construction in a manner that eliminates evidence of patching and refinishing.

3.5 CLEAN UP AND DISPOSAL

A. Remove and dispose of materials resulting from operations as work progresses.

B. Burning or burying of removed materials will not be permitted on the site of work.

C. Except for items or materials indicated to be salvaged, remove materials from demolition and removals, debris, waste/trash, off the Project site and legally disposed of.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces, areas or waterways.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition and removal operations. Return and maintain adjacent areas to condition existing before start of clearing, demolition, and removal operations.

END OF SECTION

SECTION 03 30 00 – MARINE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions.

1.2 SUMMARY

A. Work of this Section includes all labor, materials, equipment, and services necessary to provide new cast-in-place concrete for waterfront structures as shown on the Contract Drawings and/or specified herein, including but is not necessarily limited to the following:

1. Concrete, Reinforcement, and Formwork.
2. Wharf deck slab and beams.
3. Accessory materials and installation for cast-in-place concrete work.

B. Constructed concrete elements shall comply with Contract Drawing details and specification requirements of indicated design criteria for elements and the Contract Documents.

C. Related Sections include the following:

1. Division 2 Section 02226 “Marine Demolition and Removals” for removals of existing wharf.

2. Division 5 Section 05501 “Miscellaneous Metals” for any embedded items as indicated.

1.3 DEFINITIONS

A. "Blending size" is an aggregate that complies with the quality requirements in ASTM C33 and paragraph entitled "Aggregates" and as modified herein and can be blended with coarse and fine aggregate to produce a well graded combined grading.

B. "Cementitious material" as used herein shall include Portland cement, pozzolan, fly ash, ground granulated blast-furnace slag.

C. "Design strength" (f'_c) is the specified compressive strength of concrete to meet structural design criteria.

D. "Marine concrete" is that concrete that will be in contact with or subject to submersion, tidal variations, splash, or spray from water in navigable waterways.

E. "Mixture proportioning" is a description of the proportions of a concrete mixture that were selected to enable it to meet the performance durability requirements, constructability requirements, and the initial and life cycle cost goals.

F. "Mixture proportions" is the concrete supplier's by-mass proportions to replicate the mixture design.

G. "Pozzolan" is a silicious or silicious and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

H. "Field test strength" (f_{cr}) is the required compressive strength of concrete to meet structural and durability criteria. Determine (f_{cr}) during mixture proportioning process.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

A. Concrete Mixture Design:

1. Prior to concrete placement and at a time approved by Engineer, submit proportions for a concrete mixture of each strength and type of concrete required for Project. Include the following in addition to requirements specified in this Section:

   a. Submit a complete list of materials including type; brand; source and amount of cement, aggregate, fly ash, (or slag pozzolans), ground slag, anti-washout, corrosion inhibitors, and other admixtures for underwater concreting; and applicable reference specifications.
   b. Submittals shall clearly indicate where each mixture will be used when more than one concrete mix design is submitted.
   c. Submit additional data regarding concrete aggregates if the source of aggregate changes.
   d. An identical concrete mixture meeting the requirements herein and previously approved within the past 12 months by the Owner, may be used without further approval, if copies of the previous approval and aggregate, fly ash, silica fume, and pozzolan test results are submitted. The approval of aggregate, fly ash, and pozzolan tests results shall have been within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

2. The concrete mix design(s) shall be prepared by an accredited laboratory experienced in this field and under the direction of the Contractor's Professional Engineer, who shall sign all reports and designs.

B. Formwork Design: Contractor shall be responsible for the proper design, bracing, shoring, and construction of all formwork for Project conditions and shall retain a licensed professional engineer to design such formwork, bracing, and shoring.

C. Joint Construction: Joint sizes indicated between concrete elements and between concrete elements and other adjacent construction are based on joint conditions at a design temperature of 70 degrees F. Joint construction at other temperatures shall be adjusted in size to suit on-site temperature conditions at time of installation as approved by Engineer.

1.5 SUBMITTALS

A. Qualifications Submittals:

1. Contractor's Surveyor: Submit qualifications of the Contractor's Surveyor to adequately survey all sleeves for conduits, deck openings, and anchor bolts for future work.
2. Testing Technician(s) and Testing Agency shall be as hired directly by the APDC. Contractor shall cooperate in all ways possible with the testing agency and technicians during the performing of all concrete work.

B. Product Data:

1. Concrete materials and ingredients related to products used in concrete mix design(s) and submittal requirements for Test Reports specified herein.
2. Form materials for exposed concrete and special forming conditions.
3. Reinforcing with epoxy coatings.

4. Reinforcement supports.
5. Joint sealants.
6. Joint filler.
7. Epoxy bonding compound.
8. Epoxy coatings.
9. Non-shrink grout.
10. Preformed joint filler and sealer.
11. Materials for curing concrete.

C. Shop Drawings: Prepare and submit shop drawings for approval, including plans, elevations, sections, details and schedules as required to fully illustrate details of work and to meet job conditions. Reproductions of Contract Drawings are unacceptable as shop drawings. Marked copies of the Contract Drawings will not be accepted as placing drawings.

1. General Requirements: Dimensions for concrete work shall be confirmed and correlated at the job site. Shop drawings and other submittals shall include fabrication processes, techniques of construction, relationship of concrete work with embedded or built-in items, and relationship to adjacent construction.

    a. After stake layout of on-site conditions, confirm locations of on-site elements together with Engineer or Owner and revise layout of reinforcing steel and form-work drawings as necessary to reflect adjustments.

2. Reinforcing Steel: Comply with ACI 315. Submit bending and cutting diagrams, assembly diagrams, splicing placement and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars. Only complete shop drawings will be accepted.
3. Formwork: Comply with ACI 347R. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components. Indicate placement schedule, construction, and location and method of forming control joints.

    a. Include locations of inserts, pipe work, conduit, sleeves, and other embedded items.
    b. Include recesses, depressions, pockets, block outs, penetrations and provisions for future utilities or other elements to be installed.
    c. Furnish drawings and descriptions of shoring and re-shoring methods proposed for slabs, beams, and other horizontal concrete members.

4. Construction Joints: Show locations of construction joints and crack control joints.

D. Quality Control Submittals:

1. Design Data:

    a. Concrete Mixture Design(s):

        1) Prepare and submit a detailed report of materials and methods used, test results, and the field test strength (f_{cr}) for marine concrete required to meet durability requirements.
        2) Mix design(s) shall be signed and sealed by a Contractor's professional engineer licensed in the State of New York and shall include time/strength curves for the various mix designs and the recommended design.

2. Test Reports:

    a. Concrete Mixture Proportions:

1) Submit copies of test reports by independent test labs conforming to ASTM C1077 showing that the mixture has been successfully tested to produce concrete with the properties specified and that mixture will be suitable for the job conditions. Test reports shall be submitted along with the concrete mixture proportions. Obtain approval before concrete placement.
2) Fully describe the processes and methodology whereby mixture proportions were developed and tested and how proportions will be adjusted during progress of the work to achieve, as closely as possible, the designated levels of relevant properties.

b. Fly Ash and Natural Pozzolan: Submit test results in accordance with ASTM C618. Submit test results performed within 6 months of submittal date.
c. Ground Iron Blast-Furnace Slag: Submit test results in accordance with ASTM C989 for ground iron blast-furnace slag. Submit test results performed within 6 months of submittal date.
d. Aggregates: Submit test results for aggregate quality in accordance with ASTM C33, and the combined graduation curve for grading proposed for use in the work and used in the mixture qualification, and ASTM C295 for results of petrographic examination. Where there is potential for alkali-silica reaction, provide results of tests conducted in accordance with ASTM C227 or ASTM C1260. Submit results of all tests during progress of the work in tabular and graphical form as noted above, describing the cumulative combined aggregate grading and the percent of the combined aggregate retained on each sieve.
e. Admixtures: Submit test results in accordance with ASTM C494 and ASTM C1017 for concrete admixtures, ASTM C260 for air-entraining agent, and all manufacturer's literature and test reports available. Submitted data shall be based upon tests performed within 6 months of submittal.
f. Cement: Submit test results in accordance with ASTM C150 Portland Cement and/or ASTM C595 and ASTM C1157 for blended cement. Submit current mill data.
g. Water: Submit test results in accordance with ASTM D512 and ASTM D516.
h. Reinforcement and Protective Coating: Provide coating manufacturer's and coating applicator's test data sheets certifying that applied coating meets the requirements of ASTM A775/A775M.

3. Certificates:

a. Mill certificates and heat numbers, with matching referenced delivery tickets and tags , for all reinforcing steel.

4. Procedures and Work Plans for Quality Control:

a. General: Develop and submit for approval a quality control plan in accordance with the guidelines of ACI 121R and as specified herein. The plan shall include plans for the concrete supplier, the reinforcing steel supplier, and concrete installer. Maintain a copy of ACI SP-15 and CRSI Manual of Practice at the Project site.

5. Concrete Placement and Compaction:

a. Submit technical literature for equipment and methods proposed for use in placing concrete. Include pumping or conveying equipment including type, size and material for pipe, valve characteristics, and the maximum length and height concrete will be pumped. No adjustments shall be made to the mixture design to facilitate pumping.
b. Submit technical literature for equipment and methods proposed for vibrating and compacting concrete. Submittal shall include technical literature describing the equipment including vibrator diameter, length, frequency, amplitude, centrifugal force, and manufacturer's description of the radius of influence under load. Where flat work is to be cast, provide similar information relative to the proposed compacting screed or other method to ensure dense placement.

6. Curing Concrete Elements: Submit proposed materials and methods for curing concrete elements.
7. Form Removal Schedule: Submit schedule for form removal indicating element and minimum length of time for form removal. Submit technical literature of forming material or liner, form release agent, form ties, and gasketing to prevent leakage at form and construction joints. Provide a full description of materials and methods to be used to patch form-tie holes.

E. Samples for Verification:

1. Joint Materials, Each Type: Representative size/profile, 12" long.

F. Field Sample for Evaluation of Mix Design.

1.6 REFERENCE AND STANDARDS

A. Publications listed below form a part of this Section to the extent referenced. Publications are referred to in the text by the basic designation only.

B. American Association of State Highway and Transportation Officials (AASHTO):

AASHTO M 182	Burlap Cloth Made From Jute or Kenaf

C. American Concrete Institute International (ACI):

ACI 117	Tolerances for Concrete Construction and Materials
ACI 121R	Quality Assurance Systems for Concrete Construction
ACI 201.2R	Durable Concrete
ACI 211.1	Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214	Evaluation of Strength Test Results of Concrete
ACI 301	Structural Concrete
ACI 304R	Measuring, Mixing, Transporting, and Placing Concrete
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 305R	Hot Weather Concreting
ACI 306.1	Cold Weather Concreting
ACI 308	Curing Concrete
ACI 309R	Consolidation of Concrete
ACI 311.1R	ACI Manual of Concrete Inspection
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318/318M	Building Code Requirements for Structural Concrete
ACI 347R	Formwork for Concrete
ACI SP-2	ACI Manual of Concrete Inspection
ACI SP-15	Structural Concrete for Buildings

D. American Society For Testing And Materials (ASTM):

ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A 775/A 775M	Epoxy-Coated Steel Reinforcing Bars
ASTM A 884/A 884M	Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM C 31/C 31M	Making and Curing Concrete Test Specimens in the Field

ASTM C 33	Concrete Aggregates
ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 94	Ready-Mixed Concrete
ASTM C 138	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143	Slump of Hydraulic Cement Concrete
ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 172	Sampling Freshly Mixed Concrete
ASTM C 173	Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 227	Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 295	Petrographic Examination of Aggregates for Concrete
ASTM C 309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 441	Effectiveness of Mineral Admixtures or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to Alkali-Silica Reaction
ASTM C 469	Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 496	Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C 595	Blended Hydraulic Cements
ASTM C 597	Pulse Velocity Through Concrete
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 642	Density Gravity, Absorption, and Voids in Hardened Concrete
ASTM C 805	Rebound Number of Hardened Concrete
ASTM C 881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	Elastomeric Joint Sealants
ASTM C 989	Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1064	Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1157	Blended Hydraulic Cement
ASTM C 1202	Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C 1218/C 1218M	Water-Soluble Chloride in Mortar and Concrete
ASTM C 1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM D 512	Chloride Ion in Water
ASTM D 516	Sulfate Ion in Water
ASTM D 1179	Fluoride Ion in Water
ASTM D 1190	Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1339	Sulfite in Water
ASTM D 1751	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D 3867	Nitrite-Nitrate in Water
ASTM E 329	Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

E. Concrete Reinforcing Steel Institute (CRSI):

CRSI MSP	Manual of Standard Practice

F. The Engineered Wood Association (formally The American Plywood Association – APA):

APA PS 1	Construction and Industrial Plywood

G. New York State Department of Transportation (NYSDOT):

NYSDOT SS	Standard Specifications

H. U.S. Army Corps of Engineers (USACOE):

COE CRD-C 61	Determining the Resistance of Freshly Mixed Concrete to Washing Out in Water

1.7 QUALITY ASSURANCE

A. Owner's Testing Agency/Laboratory: Owner will engage the services of an independent testing laboratory to perform testing specified. The laboratory performing the testing services shall meet the requirements of "Testing Agency" as specified in ACI 301.

1. Work on concrete under this Contract shall be performed by an ACI Concrete Field Testing Technician Grade 1 or Grade 2 qualified in accordance with ACI SP-2 or equivalent. Equivalent certification programs shall include requirements for written and performance examinations as stipulated in ACI SP-2.
2. Testing agencies that perform testing services on reinforcing steel shall meet the requirements of ASTM E329.
3. Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077.

B. Layout and Surveying: Contractor shall, engage the services of an approved and independent New York State licensed surveyor (Contractor's Surveyor), approved by the Engineer, for the performance of the survey work specified in this Section and required for Project work.

C. Modification of References: Accomplish work in accordance with ACI publications except as modified by Contract Documents. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and/or the "Engineer" to mean the Engineer.

