Bucksport Marine Industrial Park
Phase 1
Index of Technical Specifications

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**Moffatt & Nichol*

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Types of Submittals: All submittals are classified as indicated in paragraph "Submittal Descriptions." Submittals are also grouped as follows:

1. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by contractor or through contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate portion of work.

2. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate portion of work, but nor prepared exclusively for this contract.

3. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portion of work, illustrating portion of work or establishing standards for evaluating appearance of finished work or both.

4. Administrative submittals: Data presented for reviews and approvals to ensure that administrative requirements of project are adequately met but not to ensure directly that work is in accordance with design concept and in compliance with contract documents.

B. Submittal Descriptions

1. Preconstruction Submittals

a. Construction Progress Schedule

b. Submittal register

c. Schedule of values

d. Work plan

e. Quality control (QC) plan

f. Accident Prevention Plan (APP)

g. Activity Hazard Analysis (AHP)

h. Environmental protection plan

2. Shop Drawings

a. Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

b. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the contractor for integrating the product or system into the project.

c. Drawings prepared by or for the contractor to show how multiple systems and interdisciplinary work will be coordinated.

3. Product Data

a. Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

b. Samples of warranty language when the contract requires extended product warranties.

4. Samples

a. Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

b. Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

c. Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

5. Design Data

a. Calculations, mix designs, analyses or other data pertaining to a part of work.

6. Test Reports

a. Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

b. Report which includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

c. Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

d. Investigation reports

e. Daily checklists

f. Final acceptance test and operational test procedure

7. Certificates

    a. Statements signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

    b. Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

    c. Confined space entry permits.

8. Manufacturer's Instructions

    a. Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

9. Manufacturer's Field Reports

    a. Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions. Factory test reports.

10. Operation and Maintenance Data

    a. Data intended to be incorporated in operations and maintenance manuals.

11. Closeout Submittals

    a. Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

    b. As-built drawings

    c. Special warranties

    d. Posted operating instructions

    e. Training plan

C. Approving Authority: Person authorized to approve submittal.

D. Work: As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.02 SUBMITTALS

The Contractor shall submit the following in accordance with this Section. Note that approval of the submittals by the Owner’s Representative shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

A. Preconstruction Submittals

1. Submittal register

1.03 USE OF SUBMITTAL REGISTER

A. Prepare and maintain submittal register, as the work progresses. Submittal register shall include the following columns, at a minimum:

1. Activity number - from the project schedule

2. Transmittal number – Contractor assigned list of consecutive numbers

3. Submittal description

4. Reference drawing and/or specification section

5. Contractor submittal date

6. Response date – date Contractor receives response from Owner's Representative

7. Submittal status – Open (if under review) or Action (if response returned)

1.04 PROCEDURES FOR SUBMITTALS

A. Reviewing, Certifying, Approving Authority

1. Owner's Representative shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements. Approving authority on submittals is the Owner's Representative unless otherwise specified for specific submittal.

B. Constraints

1. Submittals listed or specified in this contract shall conform to provisions of this section, unless explicitly stated otherwise.

2. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at start time.

3. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

4. Approval of separate material, product, or component does not imply approval of assembly in which an item functions.

C. Scheduling

1. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

2. Except as specified otherwise, allow a review period, beginning with receipt by approving authority that includes at least 10 working days. Period of review for each resubmittal is the same as for initial submittal.

D. Contractor's Responsibilities

1. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.

2. Transmit submittals to Owner's Representative in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to Owner, or delays to separate contractors.

3. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the Contractor shall provide a copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.

4. For paper or sample submittals, furnish additional copies of submittal when requested by Owner's Representative, to a limit of 6 copies per submittal.

5. Complete work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.

6. Ensure no work has begun until submittals for that work have been returned as "approved," except to the extent that a portion of work must be accomplished as basis of submittal.

E. Owner's Representative Responsibilities

1. Note date on which submittal was received from contractor on each Contract Item Approval Request Form.

2. Review each submittal; check and coordinate each submittal with requirements of work and contract documents.

3. Review submittals for conformance with project design concepts and compliance with contract documents.

4. Ensure that material is clearly legible.

5. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

6. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

F. Actions Possible

1. Submittals will be returned with one of the following notations:

a. Submittals marked "No Exceptions Noted" authorize the Contractor to proceed with work covered.

b. Submittals marked "Make Corrections Noted" authorize the contractor to proceed with work as noted provided the Contractor takes no exception to the notations.

c. Submittals marked “Revise and Resubmit” or “Submit Specified Item” or “Rejected” indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.05 FORMAT OF SUBMITTALS

A. Transmittal Form: Transmit each submittal, except sample installations and sample panels, to office of approving authority. Use common form for all submittal transmittals. The transmittal form shall identify contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

B. Identifying Submittals: Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

1. Project title and location.

2. Construction contract number.

3. Section number of the specification section by which submittal required.

4. When a resubmission, alphabetic suffix on submittal description to indicate resubmission.

5. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier contractor associated with submittal.