D. Measurements and Allowable Tolerances: Conform to requirements of Reference Standards but provide more restrictive tolerances where required to meet job conditions.

1. Concrete work at exposed surface conditions, including slabs, beams, and walls shall not fall more than ½ inch away from theoretical design locations. Pile Caps shall not fall more than 1 inch away from theoretical design locations.
2. Concrete Topping: Areas to receive future paving systems and like finishing materials shall conform to contour of finished grades indicated and shall not have variations in excess of plus 1/8" in 10'-0" and minus 1/4" in 10'-0".
3. Tolerances shall not be cumulative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver concrete until forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement.

1. Conform to ACI 301 and ASTM A775/A775M for job site storage of materials.
2. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground.
3. Protect materials from contaminants such as grease, oil, and dirt.
4. Ensure materials can be accurately identified after bundles are broken and tags removed.

B. Comply with additional requirements in Part 3 Article "Placing Reinforcement and Miscellaneous Materials" herein.

PART 2 - PRODUCTS

2.1 CONCRETE QUALITY AND PROPORTIONING

A. Durability and Strength: Comply with ACI 201.2R and ACI 211.1. Adjust the concrete 28-day design strength to produce concrete of minimum design strength (f'_c) of 6,000 psi for cast-in-place concrete.

B. Contractor-Furnished Mixture Proportions:

1. General: All tests specified herein shall be performed with the proposed production mix.
2. Strength and Water-Cementitious Materials Ratio: Strength requirements shall be based on 28-day compressive strength determined on 6 by 12 inch cylindrical specimens in accordance with ASTM C39. The specified compressive strength of the concrete (f'_c) for each portion of the structure shall meet the requirements in the Contract Documents.
3. Mixture proportions for marine concrete shall be developed by the Contractor to produce the design strength (f'c) and to provide durability, workability, and mixture consistency to facilitate placement, compaction into the forms and around reinforcement without segregation or bleeding.

Table 1 - Concrete Quality Requirements

Maximum water/cement ratio:	0.40
Minimum quantity of cementitious material:	675 lbs/CY
Minimum quantity of Portland cement:	500 lbs/CY

In measuring the water/cement ratio, the water content considered shall include the water content of all liquid admixtures.

4. Maximum mass of fly ash, natural pozzolans or ground granulated blast-furnace slag that is included in the calculation of water-to-cementitious materials ratio shall not exceed the following limits:

a. Fly ash shall not be used for more than 25 percent by mass of the cementitious material. The fly ash and other pozzolans present in a Type IP or IPM blended cement, ASTM C595, shall be included in the calculated percentage. If fly ash or other pozzolan is used in concrete with slag, the Portland cement shall not be less than 50 percent of the total mass of cementitious materials. A higher percentage of fly ash may be used if tests are made using actual job materials to ascertain the early and later age strengths and durability performance specified, and the use is approved by the Engineer.
b. Weight of ground granulated blast-furnace slag conforming to ASTM C989 shall not exceed 50 percent of the weight of cement. The slag used in manufacture of a Type IS or

ISM blended hydraulic cement conforming to ASTM C595 shall be included in the calculated percentage. Higher percentage of ground granulated blast-furnace slag may be used if tests are made using actual job materials to ascertain the early and later age strengths and durability performance specified, and the use is approved by Engineer.

c. Minimum amount of Portland cement is 50 percent of the total mass of cementitious material.

5. Air Content: Concrete shall be air entrained and shall conform to the air limits specified herein.
6. Slump: Concrete mixture shall be proportioned to have, at the point of deposit (end of chute or pump discharge), a maximum slump of 4 inches (plus or minus 1 inch) as determined by ASTM C143, without 'plasticizer' admixture. Where an ASTM C494, Type F or G admixture is used, the single value target slump (plus or minus 1.5 inch) after the addition of the admixture shall be specified as a single value: 5, 6, or 7 inches, depending on the specific admixture and elected dosage rate ("low", "medium", "full", etc.). Slump tolerances shall comply with the requirements of ACI 117.
7. Fibers: Add fibers to slab concrete at a dosage rate of 1.5 lbs/CY for crack control. Fibers shall be Sika Fiber PPE fibrillated polypropylene fibers as supplied by Sika Corporation or equal.

C. Required Average Strength of Concrete: Minimum compressive strength of the selected mixture shall equal or exceed the strength required under ACI 301 for laboratory mixture designs. The average compressive strength produced under field tests shall be the minimum compressive strength (f_{cr}) required during construction.

2.2 MATERIALS

A. Cement: Comply with ASTM C150, Type II and/or ASTM C595, Type IP(MS) or IS(MS) blended cement except as modified herein. The tricalcium aluminate (C_3A) content shall not be less than 4 percent to provide protection for the reinforcement and shall not be more than 10 percent to obtain concrete that is resistant to sulfate attack. Blended cements shall consist of a mixture of ASTM C150 cement and one of the following materials: ASTM C618 pozzolan or fly ash, or ASTM C989 ground granulated blast-furnace slag. Use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

1. Fly Ash and Pozzolan: Comply with ASTM C618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Types N and F. Add with cement.
2. Ground Iron Blast-Furnace Slag: Comply with ASTM C989, Grade 120.

B. Water: Water shall be potable and shall comply with the requirements of ASTM C94 and the chloride and sulfate limits in accordance with ASTM D512 and ASTM D516. Mixing water shall not contain more than 500 parts per million of chlorides as Cl and not more than 100 parts per million of sulfates as SO_4. Water shall be free from injurious amounts of oils, acids, alkalies, salts, and organic materials. Where water from reprocessed concrete is proposed for use in the work, submit results of tests to verify that the treatment has negated adverse effects of deleterious materials.

C. Aggregates: Comply with ASTM C33, except as modified herein.

1. The combined aggregates in the mixture (coarse, fine, and blending sizes) shall be well graded from the coarsest to the finest with not more than 18 percent nor less than 8 percent, unless otherwise permitted, of the combined aggregate retained on any individual sieve with the exceptions that the No. 50 may have less than 8 percent retained, sieves finer than No. 50 shall have less than 8 percent retained, and the coarsest sieve may have less than 8 percent retained. Use blending sizes where necessary, to provide a well graded combined aggregate. Maximum aggregate size shall be 1". Reports of individual aggregates shall include standard concrete aggregate sieve sizes including one inch, ¾ inch, ½ inch, 3/8 inch, No. 4, No. 8, No. 16, No. 30, No. 50, and No. 100.

2. Provide aggregates for exposed concrete from one source, ASTM C227. Do not provide aggregates that react deleteriously with alkalies in cement. Refer to appendix, paragraph entitled "Test Method C227" of ASTM C33 for expansion limits. Provide aggregate containing no deleterious material properties as identified by ASTM C295.
3. Where a size designation is indicated, that designation indicates the nominal maximum size of the coarse aggregate.
4. Aggregate may contain materials deleteriously reactive with alkalies in the cement, if cement contains less than 0.60 percent alkalies (percent Na_2O plus .658 percent K_2O). Provide a material such as fly ash, slag, or silica fume as specified to be effective in preventing harmful expansion due to alkali-aggregate reaction by ASTM C441.
5. Where historical data is used, provide aggregates from the same sources having the same size ranges as those used in the concrete represented by historical data.
6. Marine aggregate may be used when conforming to ASTM C33 and if it originates from the up-current side of the land mass and it has been washed by the fresh water so that the total chloride and sulfate content of the concrete mixture does not exceed the limits defined herein.

D. Grout:

1. Nonshrink Type Grout: Comply with ASTM C1107. Provide Sika Grout 713 or approved equal.
2. Epoxy Type Grout: Provide Five Star HP Epoxy Grout manufactured by Five Star Products, Inc., Fairfield, Conn. or approved equal.

E. Admixtures:

1. Provide chemical admixtures that comply with the requirements shown below and in accordance with manufacturer's recommendations, and appropriate for the climatic conditions and the construction needs. Do not use calcium chloride or admixtures containing chlorides from other than impurities from admixture ingredients.
2. Concentrations of corrosion-inducing chemicals shall not exceed limits shown in Table 2 below. For concrete that may be in contact with prestressing steel tendons, the concentration shall not exceed 60 percent of the limits given in Table 2.

Table 2 - Limits on Corrosion-Inducing Chemicals

Chemical*	Limits, Percent**	Test Method
Chlorides	0.10	ASTM D512
Fluorides	0.10	ASTM D1179
Sulphites	0.13	ASTM D1339
Nitrates	0.17	ASTM D3867

* Limits refer to water-soluble chemicals
** Limits are expressed as a percentage of the mass of the total cementitious materials.

3. Provide anti-washout admixtures for underwater placement with a proven record of performance and compatible with the chosen cement.
4. The total alkali content shall not increase the total sodium-oxide equivalent alkali content of the concrete by more than 0.5 lb/yd^3.
5. Air Entraining Admixture: Provide air entraining admixtures conforming to ASTM C260. Provide the admixture of such a type and dosage that the total air content in the hardened concrete can be readily maintained within 4.5 to 7.5 percent total air content by volume.
6. Accelerating: Comply with ASTM C494, Type C.
7. Retarding: Comply with ASTM C494, Type B, D, or G.
8. Water Reducing: Comply with ASTM C494, Type A, E, or F.
9. High Range Water Reducer (HRWR): Comply with ASTM C494, Type F and ASTM C1017.

F. Materials for Forms:

1. General: Provide forms of wood, plywood, or steel as specified. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood shall be PS-1, B-B faced concrete form panels or better. Steel form surfaces shall not contain irregularities, dents, or sags.
2. Form Ties and Form-Facing Material:

    a. Provide a form tie system that does not leave mild steel after break-off or removal any closer than 2 inches from the exposed surface. Do not use wire alone. Form ties and accessories shall not reduce the effective cover of the reinforcement.
    b. Form-facing material shall be structural plywood or other material that can absorb air trapped in pockets between the form and the concrete and some of the high water-cementitious materials ratio surface paste. Maximum form-facing use shall be three times. Provide forms with a form treatment to prevent bond of the concrete to the form.
    c. As an option to using an absorptive wood form contact face as a form liner, use "Zendrain" or an approved equal in strict accordance with the manufacturer's recommendations.

G. Reinforcement:

1. Reinforcing Bars: Comply with ASTM A615/A615M Grade 60. Unless otherwise indicated, all bars shall be epoxy coated in conformance with ASTM A775/A775M. Splices shall conform to the requirements of ACI 318 and ACI 315.
2. Mechanical Reinforcing Bar Connectors: Comply with ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar. Coat connectors in accordance with the same requirements as reinforcing bars.
3. Welded Wire Fabric: Comply with ASTM A185 or ASTM A497, epoxy coated per ASTM A884/A 884M. Provide flat sheets of welded wire fabric for slabs and toppings.
4. Wire: Comply with ASTM A82 or ASTM A496, epoxy coated per ASTM A884/A884M.

H. Materials for Curing Concrete:

1. Impervious Sheeting: Comply with ASTM C171; waterproof paper type, clear or white polyethylene sheeting, or polyethylene-coated burlap.
2. Pervious Sheeting: Comply with AASHTO M 182.
3. Liquid Membrane-Forming Compound: Comply with ASTM C309, white-pigmented, Type 2, Class B.

I. Joint Materials:

1. Polyethylene Bond Breaker: Sheeting conforming to ASTM D2103, 6mil thick (0.006 inch), unless other thickness indicated.
2. Expansion/Contraction Joint Filler: Comply with ASTM D1751 or ASTM D1752, ½ inch thick, unless otherwise indicated.
3. Joint Sealants:

    a. Horizontal Surfaces, 3 Percent Slope, Maximum: Comply with ASTM D1190 or ASTM C920, Type M, Class 25, Use T.
    b. Vertical Surfaces Greater Than 3 Percent Slope: Comply with ASTM C920, Type M, Grade NS, Class 25, Use T.

J. Epoxy Bonding Compound: Comply with ASTM C881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F.; Class B if placement temperature is between 40 and 60 degrees F.; or Class C if placement temperature is above 60 degrees F.

K. Sleeves:

1. Sleeves for typical penetrations of conduits and pipes and for drain sleeves shall be PVC Schedule 40 conforming to provisions of ASTM D1785.
2. Where otherwise indicated, metallic sleeves shall be hot dip galvanized steel pipe conforming to ASTM A53, Grade 3, standard weight.

2.3 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

A. General: Conform to ASTM C94, ACI 301, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 per cent for cement and water, 2 percent for aggregate, and 3 percent for admixtures.

1. Furnish mandatory batch tickets imprinted with mix identification, batch size, batch design and measured weights, moisture in the aggregates, and time batched for each load of ready mix concrete within one business day of delivery of concrete to the site.
2. When a pozzolan is batched cumulatively with the cement, it shall be batched after the cement has entered the weight hopper.

B. Measuring: Make measurements at intervals as specified in Part 3 Article “Field Quality Control” (paragraphs entitled "Sampling" and "Testing"). Adjust batch proportions to replicate the mixture design using methods provided in the approved quality assurance plan. Base the adjustments on results of tests of materials at the batch plant for use in the work. Maintain a full record of adjustments and the basis for each.

C. Mixing: Conform to ASTM C94 and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F.

1. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes.
2. Additional water may be added, if both the specified maximum slump and water-cementitious material ratio are not exceeded. When water is added, an additional 30 revolutions of the mixer at mixing speed is required.
3. If time of discharge exceeds time required by ASTM C94, submit a request along with description of precautions to be taken.
4. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

D. Transporting: Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete that has segregated in transporting and dispose of as approved or otherwise directed by Owner.

PART 3 - EXECUTION

3.1 EXISTING SURFACES PREPARATION

A. Prior to installation of new concrete work, verify completion of preparations including removal of loose, spalled, deteriorated, and disintegrated existing concrete and cleaning of remaining existing concrete surfaces as specified including removal of marine growth.

3.2 FORMS

A. General: Conform to ACI 301 as a minimum. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete one (1) inch unless otherwise indicated. Forms submerged in water shall be watertight.

1. Provide formwork with clean-out openings to permit inspection and removal of debris.
2. Formwork shall be gasketed or otherwise rendered sufficiently tight to prevent leakage of paste or grout under heavy, high-frequency vibration.
3. Limit reuse of plywood forms to no more than three times. Reuse may be further limited by the Engineer if it is found that the pores of the plywood are clogged with paste to the degree that the wood does not absorb the air or the high water-cementitious materials ratio concrete surface.

B. Form Coating: Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Use a release agent that does not cause surface dusting. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

C. Removal of Forms and Supports: After placing concrete, forms shall remain in place for the time periods specified in ACI 347R, except for concrete placed underwater. For concrete placed underwater, forms shall remain in place 48 hours. Prevent concrete damage during form removal.

1. Special Requirements for Reduced Time Period. Forms may be removed earlier than specified if ASTM C39 test results of field-cured samples from a representative portion of the structure or other approved and calibrated non-destructive testing techniques show that the concrete has reached a minimum of 85 percent of the design strength.

D. Reshoring: Do not allow construction loads to exceed the superimposed load which the structural member, with necessary supplemental support, is capable of carrying safely and without damage. Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring.

1. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members.
2. After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms and Supports".
3. Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carry capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

E. Patch form tie holes with a nonshrink patching material in accordance with the manufacturer's recommendations and subject to approval.

3.3 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

A. Conform to ACI 301 as a minimum. Remove rust, scale, oil, grease, clay, or foreign substances from reinforcing that would reduce the bond of the reinforcing. Do not tack weld. Inspect placed coated steel reinforcing for coating damage prior to placing concrete. Repair all visible damage.

B. Epoxy coated reinforcing shall meet the requirements of ASTM A775/A775M except as otherwise specified herein.

1. Reinforcing Steel Delivery, Handling, and Storage:

   a. For coated bars, record coating lot on each shipping notice and carefully identify and retag bar bundles from bending plant. Provide systems for handling coated bars which have padded contact areas, nylon slings, etc., all free of dirt and grit. Lift bundled coated bars with strong back, multiple supports, or platform bridge to prevent sagging and abrasion. Bundling bands shall be padded where in contact with bars. Do not drop or drag bars or bundles.
   b. Store bars both in shop and in field, aboveground, on wooden or padded cribbing. Space the dunnage close enough to prevent excessive sags. Stack large quantities of straight bars with adequate protective blocking between layers.
   c. Schedule deliveries of bars to the job site to avoid the need for long term storage. Protect from direct sunlight and weather. Bars to be stored longer than 2 months at the job site shall be covered with opaque polyethylene sheeting or other suitable equivalent protective material.

2. Reinforcing Steel Placement and Coating Repair: Carefully handle and install bars to minimize job site coating repair. Use the same precautions as described above for delivery, handling, and storage when placing reinforcement. Do not drag bars over other bars or over abrasive surfaces. Keep bar free of dirt and grit. When possible, assemble reinforcement as tied cages prior to final placement into the forms. Support assembled cages on padded supports. It is not expected that coated bars, when in final position ready for concrete placement, will be completely free of damaged areas; however, excessive nicks and scrapes exceeding the limits specified by ASTM A775/A775M, which expose steel will be cause for rejection. Criteria for defects which require repair and for those that do not require repair are as indicated. Inspect for defects and provide required repairs prior to assembly. After assembly, reinspect and provide final repairs.

   a. Immediately prior to application of the patching material to damaged coated bars, any rust and debonded coating shall be manually removed from the reinforcement by suitable techniques employing devices such as wire brushes and emery paper. Care shall be exercised during this surface preparation so that the damaged areas are not enlarged more than necessary to accomplish the repair. Damaged areas shall be clean of dirt, debris, oil, and similar materials prior to application of the patching material.
   b. Repair and patching of coated bars shall be done in accordance with the patching material manufacturer's recommendations. These recommendations, including cure times, shall be available at the job site at all times.
   c. Allow adequate time for the patching materials to cure in accordance with the manufacturer's recommendation prior to concrete placement.
   d. Rinse placed reinforcing bars with fresh water to remove chloride contamination prior to placing concrete.

3. Reinforcement Supports: Place reinforcement and secure with noncorrodible chairs, spacers, or metal hangers. Support reinforcement on the ground with concrete or other noncorrodible material, having a compressive strength equal to or greater than the concrete being placed.

   a. Epoxy-coated reinforcing bars supported from formwork shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable material.

b. Wire bar supports shall be coated with dielectric material, compatible with concrete, for a minimum distance of 2 inches from the point of contact with the epoxy-coated reinforcing bars.
c. Proprietary combination bar clips and spreaders used in construction with epoxy-coated reinforcing bars shall be made corrosion resistant or coated with dielectric material.
d. Epoxy-coated bars shall be tied with plastic-coated tie wire; or other materials acceptable to the Engineer.

4. Splicing: As indicated. For splices not indicated, conform to ACI 301 and ACI 318. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches.
5. Cover: Concrete cover for reinforcement shall be 3 inches, unless noted otherwise.

C. Setting Miscellaneous Material:

1. Place and secure anchors, bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb sleeves and anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete. Electrically isolate exposed steel work and its anchor systems from the primary steel reinforcement with at least 2 inches of concrete.
2. Coat exposed steel work to reduce corrosion. Take particular care to ensure against corrosion on edges and horizontal surfaces. Use epoxy coatings for protection of carbon steel plates and fittings.
3. For miscellaneous materials to be installed under other contracts, coordinate through Engineer and provide sufficient clearance between reinforcement for drilled-in bolts for railings, building columns, miscellaneous structures, equipment, devices and the like to be installed by others under other Owner's separate contract(s).

D. Joints: Provide joints in concrete construction as indicated and/or suit conditions specified as approved by Engineer. Protect and maintain all constructed joints from intrusion of foreign matter.

1. Construction Joints: Locate construction joints to least impair strength (generally at the quarter points of the spans) and at Engineer approved locations prior to concrete placement. Continue reinforcement across joints unless otherwise indicated.
2. Expansion Joints:

a. Except where preformed compression sealed joints are shown, provide expansion joint at edges of slabs on grade abutting vertical surfaces, aligned with and above existing expansion joints where top of bulkhead is being raised and as indicated. Make expansion joints ½ inch wide unless indicated otherwise.

1) Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used.

3. Contraction Joints: Place contraction joints, with a jointing tool, to the indicated depth after the surface has been finished.
4. Tooled crack control joints in the topping slab shall be located as shown on the plans (generally in alignment with the caisson cap beam joints and at mid-span between bents) or as otherwise directed by the engineer. The tooled joints shall be run as early as possible/practical in the finishing process. Sawcut control joints will not be permitted unless approved by the Engineer.

E. Pits and Trenches: Place bottoms and walls monolithically unless indicated otherwise.

3.4 PLACING CONCRETE

A. Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms.

1. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other or lifts for vertical construction.
2. Position grade stakes on 10-foot centers maximum in each direction when pouring topping slabs.
3. When placing concrete in the tidal zone, begin placement on a falling tide after the water level has fallen below a level where waves will not overtop or enter into the form.

B. Vibration: Comply with the requirements of ACI 309R and ASTM A775/A775M using vibrators with a minimum frequency of 9000 vibrations per minute (VPM). Use only high cycle or high frequency vibrators. Motor-in-head 60 cycle vibrators may not be used. For walls and deep placement conditions (ie: beams), use a minimum of two vibrators with the first to melt down the mixture and the second to thoroughly consolidate the mass. Furnish and maintain spare vibrator(s) at the casting site whenever concrete is placed.

1. Place concrete in 18-inch maximum vertical lifts. Insert and withdraw vibrators approximately 18 inches apart. Penetrate at least 8 inches into the previously placed lift with the vibrator when more than one lift is required. Extract the vibrator using a series of up and down motions to drive the trapped air out of the concrete and from between the concrete and the forms.
2. For slab construction, use vibrating screeds designed to consolidate the full depth of the concrete. Where beams and slabs intersect, use an internal vibrator to consolidate the beam. Do not vibrate concrete placed with anti-washout admixtures. Vibrators shall be equipped with rubber vibrator heads.

C. Application of Epoxy Bonding Compound: Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is tacky. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

D. Pumping: Conform to ACI 304R and ACI 304.2R as a minimum. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Do not use pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of coarse aggregate to 33 percent of the diameter of the pipe. Maximum size of well-rounded aggregate shall be limited to 40 percent of the pipe diameter.

1. Take samples for testing at both the point of delivery to the pump and at the discharge end.

E. Cold Weather: Conform to ACI 306.1 as a minimum. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when ambient temperature is below 40 degrees F. or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F. minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F. in any one hour and 50 degrees F. per 24 hours after heat application.

F. Hot Weather: Conform to ACI 305R as a minimum. Maintain required concrete temperature using Figure 2.1.5, "Effect of Concrete Temperatures, Relative Humidity, and Wind Velocity on the Rate of Evaporation of Surface Moisture From Concrete" in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly

placed concrete. Shade the fresh concrete as soon as possible after placing. All best efforts shall be made to schedule the concrete pour as possible to limit premature rapid concrete drying. Such pour scheduling shall include casting the concrete on days and at times of lower air temperature; lower the concrete temperature, allow for higher atmospheric humidity and avoid days of direct sunlight or cover concrete as soon as possible to limit the surface water evaporation rate. The days selected for concrete topping slab casting must be approved by the Owner. Consider the potential negative effects of the addition of retarder on certain days, as this may expose the concrete to 'drying conditions' for a longer time, even as increasing working time for topping flatwork.

1. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period.
2. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete.
3. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

G. Depositing Concrete Under Water: ACI 301 methods and equipment used shall prevent the washing of the cement from the mixture, minimize the formation of laitance, prevent the flow of water through the concrete before it has hardened, and minimize disturbance to the previously placed concrete.

1. Do not deposit concrete in running water or in water temperatures below 35 degrees F.
2. Tremies, if used, shall be watertight and sufficiently large to permit a free flow of concrete. Keep the discharge end continuously submerged in fresh concrete. Keep the shaft full of concrete to a level well above the water surface. Discharge and spread the concrete by raising the tremie to maintain a uniform flow.
3. Place concrete without interruption until the top of the fresh concrete is at the required height.

3.5 SURFACE FINISHES EXCEPT SLABS

A. Surfaces Not Against Forms (Top of Walls): Finish surfaces not otherwise specified with wood floats to even surfaces, and match adjacent finishes.

B. Formed Surfaces:

1. Tolerances: Conform to ACI 117 and to requirements as indicated.
2. As-Cast Rough Form: Provide for surfaces not exposed to public view. Patch holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.
3. As-Cast Form (for surfaces exposed to view): Provide form-facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture, appearance and durability of the concrete surface shall not be used. Patch tie holes and defects with epoxy mortar and completely remove fins.

C. Defects: Repair formed surfaces by removing minor honeycombs, pits greater than one square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate or other defects that affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise indicated.

1. Defects shall be defined by the more stringent of ACI 301 requirements for "Architectural Concrete" or the following:

    a. Pockets of honeycomb (uncemented coarse aggregate) more than one-inch deep and 100 sq. in. area are found.
    b. Sand streaks (pockets or streaks of uncemented fine aggregate more than one inch deep and 100 sq. in. area) are found.
    c. Corners of forms are not filled.
    d. Bottom of concrete is not down to indicated levels or shows uncemented material at the bottom.
    e. Members are undersize.
    f. Concrete fails to "set-up" (indents under a hammer blow, after 7 days).

3.6 FINISHES FOR HORIZONTAL CONCRETE SURFACES

A. Conform to ACI 301 for finishing and to placing requirements as indicated. Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

1. Scratched: Use a scratched finish for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled, the surface shall be roughened with stiff brushes of rakes before final set.
2. Broomed: Use a broomed finish for deck slabs where not otherwise specified. Perform all surface finishing work in accordance with APDC requirements and under the direct supervision of the Engineer and APDC representatives. Broom finish a small test area prior to full casting and finishing of entire slab. Exact broom finish to satisfy any and all APDC requirements regarding amplitude of finish and non-skid aspect of finish.
3. Concrete Toppings Placement: Conform to ACI 301 as a minimum and the following requirements that apply to the placement of toppings of concrete on concrete surfaces that are either freshly placed or still plastic, or on hardened base slabs.

    a. Placing on Fresh Concrete: Screed and bull float the base slab. As soon as water sheen has disappeared, lightly rake surface of the base slab with a stiff bristle broom to produce a bonding surface for the topping. Immediately spread topping mixture evenly over the roughened base before final set takes place. Finish the concrete topping slab as specified.
    b. Bonding to a Hardened Concrete: When the topping is to be bonded to a roughened hardened base, remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances a head of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 10 degrees F. at the time of placing. Place the concrete topping slab and finish as specified.

3.7 CURING AND PROTECTION

A. All concrete shall be cured using the moist (wet) curing method(s) specified unless otherwise approved by Engineer for a specific condition, and shall be in accordance with these specifications.

B. Conform to ACI 301 and ACI 308 unless otherwise specified. Prevent concrete from drying by misting surface of concrete until curing commences. Begin curing immediately following final set.

1. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, by rain or running water, adverse weather conditions, and any other activity resulting in ground vibrations.
2. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period.
3. Do not use membrane-forming compound on surfaces where exposed to public view unless approved by the Engineer, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded.
4. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period.

C. Wet cure concrete using potable water for a minimum of 7 days. Do not allow construction loads to exceed the superimposed load that the structural member, with necessary supplemental support, is capable of carrying safely and without damage.