6. Protect identification and location in project.

C. Format of Product Data

1. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

2. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

3. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project.

D. Format of Shop Drawings

1. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.

2. Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by this section. Present larger drawings in sets.

3. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."

4. Dimension drawings, except diagrams and schematic drawings; prepare drawings

demonstrating interface with other trades to scale. Shop drawing dimensions shall be the same unit of measure as indicated on the contract drawings. Identify materials and products for work shown.

E. Format of Samples

1. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less than 2 by 3 inches: Built up to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variation.

c. Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variation.

d. Sample of Linear Devices or Materials: 10 inches length or length to be supplied if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

e. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

f. Color Selection Samples: 2 by 4 inches.

g. Sample Panel: 4 by 4 feet.

h. Sample Installation: 100 square feet.

2. Samples Showing Range of Variation: Where variations are unavoidable due to nature of materials, submit sets of samples of not less than three units showing extremes and middle of range.

3. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.

4. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final cleanup of project.

5. When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

F. Format of Administrative Submittals

1. When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply contractor's approval stamp to document, but to a separate sheet accompanying document.

2. Operations and Maintenance Manual Data: Submit in accordance with Section 01 78 23, "Operation and Maintenance Data." Include components required in that section and the various technical sections.

1.06 QUANTITY OF SUBMITTALS

A. Where feasible, submit electronic versions of submittals. Where non-electronic submittals are required, submit one (1) sample or four (4) copies of remaining submittal types.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

*****END OF SECTION*****

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Quality assurance – control of installation.

B. Tolerances

C. References and standards.

D. Testing laboratory services.

E. Manufacturer's field services.

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures: Submission of manufacturer's instructions and certificates.

B. Section 01 45 23 – Testing and Inspecting Services.

1.03 QUALITY ASSURANCE – CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer's instructions, including each step in sequence.

C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.04 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturer's tolerances. Should manufacturer's tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions and position before securing in place.

D. Accessible routes shall not exceed maximum ADA allowable slopes.

1.05 REFERENCES AND STANDARDS

A. For products or workmanship specified by association, trade, or other consensus standards, complies with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current with date specified in the individual specification sections, except where a specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. Neither the contractual relationships, duties, nor responsibilities of the parties in Contract or those of the Architect/Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.06 TESTING SERVICES

A. Contractor will appoint and employ services of an independent firm to perform testing. Contractor shall pay for testing services required by the specifications.

B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Owner.

C. Testing and source quality control may occur on or off the project site. Perform off–site testing as required by the Owner.

D. Reports will be submitted by the independent firm to the Engineer and Contractor, indicating observations and results of tests and indicating compliance or non–compliance with Contract Documents.

E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services.

2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

F. Testing does not relieve Contractor to perform Work to contract requirements.

G. Re–testing required because of non–conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for re–testing will be made by the Contractor.

1.07 MANUFACTURER’S FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, as applicable, and to initiate instructions when necessary.

B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Owner.

C. Report observations and site decisions or instructions given to applicators or installers supplemental or contrary to manufacturer's written instructions.

D. Refer to Section 01 33 00 – SUBMITTAL PROCEDURES, MANUFACTURER'S FIELD REPORTS article.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.

B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

*****END OF SECTION 01 45 00*****

SECTION 01 45 23

TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Selection and payment.

B. Contractor submittals.

C. Testing agency responsibilities.

D. Testing agency reports.

E. Limits on testing authority.

F. Contractor responsibilities.

G. Schedule of tests.

1.02 RELATED SECTIONS

A. Testing and acceptance required by public authorities.

1.03 REFERENCES

A. ASTM C 802 – Practice for Conducting an Interlaboratory Test Program to Determine the Precision of Test Methods for Construction Materials.

B. ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

C. ASTM C 1093 – Practice for Accreditation of Testing Agencies for Masonry.

D. ASTM D 3740 – Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

E. ASTM D 4561 – Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials.

F. ASTM E 329 – Specification for Agencies Engaged in Construction Inspection and/or Testing.

G. ASTM E 543 – Practice for Agencies Performing Nondestructive Testing.

H. ASTM E 548 – Guide for General Criteria Used for Evaluating Laboratory Competence.

I. ASTM E 699 – Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.

1.04 SECTION AND PAYMENT

A. Employment and payment by Contractor for services of an independent testing agency or laboratory to perform specified testing.

B. Employment of testing agency or laboratory in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

1.05 QUALITY ASSURANCE

A. Comply with requirements of practices listed in paragraph 1.03.

B. Laboratory: Authorized to operate in State in which project is located.

C. Laboratory Staff: Maintain a full-time registered Engineer on staff to review services.

D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.06 CONTRACTOR SUBMITTALS

A. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full-time registered Engineer and responsible officer.

B. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.07 TESTING AGENCY RESPONSIBILITIES

A. Test samples of mixes submitted by Contractor.

B. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.

C. Perform specified sampling and testing of products in accordance with specified standards.

D. Ascertain compliance of materials and mixes with requirements of Contract Documents.

E. Promptly notify Engineer and Contractor of observed irregularities or non– conformance of Work or products.

F. Perform additional tests required by Engineer.

G. Attend preconstruction meetings and progress meetings.

1.08 TESTING AGENCY REPORTS

A. After each test, promptly submit two copies of report to Engineer and to Contractor.

B. Include:

1. Date issued.

2. Project title and number.

3. Name of inspector.

4. Date and time of sampling or inspection.

5. Identification of product and specifications section.

6. Location in the Project.

7. Type of inspection or test.

8. Date of test.

9. Results of tests.

10. Conformance with Contract Documents.

C. When requested by Engineer, provide interpretation of test results.

1.09 LIMITS ON TESTING AUTHORITY

A. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Agency or laboratory may not approve or accept any portion of the Work.

C. Agency or laboratory may not assume any duties of Contractor.

D. Agency or laboratory has no authority to stop the Work.

1.10 CONTRACTOR RESPONSIBILITIES

A. Deliver to agency or laboratory at designated location, adequate samples of materials proposed to be used requiring testing, along with proposed mix designs.

B. Cooperate with laboratory personnel and provide access to the Work.

C. Provide incidental labor and facilities:

1. To provide access to Work to be tested.

2. To obtain and handle samples at the site or at source of products to be tested.

3. To facilitate tests.

4. To provide storage and curing of test samples.

D. Notify Engineer and laboratory 48 hours prior to expected time for operations requiring testing services.

E. Employ services of an independent qualified testing laboratory. Arrange with laboratory and pay for additional samples and tests required by Contractor beyond specified requirements.

1.11 SCHEDULE OF TESTS

Section	Test	Frequency	Date	Performed By	Notes
03 31 29 – Marine Concrete					
	Mix Designs	1 per mix design			

	Compressive Strength	3 test cylinders for every 50 cubic yards or less of each mix design placed daily			
		1 cylinder broken at 7 days			
		2 cylinders broken at 28 days			
	Slump	1 test for each set of cylinders taken			
31 00 00 – Earthwork					
	Compaction				
	Unpaved	1 test per horizontal layer per 10,000 sf of fill area			
	Paved	1 test per horizontal layer per 5,000 sf of subgrade			
	Building Pad	1 test per horizontal layer per 1,500 sf of fill area			
	Curb & gutter / Trench	1 test per 200 lf			
	Proof Rolling	As necessary			
32 11 23 – Aggregate Base Courses					

Section	Test	Frequency	Date	Performed By	Notes
	Base Density	1 test per 5,000 sf			
32 11 26 – Asphaltic Base Courses					
	Asphalt Extraction & Gradation	1 test per each 250 tons placed			
	Marshall Stability	1 test per each 250 tons placed			
	Core	1 test for each 250 tons placed			
	Field Density	1 test per 5,000 sf			
32 12 16 – Asphalt Paving					
	Asphalt Extraction & Gradation	1 test for each 250 tons placed			
	Marshall Stability	1 test for each 250 tons placed			

	Field Density	1 test for each 250 tons placed			
	Cores	1 test for each 250 tons placed			
33 40 00 – Storm Drainage Utilities					
	Compaction				
	Traffic Areas	1 per 100 lf or less for each 4 ft. of depth			
	Non–Traffic	1 per 500 lf or less for each 6 ft. of depth			

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

Not Used

*****END OF SECTION 01 45 23*****

SECTION 01 55 26
TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SUMMARY

A. This section covers furnishing, installation, and maintenance of all traffic control devices, portable signal equipment, warning signs, and temporary traffic lanes used during construction of the project.