D. Moist Wet Curing: Remove water without erosion or damage to the structure.

1. Ponding or Immersion: Continually immerse the concrete throughout the curing period. Water shall not be 20 degrees F. less than the temperature of the concrete. For temperatures between 40 and 50 degrees F., increase the curing period by 50 percent.
2. Fog Spraying or Sprinkling: Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.
3. Pervious Sheeting: Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.
4. Impervious Sheeting: Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period.

    a. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured.
    b. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting.
    c. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

E. Liquid Membrane-Forming Curing Compound: Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen that may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5, “Effect of Concrete Temperatures, Relative Humidity, and Wind Velocity on the Rate of Evaporation of Surface Moisture From Concrete” in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

1. Application: Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

2. Protection of Treated Surfaces: Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

F. Curing Periods: Moist cure concrete using potable water for a minimum of 7 days. Continue additional curing for a total period of 21 days. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by the Engineer.

3.8 FIELD QUALITY CONTROL

A. General: Costs for field inspection of reinforcing steel and placing concrete; for plant inspection at the mixer related to concrete placed in the field; and for the taking, collecting, and testing concrete cylinders in the field will be paid for by the APDC.

1. Testing Agency/Laboratory to perform all sampling and testing specified in this Article during construction by providing incidental labor to collect and store samples.

    a. In cold weather conditions, Contractor shall provide a uniformly heated enclosure (minimum 65 degrees F.) for on-site storage of test cylinders until the testing laboratory picks them up.

2. Concrete inspections and testing will include but not be limited to the following:

    a. Forms will be inspected to see that they are in the correct location and that they will result in concrete of the required dimensions as shown on Contract Drawings.
    b. Reinforcement installations will be checked for size, bending, spacing, location, firmness of installation, and surface condition. Reviewed shop drawings should be used in conjunction with Contract Documents.
    c. Operations of mixing, conveying, placing, compacting, finishing, and curing of concrete will be inspected and will include control of field proportioning and field testing.

3. Should test(s) yield results which do not meet the requirements of the Contract Documents, the Contractor will be required to perform coring for additional testing and/or replacement of defective concrete as directed/approved by Engineer.

B. Evaluation of Mixture Designs (Using Test Slab and Wall)

1. The adequacy of the mixture design to produce the minimum specified strength and durability shall be confirmed by testing field batches; casting concrete in a slab and a wall at the job using job materials, equipment, and personnel; and testing the hardened concrete as described herein. Contractor shall cast the slab and wall. The slab shall be at least 8 feet square and have thickness of at least 8 inches. The wall shall be 8 feet long, 4 feet high and at least 8 inches thick. Slump shall not exceed the slump proposed for the work. Water cure the castings for 7 days.
2. Test the fresh concrete as follows:

    a. Slump in accordance with ASTM C143.
    b. Air content in accordance with ASTM C231 or ASTM C173.
    c. Unit weight in accordance with ASTM C138.
    d. For strength, cast nineteen 6 by 12 inch cylinders in accordance with ASTM C31/C31M.

3. Test 6 by 12 inch cylinders cast under subparagraph d above as follows:

a. Measure and weigh each specimen to determine unit weight as they are stripped from the molds.
b. Test specimens to be tested at each age for pulse velocity through concrete in accordance with ASTM C597.
c. Two at each age of 24 hours and 3 and 7 days in accordance with ASTM C39.
d. Three at each age of 28, 56, and 90 days in accordance with ASTM C39.
e. Two at each age of 28 and 90 days in accordance with ASTM C496.

4. Take twenty-five 4-inch cores from each the wall and the slab in accordance with ASTM C42. Those to be tested at 7 days or earlier age shall be drilled on the test date and tested as cored. Those to be tested at later ages shall be drilled in adequate time for wet curing before testing. Test cores as follows:

   a. All cores: Pulse velocity through concrete in accordance with ASTM C597.
   b. Two cores: Static modulus of elasticity in accordance with ASTM C469 at age 28 days.
   c. Two cores: Specific gravity, absorption, and voids in concrete in accordance with ASTM C642.
   d. Compressive strength in accordance with ASTM C39 as follows:

      two cores at 7 days
      two cores at 28 days
      one spare core

5. Sampling and determination of water-soluble chloride ion content in accordance with ASTM C1218/C1218M. Maximum water soluble chloride ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures shall not exceed 0.08 percent by weight of cement for nonprestressed concrete and 0.06 percent by weight of cement for prestressed concrete.
6. Submit test results for evaluation and acceptance.

C. Sampling:

1. Samples of fresh concrete collected to perform tests specified will be in accordance with ASTM C172 and ASTM C31/C31M for making test specimens.
2. Sample concrete on a random basis except where a batch appears to be deficient and the test can be used to verify the observed deviation. Identify samples so taken in a manner that they can be segmented from other tests. Obtain at least one sample for each 100 cubic yards, or fraction thereof, of each design mixture of concrete placed in any one day. When the total quantity of concrete with a given design mixture is less than 50 cubic yards, the strength tests may be waived by the Engineer, if in his judgment, adequate evidence of satisfactory strength is provided.
3. For pumped concrete, take samples for testing at both the point of delivery to the pump and at the discharge end.

D. Testing:

1. Slump Tests: Take concrete samples for slump tests during concrete placement in accordance with ASTM C143. The maximum slump may be increased as specified with the addition of an approved high range water reducing (HRWR) admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.
2. Temperature Tests:

   a. Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions below 50 degrees F. and above 80 degrees F. for each batch (minimum) or every 10 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

b. Determine temperature of each composite sample in accordance with ASTM C1064. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40 degrees F. for more than 3 successive days, concrete shall be delivered to meet the following minimum temperature at the time of placement:

1) 55 degrees F. for sections less than 12 inches in the least dimension.
2) 50 degrees F. for sections 12 to 36 inches in the least dimension.
3) 45 degrees F. for sections 36 to 72 inches in the least dimension.
4) 40 degrees F. for sections greater than 72 inches in the least dimension.

c. The minimum requirements may be terminated when temperatures above 50 degrees F. occur during more than half of any 24-hour duration. The temperature of concrete at time of placement shall not exceed 90 degrees F.

3. Compressive Strength Tests: Conduct strength tests of concrete during construction in accordance with ACI 214 and the following procedures:

a. Mold and cure six 6 by 12 inch cylinders from each sample taken in accordance with ASTM C31/C31M. Prevent evaporation and loss of water from the specimen.
b. Test cylinders in accordance with ASTM C39. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. The compressive strength test results for acceptance shall be the average of the compressive strengths from the two specimens tested at 28 days. If one specimen in a test shows evidence of improper sampling, molding or testing, discard the specimen and consider the strength of the remaining cylinder to be the test result. If both specimens in a test show any defects, the Engineer may allow the entire test to be discarded.
c. If the average of any three consecutive strength test results is less than the specified strength (f_c) or the minimum test strength (f_{cr}) for durability, whichever is higher, by more the 500 psi, the Contractor shall take a minimum of three core samples in accordance with ASTM C42 from the in-place work represented by the low test results. Locations represented by erratic core strengths shall be retested and the Contractor will be backcharged for the cost of the testing. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.
d. Strength test reports shall include location in the work where the batch represented by a test was deposited, batch ticket number, time batched and sampled, slump, air content (where specified), mixture and ambient temperature, unit weight, and water added on the job. Reports of strength tests shall include detailed information of storage and curing of specimens prior to testing.

4. Air Content: Conform to ASTM C173 or ASTM C231 for testing normal weight concrete. Make air content tests on samples from the first three batches in the placement and until three consecutive batches have air contents within the range of the specified air content, at which time test every fifth batch. Maintain this test frequency until a batch is not within the specified range at which time resume testing of each batch until three consecutive batches have air contents within the specified range.

a. Take air content tests from planned composite samples or from samples taken in accordance with ASTM C172 at the point of concrete placement.
b. Perform additional tests as necessary for control.

5. Anti-Washout Admixture: Determine cumulative mass loss in accordance with COE CRD-C 61. Perform test once for each 350 cubic yards of underwater concrete.

E. Non-Destructive Tests:

1. Use of the rebound hammer for non-destructive tests in accordance with ASTM C805, ASTM C597, or other non-destructive processes, may be permitted by the Engineer in evaluating the uniformity and relative concrete strength in place or for selecting areas to be cored. Evaluate and validate test results conducted on properly calibrated equipment in accordance with standard ASTM procedures indicated.
2. Core Tests: Obtain and test cores in accordance with ASTM C42. If concrete in the structure is dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for 7 days before testing and test dry.

    a. If concrete in the structure will be more than superficially wet under service conditions, test the cores, after moisture conditioning, in accordance with ASTM C42. Take at least three representative cores from each member or area of concrete in place that is considered potentially deficient. Impair the strength of the structure as little as possible.
    b. If, before testing, cores show evidence of having been damaged subsequent to or during removal from the structure, take replacement cores.
    c. Fill core holes with low slump concrete or mortar of a strength equal to or greater than the original concrete.
    d. Engineer will evaluate and validate core tests in accordance with the specified procedures. Before testing in compression, test each core to determine pulse velocity through concrete in accordance with ASTM C597. Correlate pulse velocity of concrete cores with pulse velocity of in-place concrete.

F. Acceptance of Concrete Strength:

1. Standard Molded and Cured Strength Specimens: When the averages of all sets of three consecutive compressive strength test results equal or exceed the design compressive strength (f'_c) or the required field test strength (f_{cr}) whichever is higher, and no individual strength test falls below the specified compressive strength (f'_c) or the required field durability strength (f_{cr}) by more than 500 psi, whichever is higher. These criteria also apply when accelerated strength testing is specified unless another basis for acceptance is specified.
2. Non-Destructive Tests: Non-destructive tests may be used when permitted to evaluate concrete where standard molded and cured cylinders have yielded results not meeting the criteria.
3. Core Tests: When the average compressive strengths of the representative cores are equal to at least 85 percent of the design strength (f'_c) or the required average test strength (f_{cr}), whichever is higher, and if no single core is less than 75 percent of the specified strength (f'_c) or the required average field test strength (f_{cr}), whichever is higher, strength of concrete is satisfactory.

G. Inspection: Inspect concrete placed under water with ACI 311.1R and with qualified engineer/divers.

H. Verification of Miscellaneous Items to be Surveyed: The Contractor's Surveyor shall take optical survey measurements to certify the location of all conduit sleeves, deck openings, and anchor bolts for future work.

END OF SECTION

SECTION 05 80 00 – MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions.

1.2 SUMMARY

A. Work of this Section includes all labor, materials, equipment, and services necessary to provide and complete the items and metal fabrications work as indicated on the Contract Drawings and/or specified herein, including but not limited to, the following:

1. Miscellaneous metals, bracing, supports, anchors, bolts, shims, fastenings, and all other supplementary parts indicated on Contract Drawings or as required to complete each item of work of this Section and/or of Project.
2. Galvanizing fabricated/manufactured items and/or components of Contract work where requirement for galvanizing indicated.

B. Related Sections include the following:

1. Division 3 Section 03311 “Marine Concrete” for embedment of items in cast-in-place concrete elements.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

A. For Work To Be Galvanized: Avoid fabrication techniques that could cause distortion or embrittlement of steel items to be hot-dip galvanized. Fabricator shall consult with hot-dip galvanizer regarding potential warpage problems or handling problems during the galvanizing process that may require adjustment of fabrication techniques or design before finalizing shop drawings and beginning of fabrication.

1.4 SUBMITTALS

A. Qualification Submittals:

1. Galvanizing Applicator: Submit confirmation of qualifications for hot-dip galvanizing applicator with identification and location of firm, equipment and processes used, and quality control procedures typically followed and additionally procedures that will be instituted for item(s) of this Section and other work of this Project.

B. Product Data: Submit manufacturer's specifications, load tables, dimension diagrams, anchor details, and installation instructions for manufactured items, components, and products to be used in the fabrication of miscellaneous metal work and/or to be installed including the following:

1. Paint products, coatings, and other finishes as applicable to item or condition.
2. Installation accessory materials for each type and condition as applicable.

C. Shop Drawings: Submit shop drawings for the fabrication and erection of each item or assembly of metal fabrications and miscellaneous metal work that are not completely shown by manufacturer's data sheets.

Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1-0" scale. Show anchorage and accessory items.

1. General Submittal Requirements for Metal Fabrication Shop Drawings:

    a. Shop Drawings for each item shall indicate the methods for securing the item to the structure. Include design/engineering data as applicable and specified for "Quality Control Submittals" herein.
    b. Welding shall be indicated on shop drawings using AWS symbols and showing length, size and spacing (if not continuous). Auxiliary views shall be shown to clarify all welding. Notes on shop drawings such as 1/4" weld, weld and tack weld, and the like are not acceptable.
    c. Contractor shall be responsible for correct coordination and dimensioning of work where it comes in conjunction and/or contact with any other work.
    d. Show, as applicable to item, any additional provisions to be made for hot-dip galvanizing of assemblies and components. Include record of consultation with Galvanizer.

D. Quality Control Submittals:

1. Design/Engineering Data:

    a. Before any metal fabrications required to resist structural loading are fabricated, submit design engineering data for review indicating how performance standards shall be met for each applicable item or assembly. Submit together with submittal of shop drawings. Contractor is responsible for the structural design and supports for these systems and shall show proposed systems on related shop drawings for the item.

    b. Engineering data and shop drawings submitted shall show all load conditions and design calculations relative to connections, fastening devices and anchorage, as well as size and gauge of members.
    c. Calculations, data, and drawings shall be prepared by or under direction of the Contractor's Engineer (for delegated design) licensed in the State of New York and shall be signed and sealed by this Engineer.

2. Certifications:

    a. For Galvanizing Work: Submit certificates for hot-dip galvanized steel items to identify each item galvanized and to show compliance of application. The Certificate shall be signed by the galvanizer and shall contain a detailed description of the material processed and the ASTM standard used for the coating and, the weight of the coating. In addition, and as attachment to Certification, submit reports of testing and inspections indicating compliance with the provisions of this Section.
    b. Mill Test Reports:

        1) Submit copies of certified mill test reports for each heat of steel for cleat anchor bolts including nuts and washers.