1.02 ADDITIONAL REQUIREMENTS

A. All traffic control shall be in compliance with the attached SCDOT encroachment permit.

1.03 RESPONSIBILITY

A. The Contractor shall furnish, install, and maintain all necessary automated signals, barricades, concrete traffic barriers, warning signs, traffic barriers, traffic lanes, and other protective devices. Ownership of these temporary warning devices shall remain with the Contractor provided devices are removed promptly after completion and acceptance of work to which devices pertain. If such warning devices are left in place for more than 30 days after specified time for removal, Owner shall have the right to remove such devices and to claim possession thereof.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All barricades signs, and traffic control signal devices shall conform to requirements of the current South Carolina Manual on Uniform Traffic Control Devices except as may be modified in these project specifications.

B. Portable traffic control signal devices, barricades, signs and other Control Devices shall be either new or in acceptable condition when first erected on Project and shall remain in acceptable condition throughout the construction period.

C. All signs shall have a black legend and border on an orange reflectorized background and will be a minimum of engineering grade reflective.

PART 3 - EXECUTION

3.01 ERECTION

A. Prior to commencement of any actual construction on the project, Contractor shall erect appropriate advance warning signs and place concrete traffic barriers where necessary. Subsequently, as construction progresses and shifts from one side of road to the other, temporary lanes must be installed to provide continuous two-way traffic and bike thoroughfare. All appropriate signs and traffic control devices pertinent to the work shall be erected ahead of construction site to advise and warn travelling public of activity and any necessary detours.

3.02 DELAYS TO TRAFFIC

A. Except in rare and unusual circumstances and with SCDOT's approval, two–way traffic shall be maintained at all times by temporary and/or permanent roads. There are to be no traffic delays during the hours between 7 AM – 10 AM and 4 PM – 10 PM. Between the hours of 10 AM and 4 PM the maximum delay is to be 15–minutes.

B. When traffic is halted temporarily due to transition procedures including the ingress and egress of construction vehicles, Contractor shall provide necessary flagging personnel with proper equipment and clothing to hold such traffic per SCDOT's standards.

3.03 TEMPORARY TRAFFIC LANES

A. Two–lane traffic shall be maintained at all times unless prior written permission has been given by SCDOT and Engineer and all necessary flagging personnel and/or signage has been installed. Temporary lane line stripes shall be applied to the detour paving, as agreed to by Engineer and Owner's representative. The no–passing double center–line stripes shall be yellow. Such stripes shall be a temporary, degradable, reflectorized tape strip. All temporary striping shall be maintained throughout the period traffic control is needed.

B. Contractor is responsible for installation and removal of all temporary roads and trails throughout the construction process. These detour roads are to be in accordance with the Pavement Specifications herein.

3.04 SIGNS AND BARRICADES

A. Contractor shall provide a detailed map showing location and verbiage of all traffic control signs and methods for the project. All critical warning signs for the project will be a minimum of engineering grade reflective material and include appropriate flashing lights.

B. Appropriate Safety Barricades shall be installed between bicycle trails, sidewalks, and the temporary traffic lanes. These barricades shall be impact resistant for passenger vehicles with a travelling speed of 40 mph.

1. Advance warning signs: These signs shall be placed approximately 500 feet in advance of the construction site and detour on each approach to the construction area with subsequent warning signs every 250 feet, until construction site is met.

2. Road Construction Signs: Before and during construction of the detour, advance road construction signs shall be located as already stated above. The construction site detour lanes will have reflective trestle type barricade with flashing lights spaced a maximum of 25 feet apart to delineate each side of any temporary roadway. Additional signage shall be placed to indicate a reduced speed limit for the entire construction area. Other signs as appropriate to a particular activity in the work area shall be erected in advance of that activity per SCDOT's standards.

3. Barricades: While detour is open to traffic, a line of concrete traffic barricades shall be placed across the closed roadway to channelize traffic onto detour. They shall be spaced across the blocked roadway end to end so no vehicle will be able to pass between any two adjacent barricades.

4. Barriers: Shall be 6' wide and wooden having a minimum of three horizontal 6 inch rails spaced 20 inches on center. Markings for barrier rails shall be 6 inches wide alternate orange and white reflectorized stripes sloping downward at 45 degrees in the direction traffic is to pass.