1.5 REFERENCES AND STANDARDS

A. The work covered by this Section shall conform to the following standards to the extent referenced. Publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM):

ASTM A 36/A 36M	Carbon Structural Steel
ASTM A 47	Ferritic Malleable Iron Castings
ASTM A 48	Gray Iron Castings
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 148/A 148M	Steel Castings, High Strength, for Structural Purposes.
ASTM A 143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel.
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193/A 193M	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 240	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 276	Stainless and-Heat Resisting Steel Bars and Shapes
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 385	Practice for Providing High Quality Zinc Coatings.
ASTM A 479/A 479M	Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 569	Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM C 1107	Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1187	Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM F 1554	Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

2. American Institute of Steel Construction (AISC):

AISC ASD Manual	Manual of Steel Construction Allowable Stress Design.

3. American Galvanizers Association (AGA):

AGA T- IPAF	The Inspection of Products to be Hot-Dip Galvanized after Fabrication Including a New Section on Touch-Up and Repair
AGA D-PGAF	The Design of Products to be Hot-Dip Galvanized after Fabrication

4. ASME International (ASME):

ASME 18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Square and Hex Nuts (Inch Series)
ASME B18.21.1	Lock Washers (Inch Series)
ASME B18.22.1	Plain Washers
ASME 18.6.3	Machine Screws and Machine Screw Nuts

5. American Welding Society (AWS):

AWS D1-1	Structural Welding Code

6. The Society for Protective Coatings (SSPC), formerly known as Steel Structures Painting Council:

SSPC SP-3	Surface Preparation Specification No. 3, Power Tool Cleaning.
SSPC PA-1	Painting Application Specification

7. Federal Specifications (FS):

FS A-A-1922A Shield, Expansion (Caulking Anchors, Single Lead)

8. Industrial Fasteners Institute (IFI): Handbook on Bolt, Nut and Rivet Standards.
9. National Association of Architectural Metal Manufacturers (NAAMM)

   NAAMM MBG 532 Heavy Duty Metal Bar Grating Manual

10. U.S. Department of Defense (DOD)

    MIL-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

B. Reference Division 1 Section 01420 “References and Definitions” for additional and related provisions.

1.6 QUALITY ASSURANCE

A. General: Materials, methods of fabrication, fitting, assembly bracing, supporting, fastening, operating devices, and erection shall be in accordance with Contract Documents, approved shop drawings, and shall be of highest quality practices in the industry. Use new and clean materials as specified, having structural properties sufficient to safely sustain or withstand stresses and strains to which materials and assembled work will be subjected. All work shall be accurately and neatly fabricated, assembled, and erected.

1. Parts not specifically identified shall be made of materials most appropriate for their intended use as approved by Engineer.
2. Profiles and sizes of exposed surfaces shown shall be maintained as indicated.
3. Insofar as possible, all materials and equipment used in the installation of this work shall be of the same brand or manufacturer throughout all work and duration of total project for each class of material or equipment. Conform to Reference Standards as a minimum.
4. Comply with specified Performance Requirements as a minimum.

B. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

C. Shop Assembly: Pre-assemble and fit items in 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 re-assembly and coordinated installation.

1. Connections for installation of assemblies in field shall be by approved mechanical fasteners. Welding of assemblies or components on-site shall not be permitted unless specifically shown on Contract Drawings as a field weld and is approved by Engineer specific to a condition of installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metals, General:

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
2. Steel Plates, Shapes and Bars: Conform to ASTM A36.

3. Steel Tubing: Cold formed, conforming to ASTM A500; or hot rolled, conforming to ASTM A501.
4. Structural Steel Sheet: Hot rolled, conforming to ASTM A570; or cold rolled, conforming to ASTM A611, Class 1; of grade required for design loading.
5. Galvanized Structural Steel Sheet: Conform to ASTM A924, of grade required for design loading. Provide Coating Designation G90 unless otherwise indicated.
6. Steel Pipe: Conform to ASTM A53, with type and grade as selected by fabricator and as required for design loading; black finish unless galvanizing is indicated; standard weight (Schedule 40), unless otherwise indicated.
7. Gray Iron Castings: Conform to ASTM A48, Class 30, unless another class is indicated or required by structural loads.
8. Malleable Iron Castings: Conform to ASTM A47, grade as selected by fabricator.

B. Concrete Inserts: Provide threaded or wedge type inserts of galvanized ferrous castings; either malleable iron, conforming to ASTM A47, or cast steel, conforming to ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, conforming to ASTM A153.

C. Grout:

1. Non-shrink cement grout such as Sikagrout 713 or approved equal.
2. For filling the small spaces around the tops of anchor bolts provide epoxy grout as approved by the engineer.

D. Fasteners:

1. General: Provide stainless steel fasteners where indicated. If not otherwise indicated, provide zinc-coated (hot-dip galvanized) fasteners for exterior use or where built into exterior walls. Select all fasteners for the type, grade, and class required.
2. Bolts and Nuts: Regular hexagon head type, conforming to ASTM A307, Grade A.
3. Stainless Steel Bolts: Stainless steel bolts, where indicated for use, shall conform to ASTM A193, Class 2B, Grade B8M2, with nuts of a matching grade conforming to ASTM A194.

E. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes shall be as recommended by producer of metal to be welded, and as required for color match, strength, and compatibility in the fabricated item. Comply with AWS D1.1 or D1.6 as applicable to item and as a minimum.

F. Bituminous Paint: Cold applied asphalt emulsion complying with ASTM D1187.

G. Splash Zone Compound: Carboguard A788 as manufactured by Carboline Company, 350 Hanley Industrial Court, St. Louis, MO 63144-1599 (Phone: 800/848-4645 or 314/644-1000, FAX: 314/644-4617, www.carboline.com), or approved equal.

H. Galvanize Repair Coating: For touching up galvanized surfaces after erection and conforming to MIL-P-21035, provide Z.R.C. Cold Galvanizing Compound material containing a minimum 95% zinc by weight in dry film made by Z.R.C. Chemical Products Co.; or approved equal.

I. Supplementary Parts:

1. Provide as necessary to complete each item of work, even though such supplementary parts are not shown or specified.
2. Reference additional miscellaneous metal items and components required by fabrications specified in Article “Item Fabrications” herein.

2.2 GALVANIZING

A. Scope: All ferrous metal except items of stainless steel and cast steel mooring cleats shall be cleaned and then hot-dipped galvanized after fabrication.

B. Cleaning:

1. Thoroughly clean metal surfaces of all mill scale, rust, dirt, grease, oil, moisture and other contaminants prior to galvanizing.
2. Remove by blast cleaning or other proven method surface contaminants and coatings.

C. Application: Hot-dip galvanizing shall be applied in accordance with the following Reference Standards as a minimum:

1. ASTM A123: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A153: Galvanized Coating on Iron and Steel Hardware - Table 1.
3. ASTM A385; Practice for Providing High Quality Zinc Coatings.
4. ASTM A143; Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel.
5. Minimum weight of galvanized coating shall be two (2) oz. per square foot of surface.

D. To minimize surface imperfection (eg: flux inclusions), material to be galvanized shall be dipped into a solution of Zinc Ammonium Chloride (pre-flux) and oven dried immediately prior to galvanizing. The type of galvanizing process utilizing a flux blanket overlaying the molten zinc will not be permitted.

E. After galvanizing, all materials not exposed to view must be chromated by dipping material in a 0.2% chromic acid solution.

F. Galvanized surfaces, where exposed to view, must have a smooth, level surface finish. Where this does not occur, piece shall be rejected and replaced to the acceptance of the Owner.

G. Source Quality Control for Galvanizing Work:

1. Galvanizer shall verify that units to be galvanized have been correctly fabricated for galvanizing.
2. Inspection and testing of hot-dip galvanized coatings shall be done under the American Hot-Dip Galvanizers Association (AGA) guideline publication "Inspection of Products Hot-Dip Galvanized after Fabrication" (T-IPAF).
3. Include visual examination and tests in accordance with ASTM A123 or A153, as applicable, to determine weight or mass of zinc coating per unit area of metal.

2.3 FABRICATION STANDARDS

A. General

1. Miscellaneous metal work, with respect to item, shall be fabricated by an experienced fabricator or manufacturer and installed by an experienced tradesman.
2. Refer to Article “Quality Assurance” herein for related and additional provisions
3. Protective Coatings: Whenever dissimilar metals will be in contact, separate contact surfaces by coating each contact surface prior to assembly or installation with one (1) coat of specified bituminous paint. Mask off those surfaces not required to receive protective coating.
4. Reference additional miscellaneous metal items and components required by fabrications specified in Article “Item Fabrications” herein.

B. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

C. Shop Assembly: Insofar as practicable, fitting and assembly of work shall be done in shop. Shop assemble work in largest practical sizes to minimize fieldwork. It is the responsibility of the fabricator to assure itself that the shop-fabricated miscellaneous metal items will properly fit the field condition. In the event that shop-fabricated miscellaneous metal items do not fit the field condition, the item shall be returned to the shop for correction.

D. Cutting: Cut metal by sawing, shearing, or blanking. Flame cutting will be permitted only if cut edges are ground back to clean, smooth edges. Make cuts accurate, clean, sharp and free of burrs, without deforming adjacent surfaces or metals.

E. Holes: Drill or cleanly punch holes; do not burn.

F. Connections: Make connections with tight joints, capable of developing full strength of member, flush unless indicated otherwise, formed to exclude water where exposed to weather. Locate joints where least conspicuous. Unless indicated otherwise, weld or bolt shop connections; bolt or screw field connections. Provide expansion and contraction joints to allow for thermal movement of metal at locations and by methods approved by Engineer.

1. Welding:

   a. Welding shall be in accordance with "Standard Code for Welding in Building Construction" of the American Welding Society, and shall be done with electrodes and/or methods recommended by the manufacturer of the metals being welded.
   b. Welds shall be continuous, except where spot welding is specifically permitted. Welds exposed to view shall be ground flush and dressed smooth with and to match finish of adjoining surfaces; undercut metal edges where welds are required to be flush.
   c. All welds on or behind surfaces that will be exposed to view shall be done so as to prevent distortion of finished surface. Remove weld spatter and welding oxides from all welded surfaces.

2. Bolts and Screws: Make threaded connections tight with threads entirely concealed. Use lock nuts. Bolts and screw heads exposed to view shall be flat and countersunk. Cut off projecting ends of exposed bolts and screws flush with nuts or adjacent metal.

G. Forming and Bending: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain profile of member throughout entire bend without buckling, twisting, or otherwise deforming exposed surfaces of fabricated assemblies or related components.

H. Built-In Work: Furnish anchor bolts, inserts, plates, and any other anchorage devices, and all other items specified under this Section to be built into concrete, masonry or work of other trades, with necessary templates and instructions, and in ample time to facilitate proper placing and installation.

I. Coordination: Accurately cut, fit, drill and tap work of this Section to accommodate and fit work of other trades. Furnish or obtain, as applicable, templates and drawings to or from applicable trades for proper coordination of this work.

J. Exposed Work:

1. Metal surfaces exposed to view shall be clean and free from dirt, stains, grease, scratches, distortions, waves, dents, buckles, tool marks, butts, and other defects which mar appearance of finished work.
2. Metal work exposed to view shall be straight and true to line or curve, smooth arises and angles as sharp as practicable, miters formed in true alignment, profiles accurately intersecting, and with joints carefully matched to produce continuity of line and design.

3. Exposed fastenings, where approved by Engineer, shall be of the same material, color and finish as the metal to which applied, unless otherwise indicated, and shall be of the smallest practicable size.

K. Preparation for Hot-Dip Galvanizing: Fabricator shall correctly prepare assemblies for galvanizing in consultation with galvanizer and in accordance with applicable Reference Standards and AGA publication for the "Design of Products to be Hot-Dip Galvanized After Fabrication" (D-PGAF). Preparation shall include but not be limited to the following:

1. Remove welding flux.
2. Drill appropriate vent holes and provide for drainage in inconspicuous locations of hollow sections and semi-enclosed elements. After galvanizing, plug vent holes with shaped lead and grind smooth.

2.4 ITEM FABRICATIONS

A. Rough Hardware:

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing, supporting, anchoring, or securing items of Contract Work to concrete or other structures that are not otherwise specified in other Sections as part of an item.
2. Fabricate items to sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts that bear on wood connections; elsewhere, furnish steel washers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine the areas and conditions where metal fabrications are to be installed and correct any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions are corrected to permit proper installation of the work.

B. Secure field measurements required for proper and adequate fabrication and installation of the work covered in this Section. Assume responsibility for exact measurements and adjustments required to suit condition.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications and for properly transferring loads to in-place construction; including threaded fasteners for concrete inserts, through-bolts, lag bolts, wood screws, and other connectors as required.

1. Use drilling equipment and methods that will minimize spalling or shearing of material being drilled. Utilize a diamond tipped core drill with vacuum attachment for slurry attachment pickup.
2. Use locking washers on all bolts connecting items subject to movement.
3. Relate to and arrange anchorage devices together with supporting structure.

B. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level,

true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry, or similar construction.

C. Field Welding: Field welds shall not be used without the approval of the Engineer. If field welding approved for a specific condition, comply with AWS Code for procedures of manual shielded metal-arc welding, appearance, and quality of welds made, and methods used in correcting welding work.

D. Installation of Assemblies With Base Plates:

1. Prepare surface of existing concrete, paving, or stone masonry as necessary and clean the bottom surface of base plates. At surface areas that will be under base, preparation shall include the following:

    a. Chip off high points, nibs, and the like.
    b. Grout fill surface holes, variations, uneven surface between high areas, crevices, and the like to obtain full bearing of base plate or related shim.
    c. Clean off any dust or loose material.

2. Anchor Bolting of Base Plates: Install expansion anchor bolts in accordance with the manufacturer's recommendations and with bolt anchors of the appropriate size as shown on the Contract Drawings. Use templates to position bolts. Tighten anchor bolts after the supported members have been positioned and plumbed. If needed, use stainless steel wedges or shims of size that will be, when installed, smaller then base plate. Do not remove wedges or shims.
3. Base Plate Grouting: Base plate grout shall be mixed and applied in strict accord with the manufacturer's directions. Leave no voids around anchor bolts and between the base plates and the substrate.

E. Item Installations:

    a. Test set items in recesses of concrete as indicated and confirm level positioning and alignment. If required by surface of concrete as found, chip off high points and/or place grout underneath for correct and level placements.
    b. Securely fasten anchor bolts before installation. Fill any spaces around anchor bolts with epoxy grout and level off between the item and surrounding concrete or recess with specified non-shrink cement grout or as directed by the Engineer.

F. Field Touch-up:

1. For Paint Coated Assemblies: After assembly or erection, the field installed bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned, primed, and coated with paint of the same quality and dry film thickness as that used for the shop or field applied coating.
2. For Galvanized Assemblies: If existing or new galvanized steel surfaces are damaged during handling and installation, prepare and grind surfaces and apply a minimum 2 separate coats of specified Cold Galvanizing Compound.

END OF SECTION

SECTION 06 13 00 – PIER TIMBERWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

A. Work of this Section includes all labor, materials, equipment, and services necessary to provide treated heavy timber materials and construction as shown on the Contract Drawings and/or specified herein including but not limited to the following:

1. Treated heavy timber fendering consisting of blocking, wales, chocks, and miscellaneous timbers at Albany Wharf Sheds No. 1 to 3, and for timber curbing.

B. Related Sections include the following:

1. Division 2 Section 02461 “Marine Timber Piles” for fender piles at Albany Wharf Sheds No. 1 to 3.
2. Division 5 Section 05501 “Miscellaneous Metals” for galvanizing and additional fabrication criteria and for fabrication and installation of other metal components.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s specifications, technical data, certifications, and installation instructions for all materials, components, and accessories of this Section including the following:

1. For Timber/Lumber Material: Submit material certificates for timber/lumber specified to confirm compliance with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the American Lumber Standards Committee's (ALSC) Board of Review.

    a. Include example of identifying mark that will be exhibited on each timber piece as specified in Part 2 Article “Lumber and Timber Material” herein.

2. For Preservative Treatment Material: Submit wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, and installing treated materials:

    a. Timber Preservative Inspection: Submit the inspection report of an independent inspection agency that timber products to be used on this Project requiring preservative treatment comply with applicable AWPA and WWPI BMP Standards. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee.
    b. Include Material Safety Data Sheets (MSDS) and Consumer Information Sheets (CIS) associated with timber preservative treatment. Contractor shall comply with all safety precautions indicated on MSDS and CIS.

3. Timber fasteners / rough hardware, each type.
4. Epoxy anchoring system to be used to install anchor bolts into concrete.

5. Seal, and coating materials.

B. Quality Control Submittals:

1. Delivery Inspection List: Field inspect and submit a verification list of each treated timber/lumber member and each strapped bundle of treated timber/lumber material indicating the wording and lettering of the quality control markings, the species, and the condition of the wood.

1.4 REFERENCES AND STANDARDS

A. Work covered by this Section shall conform to the following standards to the extent referenced or required. Publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM):

ASTM A123/A123M	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM F1667	Driven Fasteners, Nails, Spikes and Staples

2. American Wood-Preservers' Association (AWPA):

AWPA C1	Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	Lumber, Timber, Bridge Ties and Mine Ties – Preservative Treatment by Pressure Processes
AWPA C18	Pressure Treated Piles and Timber in Marine Construction
AWPA M4	Care of Preservative-Treated Wood Products
AWPA M6	Brands Used on Forest Products
AWPA P5	Waterborne Preservatives

3. U.S. Department of Defense (DOD):

MIL-P-21035	Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

4. Western Wood Preservers Institute (WWPI):

BMP	Best Management Practices for the Use of Treated Wood in Aquatic Environments - Joint Publication with Canadian Institute of Treated Wood

5. American Society of Mechanical Engineers/American National Standard Institute (ASME/ANSI):

Standard B18.2.1	Square and Hex Bolts and Screws.

6. Standard Grading Rules for Southern Pine Lumber.
7. Grading Rules for West Coast Lumber, Standard No. 17.

1.5 QUALITY ASSURANCE

A. Pier Timberwork Installer Qualifications: Installation of heavy timber fendering systems of this Section shall be by a Company that specialized in the products specified in this Section with a minimum of three (3) years documented heavy timber installation experience including construction in a marine environment.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Schedule delivery of materials at the site at such time as required for proper coordination of the work. Receive materials in manufacturer's unopened packages and bearing manufacturer's label.
2. Do not incorporate materials damaged in transport from plant to site. Material shall be clean and dry or it will be rejected due to environmental concerns.
3. Inspect all preservative-treated wood visually to ensure there are no excessive residual materials or preservative deposits.

B. Handling:

1. Handling and care of pressure treated wood shall conform to the requirements of AWPA-M4.
2. Handle treated timber with ropes or chain slings without dropping, breaking outer fibers, bruising, or penetrating surface with tools. Do not use cant dogs, peaveys, hooks, or pike poles.

C. Storage:

1. Protect timber and hardware from weather and damage.
2. Store open-stack untreated timber and lumber material on skids at least 12 inches aboveground, in a manner that will prevent warping and allow shedding of water.
3. Store closed-stack treated timber and lumber material in a manner that will prevent long timbers or preframed material from sagging or becoming crooked. Keep ground under and within 5 feet of such piles free of weeds, rubbish, and combustible materials.

PART 2 - PRODUCTS

2.1 LUMBER AND TIMBER MATERIAL

A. General:

1. All lumber and timber (each piece) shall be identified by the grade mark of a recognized association or independent inspection agency using the specific grading and moisture content requirements of an association recognized as covering the species used. The association or independent inspection agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.
2. Provide solid sawn lumber and timbers with all four longitudinal faces free of pith and/or heartwood.

B. Species for Fendering (wales, chocks, blocking and miscellaneous timbers): Provide solid sawn lumber and timbers of 1200f grade stress-rated Southern Pine, Douglas Fir-Larch or approved equal. Preservative treat as specified in paragraph entitled "Preservative Treatment" of this Article.

C. Preservative Treatment: To the extent practical and as approved by Engineer, fabricate lumber and timbers before preservative treatment. Each piece of treated lumber or timber shall be branded, by the producer, in accordance with AWPA M6 that identifies the treatment by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee.

1. Treat wood that is to be or may be in contact with salt water or saltwater splash in accordance with AWPA C2 (Salt Water Use) and AWPA C18 with chromated copper arsenate (CCA). Contractor shall be responsible for the quality of treated wood products.

    a. Preservative: Use Chromated Copper Arsenate (CCA) conforming to AWPA P5.

b. Minimum retention 2.50 lbs./cu. ft. of CCA treatment.

2. Unless treated lumber has aged at least six (6) months prior to installation, treatment shall conform to WWPI BMP to avoid leaching of preservative chemicals into the Hudson River.
3. Contractor shall submit the inspection report of an independent inspection agency, approved by the Engineer, that treated products for use on this Project comply with WWPI BMP's. Materials shall be clean and dry or it will be rejected because of environmental concerns.

D. Field Applied Preservative Treatment Materials: Furnish wood preservatives for field treatment and application on surfaces and holes cut after pressure applied pre-treatment meeting the requirements of AWPA M4.

2.2 HARDWARE AND ACCESSORIES

A. General: Provide bolts with necessary nuts and washers, timber connectors, drift pins, dowels, nails, screws, spikes, and other fastenings as required to complete assembly and attachment of timberwork.

1. Bolts and nuts shall conform to ASTM A307. Bolt heads and nuts shall be square. Provide cast-iron ogee washers wherever nut or head of bolt bears directly on timber unless malleable iron washers, or plate or cut washers are indicated. Provide bolts with washers under nut and head.
2. Lag screws shall conform to ASME/ANSE Standard B18.2.1.
3. Spikes shall be cut spikes conforming to ASTM F1667, Type III, Style 4.
4. Provide timber connectors and other metal fastenings of type and size shown. Provide with threaded lengths to allow future re-tightening as specified.
5. Hot-dip galvanize all hardware unless otherwise indicated specific to a condition.

B. Adhesive-bonded Anchors: Epoxy grout for securing anchor bolts into concrete shall be Hilti Hit RE 500 V3 Epoxy Adhesive Anchor System by Hilti or approved equal.

C. Miscellaneous Items of Steel: Conform to ASTM A36 unless otherwise indicated by Contract Documents.

D. Zinc-Coating: Galvanize steel specified or indicated by the hot-dip process in accordance with ASTM A123/A123M or ASTM A153/A153M, as applicable. Touch up material shall be as specified in Part 3 Article "Field Treatment".

E. Hot Pitch and/or Bitumastic Paint:

1. Pitch furnished shall conform to the requirements of ASTM D450. Type II.
2. Bitumastic Paint shall be Wasser MC Tar by Wasser High-Tech Coatings, Inc., 1004 W. James Street, Suite 100, Kent, WA 98032, (253/850-2967); Carboline Bitumastic 50 by Carboline Company, 350 Hanley Ind. Ct., St. Louis, MO 63144, (314/644-1000); or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions of work in place before beginning work; report defects.

B. Measurements: Take field measurements; report variance between Contract Drawings and field dimensions.

3.2 PREPARATION

A. Coordination: Relate to and arrange pier timberwork installation together with fender pile construction as specified in Division 2 Section 02461 “Marine Timber Piles”.

B. Provide protective equipment for personnel fabricating, field treating, or handling materials treated with preservatives. Comply with applicable "MSDS and CIS" requirements.

3.3 INSTALLATION / CONSTRUCTION

A. General:

1. Cut, bevel, and face timbers prior to plant preservative treatment to extent possible and to minimize field cutting. Provide protective equipment for personnel fabricating, field treating, or handling materials treated with preservatives.
2. Cut and frame lumber and timber so that joints will fit over contact surface with even bearing without shimming. Secure timbers and piles in alignment. Open joints are not acceptable.

B. Hole Boring:

1. Bore holes for drift pins and dowels with a bit 1/16 inch less in diameter than the pin or dowel used.
2. Bore holes for bolts with a bit 1/16 inch larger in diameter than rod or bolt used.
3. Bore holes for lag screws in two parts. Make lead hole for shank the same diameter as shank. Make lead hole for the threaded portion approximately two-thirds of the shank diameter.
4. Bore holes in small timbers for boat or wire spikes with a bit of the same diameter or smallest dimension of the spike to prevent splitting.
5. Holes to receive timber fasteners shall be counterbored so as not to cause timber to crack or split when fastenings are installed.
6. Counterbore for countersinking wherever smooth faces are indicated or specified.

C. Fender Systems: Face fender piles to receive chocks. Minimize splicing of wales by providing timbers in lengths to span across four (4) blocks (24 feet +/- minimum) except where precluded by end or interruptions. Use only full-length timbers for chocks and tightly fit against fender piles. Face fender piles to provide a flat bearing against wales. Splice wales in location in a manner as indicated. Additional splicing of wales will not be permitted.

D. Fastening:

1. Where bolts are used to fasten timber-to-timber, timber to concrete, or timber to steel, bolt members securely together when they are installed.

    a. Vertical bolts shall have nuts on the lower end.
    b. Provide bolts having sufficient additional threading to provide at least 3/8 inch per foot thickness of timber for future retightening.
    c. Retighten all bolts/nuts immediately prior to final acceptance of Contract work.

2. Adhesive-bonded Anchors (For securing anchor bolts to concrete): Comply with anchor manufacturer’s written instructions. Do not install anchors when air or substrate temperatures are below manufacturer’s recommendations. Embed anchors sufficiently into concrete to develop the full tensile strength of the bolt with embedment depth typically not less than 9 inches.
3. Washers shall be as shown on the Contract Drawings and shall be used as additionally required to secure work.

3.4 FIELD TREATMENTS

A. Timberwork: Field treat cuts, bevels, notches, refacing and abrasions made in the field in treated timbers in accordance with AWPA M4, MSDS and CIS. Wood preservatives are restricted use pesticides and shall be applied according to applicable standards.

1. Trim cuts and abrasions before field treatment.
2. Coat depressions or openings around bolt holes, joints, or gaps including recesses formed by counterboring, with preservative treatment used for timber.
3. After field treatment and after bolt or screw is in place, fill depressions and openings with approved epoxy compound or hot pitch or other bitumastic compound.

B. Galvanized Surfaces: Repair and recoat zinc coating which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such an extent as to expose the base metal.

1. Thoroughly clean the damaged area by wire brushing and remove traces of welding flux and loose or cracked zinc coating prior to painting.
2. Compound paint with a suitable vehicle in a ratio of one part zinc oxide to four parts zinc dust by weight.
3. Paint cleaned area with two coats of zinc oxide-zinc dust paint conforming to MIL-P-21035. Allow each coat to correctly dry between coats.

END OF SECTION

SECTION 31 62 19 – MARINE TIMBER PILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions.

1.2 SUMMARY

A. Work of this Section includes all labor, materials, equipment, and services necessary to provide new treated timber fender piles as shown on the Contract Drawings and/or specified herein.

1. Drive piles to the required penetrations indicated as a minimum.
2. Cut off piles at elevations indicated.

B. Related Sections include the following:

1. Division 2 Section 02226 “Marine Demolition and Removals” for provisions related to extraction, removal, clearing obstructions, and cut off of existing timber piles.
2. Division 2 Section 02398 “Pier Timberwork” for timber wales, chocks, blocking, and miscellaneous timbers.

1.3 SUBMITTALS

A. Product Data:

1. Treated Timber Piles: Submit for Timber Piles to identify material, size(s), order lengths, treatment, and source.
2. Hardware, each type.
3. Accessory material, each type.
4. Equipment Data – For Information: Include to identify the following as a minimum:

    a. Driving equipment. Include hammer manufacturer’s charts and graphs needed to calibrate hammer energy.
    b. Driving helmet and cushion blocks.
    c. Cushion block details as specified.

B. Shop Drawings:

1. Timber Pile Identification Plan: Prior to pile driving, submit a pile identification plan showing location of piles, pile cut-off elevations, and a numbering system for the timber piles.
2. Timber Pile Driving Work/Procedures Plan: Submit to include the following:

    a. Proposed sequence for driving all timber piles.

C. Quality Control Submittals:

1. Certificates of Compliance:

    a. Driving hammer.

b. Treated Timber Piles:

1) Submit certification with inspection report of an independent inspection agency that preservative treatment of timber (wood) piles for this Project complies with this specification as a minimum and applicable AWPA and WWPI BMP's standards in accordance with Article "Quality Assurance" herein.
2) Submit example of identifying mark that will be exhibited on each timber pile as specified in Article "Quality Assurance" herein.

2. Materials and Safety Data Sheets (MSDS) and Consumer Information Sheets (CIS): Submit Materials and Safety Data Sheets (MSDS) and Consumer Information Sheets (CIS) associated with timber pile preservative treatment. Contractor shall comply with all safety precautions indicated on MSDS and CIS.
3. Field Quality Control Records: Submit pile-driving records as specified and as may be otherwise requested by Engineer.

D. Contract Closeout Submittals:

1. Record Documents: Submit to include and record location and identification of each new timber pile installed.

1.4 REFERENCES AND STANDARDS

A. The work covered by this Section shall conform to the following standards to the extent referenced. Publications are referred to in the text by the basic designation only.

1. American Society for Testing and Materials (ASTM):

ASTM A123	Zinc (Hot Dipped) Galvanized Coatings on Iron and Steel Products
ASTM A153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
ASTM D25	Round Timber Piles
ASTM D450	Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing

2. American Wood-Preservers' Association (AWPA):

AWPA C1	All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	Lumber, Timber, Bridge, and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C3	Piles, Pressure Treatment
AWPA M4	Care of Preservative-Treated Wood Products
AWPA M6	Brands Used on Forest Products

3. Federal Specifications (FS):

FS RR-W-410	Wire Rope and Strand

4. Western Wood Preservers Institute (WWPI):

BMP	Best Management Practices for the Use of Treated Wood in Aquatic Environments - Joint Publication with Canadian Institute of Treated Wood

5. U.S. Department of Defense (DOD):

MIL-P-21035 Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

B. Refer to Division 1 Section 01420 “References and Definitions” for related and additional provisions.

1.5 QUALITY ASSURANCE

A. Timber Piles Preservative Treatment: Contractor shall be responsible for the quality of treated wood products.

1. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee.
2. Inspect all preservative-treated wood visually to ensure there are no excessive residual materials or preservative deposits. Unless treated piles have aged at least six (6) months prior to installation, treatment shall conform to WWPI BMP to avoid leaching of preservative chemicals into the Hudson River.
3. Contractor shall submit inspection report(s) of an independent inspection agency, approved by the Engineer that offered products (each pile) comply with applicable AWPA standards and WWPI BMP’s. Materials shall be clean and dry or it will be rejected because of environmental concerns.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store and handle piles in accordance with industry accepted methods to avoid damage or deformation of the timber piles.

PART 2 - PRODUCTS

2.1 TIMBER PILE MATERIAL

A. Timber Piles, Treated:

1. Provide Douglas Fir or Southern Pine clean-peeled piles conforming to ASTM D25. Piles shall be in one (1) piece. Splices will not be permitted. The producer, in accordance with AWPA M6, shall brand each treated pile.

   a. Pile circumferences shall be as a minimum 38 inches butt circumference (12 inches diameter) measured at 3 feet from the butt end. Full-length piles shall be used throughout the work; the use of splices or build-up will not be permitted. Ordered lengths shall be of sufficient length to allow a minimum one (1) foot cut-off should the butt be damaged during installation. Cut-off elevation shall be as indicated.
   b. Pile shall be fresh cut stock. Use of warehouse material stored over 90 days is prohibited.

2. Pile Treatment: Treat piles by the full-cell pressure process in accordance with AWPA C1 and AWPA C3 for piling, with waterborne preservatives for use in a Marine Environment. For piling use waterborne preservatives to a minimum retention of Chromated Copper Arsenate (CCA) 2.5 lb/cf.

B. Timber Pile Quality:

1. All timber piles shall be of sound timber suitable for driving, cut above the ground swell, free from decay, unsound knots, knots in groups or clusters, windshakes and short or reversed bends. The maximum diameter of any sound knot shall be one-third the diameter of the pile section where the knot occurs, but not more than four (4) inches in the lower half of pile length nor more than

five (5) inches otherwise. All knots shall be trimmed flush with the body of the pile and ends shall be squared with the axis.

2. Piles shall have reasonably uniform taper throughout their length and shall be so straight that a line joining the centers of point and butt shall not depart from the body of the pile. No bark or wane shall be measured in required dimensions. The diameter at any pile section is the average of the maximum and minimum dimensions at that timber pile section.

C. Inspection of Timber Piles: With every delivery and before the material is accepted, Contractor shall furnish a certificate of satisfactory inspection issued by the lumber association or agency of the material furnished. This certificate shall certify that the material furnished complies with the requirements of the specifications.

2.2 HARDWARE

A. Provide bolts with nuts and washers, timber connectors, drift pins, dowels, nails, screws, spikes, and other metal fastenings. Hot dip galvanize all steel items according to ASTM A123 or A153 as applicable.

1. Bolts and nuts shall be carbon steel conforming to ASTM A307. Bolt heads and nuts shall be square.
2. Washers shall be cast-iron ogee, malleable iron, plate or cut washers, as shown on the Contract Drawings. Provide bolts with washers under nut and head.
3. Provide expansion shield and/or lag bolt type for anchorage to concrete conforming to ASTM A307.

2.3 ACCESSORY MATERIALS

A. Epoxy Grout: Epoxy grout for securing anchor bolts into concrete shall be Hilti Hit RE 500 V3 Epoxy Adhesive Anchor System by Hilti or approved equal.

B. Hot Pitch and/or Bitumastic Paint:

1. Pitch furnished shall conform to the requirements of ASTM D450. Type II.
2. Bitumastic Paint shall be Wasser MC Tar by Wasser High-Tech Coatings, Inc., 1004 W. James Street, Suite 100, Kent, WA 98032, (253/850-2967); Carboline Bitumastic 50 by Carboline Company, 350 Hanley Ind. Ct., St. Louis, MO 63144, (314/644-1000); or approved equal.

C. Wood Preservative (For Field Treatment Applications): Comply with requirements of AWPA M4.

D. Galvanized Repair Coating: Conform to MIL-P-21035 and to requirements specified for Field Treatment in Part 3 Article “Field Fabrication” herein.

PART 3 - EXECUTION

3.1 PILE DRIVING EQUIPMENT

A. Capacity: Pile driving hammers shall develop 7,000 to 13,500 foot pounds per blow for driving piles and shall be of sufficient weight and energy to install the specified pile without damage into the soils expected to be encountered. If, in the opinion of the Engineer, satisfactory results are not obtained with the hammer furnished by the Contractor, a hammer meeting the approval of the Engineer shall be furnished and used, but at no time shall the striking energy of 13,500 ft.-lbs per blow be exceeded.

B. Operating Speed: Sufficient compressor capacity must be provided at all times to maintain the rated speed of hammer during the full time of driving a pile. The valve mechanism and other parts of the hammer shall be maintained in first class condition so that the length of stroke, for a single acting hammer, and the number of blows per minute, for a double acting hammer, for which the hammer is designed, will be obtained. Any double acting hammer not operating at the rated hammer speed specified in the manufacturer's catalogue, for the particular hammer being used, shall be deemed unsatisfactory and shall be removed from the site.

C. Diesel Hammers: All Diesel hammers shall be provided with an acceptable means of measuring hammer energy. When pressure gages are included as normal equipment, they shall be furnished and maintained in operable condition. Submit hammer manufacturer's charts and graphs that are required to calibrate hammer energy. Contractor shall also arrange easy access to the pressure gages so that Engineer may conveniently take readings at the site.

D. Leads: Pile driver leads shall be constructed in such a manner as to afford freedom of movement of the hammer. The use of either swinging or hanging leads will be permitted provided the pile is properly supported during driving and the desired final position and batter of pile is achieved. In the event the Engineer determines that the use of swinging or hanging leads is producing unsatisfactory results, he may require the Contractor to hold the leads in position with guys or stiff braces to give the required support. Contractor may, as an alternative, replace the unsatisfactory equipment with new equipment having fixed leads. Pile driving leads shall be of sufficient length so that the use of a follower will not be necessary. The driving of piles with followers shall be avoided if practicable and shall be done only with written approval and/or direction of the Engineer.

E. Driving Helmets and Cushion Blocks:

1. A driving helmet or cap including a cushion block or cap block of a design acceptable to the Engineer shall be used between the top of the pile and the ram to prevent impact damage to the pile. Driving helmet or cap and cushion block combination shall be capable of protecting the head of the pile, minimize energy absorption and dissipation, and transmit hammer energy uniformly and consistently during the entire driving period.
2. The driving helmet or cap shall fit loosely around the top of the pile may rotate slightly without binding within the driving head.
3. The cushion block shall be a solid or laminated softwood block with the grain parallel to the end of the pile enclosed in a close-fitting steel housing. Thickness of block shall be suitable for the length of pile to be driven and the character of subsurface material to be encountered. Generally, thicker blocks shall be provided for longer piles and softer subsurface material. Helmet or block shall uniformly transmit energy to pile with a minimum loss of energy.
4. Replace cushion block if it has been damaged, split, highly compressed, charred or burned, or has become spongy or deteriorated in any manner.
5. Under no circumstances will the use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy be permitted.
6. Prior to the start of pile driving operations, Contractor shall submit detail product data/drawings of the cushion block, including records of successful use where the block is other than that specified herein.

3.2 PILE INSTALLATION

A. Inspect timber piles when delivered and when in the leads immediately before driving.

B. Driving Timber Piles: Operate hammer at manufacturer's rated speed, and drive piles as indicated on the Contract Drawings.

1. Tolerances in Driving: Timber Piles shall be driven in the locations indicated.

a. Piles may be manipulated a maximum of 0.50 inch per foot of pile length in a direction parallel to the wharf face and 0.25 inch per foot of pile length in a direction perpendicular to the wharf face.
b. Remove and replace with new timber piles any timber pile damaged, mislocated, driven below the design cutoff, or driven out of alignment.

2. Protection of Piles: Square the heads and tips of piles to the driving axis. Laterally support piles during driving, but do not unduly restrain piles from rotation in the leads. Swinging leads will not be permitted. Where pile orientation is essential, take precautionary measures to maintain the orientation during driving.
3. Obstruction: Contractor is solely responsible for the costs associated with drilling-through or relocating a pile when an obstruction is encountered. All such costs shall be included in the Contractor's lump sum price.

C. Piles shall be installed with due consideration for the safety of adjacent structures and subsurface construction, by a method which leaves their strength unimpaired. If conditions at the site are such that the tip, the body or the butt of the pile is likely to suffer damage during driving, special precautions shall be taken to avoid such damage.

D. Broken or damaged piles shall not be used in the work.

E. Any pile that is raised or heaved during driving of adjacent piles shall be redriven to at least the original tip elevation or as otherwise approved by the Engineer.

F. Jetting, spudding, or predrilling will not be permitted.

G. Pile driver lead shall be marked legibly with paint at intervals of one foot, fixing the zero point at the deck of the pile driver scow. Tide staffs or gages or other elevation controls shall be installed.

H. Piles shall be supported and braced during installation until they are fixed in the permanent work as required to assure proper location of the piles. The supports, braces and guides shall be frequently verified to insure that they are holding the piles to line and slope. Supports, braces and guides shall be removed only after approval of the Engineer.

I. Timber Pile Cut-off: Refer to Article "Field Fabrication" herein.

3.3 REJECTION OF TIMBER PILES

A. The following shall be causes for rejection of a timber pile:

1. Pile location or batter is incorrect.
2. Pile damaged from any cause whatsoever.
3. Pile is determined by the Engineer to be unserviceable for other reasons related to the furnishing and installing of the pile.
4. Piles which are driven so that, when cut off, the tops are below the elevation fixed by the plans or as established by the Engineer, shall be withdrawn and replaced by new and, if necessary, longer piles at no additional cost to the Owner.
5. Piles that are split, splintered or broomed from driving operations are not acceptable. Any pile broken by reason of internal defects (even though the Engineer permitted it to be put in the leads), or by improper driving shall be rejected.

B. Correction of Deficiencies: Contractor shall remove and replace rejected piles.

1. No additional payment will be made for removal, replacement or repair of rejected piles.

2. No additional payment will be made for backfilling of cavities left by the extraction of rejected piles or from augur holes or soil deformations necessary to place pile.
3. No additional payment will be made for re-driving piles that are forced up by any cause.

3.4 FIELD FABRICATION

A. General:

1. Counterbore holes for bolts where indicated for countersinking bolt heads and washers. After installation of bolts, fill counterbored holes with an approved epoxy or bituminous material.

    a. Drill holes for through bolts 1/16 inch larger than diameter of bolt shank.
    b. Drill holes for lag bolts not larger than body of bolt at base of thread.

2. Secure piles in their proper alignment.
3. Dap piles to receive chocks.
4. Timber Pile Cut-off: After the timber piles are driven, secured in their proper alignment, and accepted, cut piles at cutoff grade to true planes and at the required elevation with pneumatic tools by sawing or other approved method. Use of explosives for cutting will not be permitted. No shims of any description will be permitted. Pile heads at cutoff shall be sound. Inaccurately cut off piles shall be repaired or replaced at no additional cost to the Owner.

    a. Piles shall have tops beveled outboard as indicated.

B. Fastening: Use washers of the size and type specified under bolt heads and nuts that would otherwise come in contact with wood.

C. Field Treatments:

1. Timber Piles: Field treat cuts, bevels, notches, re-facings, and abrasions made in the field in treated timber piles in accordance with AWPA M4, MSDS and CIS. Wood preservatives are restricted-use pesticides and shall be applied according to applicable standards.

    a. Trim cuts and abrasions before field treatment. Apply field treatment to depressions or openings around bolt holes, joints, or gaps including recesses formed by counterboring, with preservative treatment used for piles or timber.
    b. After bolt or screw is in place and treatment applied, fill depressions and openings with epoxy or hot pitch or other bitumastic compound.

2. Galvanized Surfaces: Repair and recoat zinc coating which has been field or shop cut, burned by welding, abraded, or otherwise damaged to such an extent as to expose the base metal.

    a. Thoroughly clean the damaged area by wire brushing and remove traces of welding flux and loose or cracked zinc coating prior to painting.
    b. Paint cleaned area with two coats of zinc oxide-zinc dust paint conforming to MIL-P-21035. Compound paint with a suitable vehicle in a ratio of one part zinc oxide to four parts zinc dust by weight.

3.5 FIELD QUALITY CONTROL

A. When inspections result in product rejection by the Engineer, the Contractor shall promptly segregate and remove rejected material from the premises.

B. Pile Driving Record:

1. Contractor, through Contractor's Engineer, shall maintain a record of each pile driven that includes the following as a minimum:

    a. Driving equipment used; weight of striking part of hammer in pounds; the effective height of fall of hammer in feet; and the actual energy delivered by hammer per blow in foot-pounds.
    b. Pile location.
    c. Pile condition.
    d. Pile diameter.
    e. Pile length.
    f. Pile tip elevation.
    g. Pile cut-off elevation.
    h. Behavior of pile during driving.
    i. Length of pile, after it is driven and approved from final tip elevation to cut-off elevation.

2. Contractor shall submit, in the requisite number of copies, the Pile Driving Record report of pile driving operations.

C. Verification of Pile Layout and Elevations:

1. After all piles have been installed at proposed location(s), Contractor's Surveyor shall take and record optical survey measurements to establish the elevation and position of the top of each pile immediately after driving (or redriving) and, subsequently, after driving adjacent piles.
2. Submit record survey drawings to show verification of pile layout and pile elevations.

END OF SECTION

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

Furnishing, transporting and installing asphalt pavement construction as shown on the Contract Drawings and as specified herein.

1.2 WORK INCLUDED

The work of this Section includes all labor, materials, equipment, and services necessary to complete pavement construction and shall include but not be limited to:

A. Furnishing and installing the asphalt base, binder and/or top courses.

B. Furnishing and installing tack coat.

D. Cleaning up the site.

1.3 REFERENCES

New York State Department of Transportation Standard Specifications, (NYSDOT Specs) and Addenda.

1.4 SUBMITTALS

Submit for approval prior to start of work:

A. Design mixes for the base, binder and top courses.

B. Manufacturer's literature and application rates for tack coat.

D. Proposed equipment for placing and compacting the asphalt pavement courses.

Submit to the Engineer during pavement installation:

F. Truck delivery tickets for asphalt pavement materials indicating the tonnage and weight per cubic foot of material delivered to the site. This will not be basis for payment.

1.5 QUALITY ASSURANCE

A. Pavement shall be built by a Contractor experienced in the construction of pavements as specified herein.

B. If the Contractor proposes to sublet the asphalt pavement work, the Subcontractor shall be approved as set forth in the General Conditions.

C. If the Contractor proposes to execute the pavement work by his own organization, the foreman and members of the pavement construction force shall be fully qualified by training and experience.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Asphalt materials shall conform to the requirements of NYSDOT Standard Specifications, types as shown on the Contract Drawings.

B. Asphalt emulsion tack coat shall meet the requirements of Table 702-9 of the Standard NYSDOT Specifications.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. No construction shall be performed when the subgrade is frozen, thawing or during unfavorable weather conditions. No asphalt material shall be laid when the surface temperature of the air is 45 degrees Fahrenheit and falling or when temperatures of less than 45 degrees Fahrenheit are anticipated within 24 hours.

B. No asphalt material shall be laid during wet conditions.

3.2 INSTALLATION

A. The pavement shall be constructed in accordance with NYSDOT Standard Specifications Section 401.

B. The asphalt mix shall be applied by a paver, spread and struck off to the width required and to such appropriate loose depth that when the work is completed, the required compacted thickness of mixture will be obtained.

C. Prior to commencing rolling, the loose mat shall be checked, any irregularities adjusted, and all unsatisfactory material shall be removed and replaced.

D. Immediately after the mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted with approved vibratory or rolling equipment.

E. The asphalt material shall be applied with each compacted lift not exceeding three (3) inches thick. The wearing course shall be compacted with a double drum vibratory finish roller.

3.3 TOLERANCES

A. Surface tolerances shall be plus or minus 1/4 inch. If in the opinion of the Engineer, the pavement surfaces are not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, he may test the surface with a 16 foot straight edge or string line. Variations exceeding 1/4 inch shall be satisfactorily corrected at no additional cost to the Port.

B. Thicknesses shall be as shown on the Contract Drawings, and shall be constructed within the following tolerances:

Binder Course	±1/2 inch
Top Course	±1/4 inch
Total Thickness	±1/2 inch

PART 4. - MEASUREMENT & PAYMENT

4.1 MEASUREMENT

A. The asphalt material installed, shall be measured on a square yard basis, in-place, based on the Contractor's field measurements as approved by Engineer for each type of material placed.

B. Truck delivery tickets of material delivered to the site will not be basis for payment.

4.2 PAYMENT

A. Payment for the work of this section shall include all labor, equipment, materials, cleaning, tack coat, and services necessary for the complete installation of asphalt pavement.

B. Payment for the asphalt paving shall be at the unit price specified on the Bid Form.

END OF SECTION

SECTION 34 11 00 - TRACKWORK

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

Furnishing, transporting, storing and installing new track complete with all accessories as shown on the Contract Drawings and specified herein.

1.2 WORK INCLUDED

The work covered under this Section includes the furnishing of all materials, labor, tools, equipment, and incidentals necessary to complete the installation of new track as shown on the Contract Drawings. The work includes but is not limited to:

A. Furnishing and installing new rail over new concrete wharf deck as shown on the Contract Drawings.

B. Connections of new rail to existing rail at the south end of Shed No. 3 and at the north end (near Shed No. 1), as shown on the Contract Drawings.

1.3 RELATED WORK

Related work is described in the following sections of this specification:

Section 03311 - Marine Concrete

1.4 REFERENCES

The current edition and addenda of the following publications are part of this section of the Specifications and are applicable to the extent indicated by the specific reference:

New York State Department of Transportation Standard Specifications Construction & Materials (NYSDOT Specifications).

American Railway Engineering and Maintenance of Way Association (AREMA) Specifications and Standard Railroad Practice.

American Society for Testing and Materials (ASTM).

1.5 QUALITY ASSURANCE

A. The contractor/subcontractor shall have a minimum of 10 years' experience in the installation of trackwork of this type. All trackwork shall be installed under the supervision of a foreman and superintendent with the same minimum experience.

1.6 SUBMITTALS

The Contractor shall submit to the Engineer for review the following items within the time specified:

Submit for review prior to start of work:

A. The proposed method, equipment and sequence of operations for the installation of new track.

B. The proposed new rail sections to be incorporated in the work shall have results from the manufacturer that includes reports and test results for the weight of rail, dimensioning, chemical composition, hardness testing, ultrasonic testing, hydrogen content testing and branding/stamping in accordance with AREMA and ASTM Standards.

1. The new rail chemical composition must be within the limits from AREMA Table 4-2-1-3-1a for 115 lb. specification.

2. New rail hardness shall be tested using a Brinell hardness test. These results shall be in the limits of AREMA Table 4-2-1-3-2a.

3. Ultrasonic testing for defects shall follow the standards and specifications from AREMA Chapter 4 Section 2.1.8 and ASTM A1 Section S2.

4. Interior condition/macroetch testing for defects shall follow the standards and specifications from AREMA Chapter 4 Section 2.1.9 and ASTM A1 Section 6.

C. Material that fails to conform to the requirements of the specification may be rejected. All rejections shall be reported to the manufacturer in writing.

Submit for review prior to installation:

D. Detailed shop drawings or catalog cuts of all specified and fabricated rail and rail affixation items.

E. Manufacturer's certificate of compliance to specifications, material Test Report, etc., for the new rail and rail accessories.

Submit after completion of rail installation:

F. As-built survey of new and modified track location, including alignment data, gage, top of rail elevations, etc. Top of rail elevations shall be taken at 25-foot intervals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

All materials for railroad trackwork shall be in accordance with the current manual of Recommended Practice of the American Railway Engineering and Maintenance of Way Association (AREMA), American Society for Testing and Materials (ASTM), and the NYSDOT Standard Specifications.

Contractor shall coordinate with rail manufacturer for owner/engineer mill visit for rail production observation during and after rail production, if requested.

All tests and inspections shall be made at the mill, unless otherwise agreed upon, and results forwarded to owner/engineer.

2.2 MATERIALS

A. Rail:

1. All rails for the installation of new trackage shall be new rail, inspected for any physical defects and conform to the requirements and standards of AREMA and NYSDOT specifications. Used rail of any kind will not be accepted. New rail shall also meet AREMA hardness (350 HB), Tensile strength (155 ksi) and Yield strength (105 ksi) requirements for Intermediate Strength Carbon Rail Steel.

2. All rail for installation shall be new continuously welded 115 lb. AREMA rail and inspected in accordance with AREMA specifications.

3. Except as otherwise noted, the running rail shall be spliced by an approved welding process specified in AREMA such as the Thermite welding process or approved equal. Sample Thermite welds shall be quality tested in accordance with AREMA Section 3.13 by Ultrasonic testing and visual inspection methods.

4. Physical attributes of finished rail such as dimensions, weight, sweep, etc, shall meet the requirements of AREMA 2.1.13 and/or ASTM A1 Section 8.

B. Track Hardware:

Except as noted, all accessories shall be standard for use with the rails specified in accordance with AREMA Specifications.

1. Joint bar assemblies for rail shall be new and subject to approval of the Engineer complete with new bolts, spring washers, nuts, and conform to AREMA Specifications, Chapter 4, Part 2.

2. Track bolts shall be new button head, oval neck, or low carbon steel and complete with ASA heavy square nuts and spring washers, diameter compatible with 115 lb. rail sections and in accordance with AREMA Chapter 4, Part 1.

3. Rail clips to be installed with rail on concrete shall be model name Weldlok 24 L/115 (LB), as manufactured by Gantrex Corp. Gantrex Weldlok series rail clips shall consist of weldable (SAE 1030) forged steel lower, and (SAE 1045) forged steel upper with synthetic rubber nose attached via thermal vulcanization process. The clip shall be coated with a corrosion inhibitor. Rubber pad beneath rail is not required. Gantrex shall be present to conduct production installation inspections ensuring proper installation. An inspection report shall be issued to the Engineer summarizing inspection results and ensuring the correct installation procedure was followed.

4. Anchors to be used for fastening tie plates on concrete shall be new J-Bolts meeting the requirements of ASTM A325 steel and shall be as shown on the Contract Drawings.

5. Non-shrink grout for use under rail plates on concrete shall be Sikagrout 713 Grout as manufactured by Sika Products (formerly from Master Builders).

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Installation of new trackwork shall comply with all applicable requirements of AREMA Manual for continuously welded rail, manufacturer's recommendations and as specified herein.

3.2 PREPARATION

A. The existing concrete wharf deck and rail slot shall be fully prepared, as shown on the Plans, in advance of track laying operations.

3.3 INSTALLATION

A. Trackwork on Concrete:

1. Contractor shall set and level all rail plates, by survey, prior to grouting operations.

2. Non-shrink grout shall be either poured or pumped and shall be installed in accordance with the manufacturer's recommendations.

3. Gantrex rail clips shall be installed in strict accordance with the manufacturer's installation instructions.

4. The lower component of the Gantrex rail clip shall be positioned on the plate with a 3/8 inch gap on both sides of the rail flange edge and shall be fastened to the rail plate with weld as indicated on the Contract Drawings. Contractor shall take care not to provide a weld size in excess of that specified by the manufacturer. A weld size larger than that specified by the manufacturer can cause interference between the upper and lower components of the clip. Rubber nose size shall be 5/8" or as required by the manufacturer.

5. The Contractor shall adjust component of the clip forward and ensure tight contact with rail flange edge. The nut shall be tightened with a calibrated torque wrench to a torque of 250 ft-lbs, and provide evidence to engineer that all nuts are properly torqued.

3.4 TOLERANCES

The final gauge, cross level, and horizontal and vertical alignment of constructed track shall be within the tolerances shown below. Tolerance limits from true line, grade, and gauge shall be made with smooth transitions of adequate lengths. This required level of track geometry shall exist at the time of inspection for the acceptance of work.

Cross level:

- Variation from design at any point	±1/8 inch
- Rate of change of permissible variation from design shall not exceed	±1/8 inch in 31 feet

Horizontal Track Alignment:

- Maximum permissible variation from design shall not exceed	±½ inch

- Rate of change of permissible variation shall not exceed — 3/16 in. middle ordinate to a 31 foot chord on curved, and 1/8 in. middle ordinate to a 31 foot chord on tangent.

Vertical Track Profile:

- Maximum permissible variation from design shall not exceed — ±½ inch
- Rate of change of permissible variation from design shall not exceed — 1/8 inch middle ordinate of a 31 foot chord.

Track gauges and cross level gauges for tolerance measurements shall be furnished by the Contractor and shall be checked and certified as to their accuracy with a master gauge.

PART 4 - PAYMENT

4.1 MEASUREMENT

Payment for the work of this section shall include furnishing all labor, equipment, materials, tools, survey and necessary services required for the complete execution of the work specified in the Contract Documents.

4.2 PAYMENT

Payment for the installation of trackwork shall be on a Lump Sum basis specified on the Bid Form, and shall include installation of plates, anchors, clips, grout, continuously welded rail, survey, etc.

END OF SECTION