During hours of darkness, the Contractor shall place and maintain flashing warning lights on tops of all barriers.

5. Direction Arrow Signs: At each change in traffic direction along the detour, Contractor shall install a sign with an arrow indicating change in traffic direction. This sign is to be located across the pavement from and facing on– coming traffic.

6. End Construction Sign: This sign shall be 60 inches x 24 inches and erected approximately 200 feet beyond end of construction area on the right–hand side.

*****END OF SECTION 01 55 26*****

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor to complete the relocation, the demolition, salvage of certain items, reinstallation of items temporarily removed, and removal and disposal of structures off the property as shown on the Contract Drawings and as herein specified or directed by the Owner's Representative. Unless otherwise noted within the Contract Documents, the Contractor shall be responsible for disposing of all demolition and removal items off-site. During the demolition work, adjacent tenant equipment and storage areas shall be protected from damage. Any damage resulting from demolition work shall be repaired or replaced by the Contractor to the satisfaction of the Owner's Representative at no additional cost to the Owner. Cleanup of all debris shall be done by the Contractor.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.

B. AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	Safety Requirements for Demolition Operations

C. U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety -- Safety and Health Requirements

D. U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev K) Obstruction Marking and Lighting

E. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants

1.03 DEMOLITION REQUIREMENTS

A. Do not begin demolition or deconstruction until authorization is received from the Owner. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site daily, unless otherwise directed; do not allow accumulations inside or outside the site(s). The work includes demolition, deconstruction, salvage of identified items and materials, and removal of resulting rubbish and debris. Store materials that cannot be removed daily in areas specified by the Owner's Representative. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.04 SUBMITTALS

A. The Contractor shall submit the following in accordance with Contract Documents. Note that approval of the submittals by the Owner's Representative shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

B. Preconstruction Submittals

1. Existing Conditions

2. Demolition Plan: Submit a demolition plan including sequence of work and methods for pulling piles and for demolishing structures. Include plan for capture, control, and transport of demolished materials.

3. Work Procedures: Proposed salvage, demolition, deconstruction, and removal procedures for approval before work is started.

1.05 REGULATORY AND SAFETY REQUIREMENTS

A. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6.

B. Notifications

1. General Requirements: Furnish timely notification of demolition, deconstruction, and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Owner's Representative in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M.

1.06 DUST AND DEBRIS CONTROL

A. Prevent the spread of dust and debris to adjacent building and structures, and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

1.07 PROTECTION

A. Traffic Control Signs

1. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Owner's Representative prior to beginning such work.

B. Existing Conditions Documentation: Before beginning any demolition or deconstruction work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Owner's Representative showing the condition of structures and other facilities adjacent to areas of alteration or removal. Digital photos will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish slab elevations, possible conflicting electrical conduits, mechanical lines, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document.

C. Items to Remain in Place: Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Owner. Repair or replace damaged items as approved by the Owner's Representative. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Owner's Representative prior to performing such work. Any damage to the adjacent structures or pavements during demolition shall be made good to the satisfaction of the Owner's Representative at the Contractor's expense. Stop work immediately if adjacent structures appear to be in danger.

D. Existing Construction Limits and Protection: Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove snow, dust, dirt, and debris from work areas daily.

E. Weather Protection: Protect materials and equipment from the weather at all times. Have materials and workmen ready to provide adequate and temporary covering of exposed areas and materials where necessary.

F. Utility Service: Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction operations. Locate and mark utilities to remain with highly visible tags or flags, with identification of utility type. Coordinate work with utility companies and notify before starting work. Comply with their requirements and obtain required permits. Do not disrupt public utilities without permit from the authority having jurisdiction. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification and approval from the Owner. Do not close, shut off, or disrupt existing utility branches or take-off that are in use without at least 3 days prior written notification and approval from the Owner. The cost of either relocation or removal and plugging of utilities shall be incidental to the demolition and removal work. Provisions shall be made to install temporary services to supply the adjacent structures where necessary.

G. Facilities: Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Piles, caps, sheet piles and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the Owner's Representative. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

H. Protection of Personnel: Before, during and after the demolition and deconstruction work the Contractor shall continuously evaluate the condition of the structures being demolished and deconstructed and take immediate action to protect all personnel working in and around the project site. No area, section, or component of piles, caps, decking, sheeting, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.08 BURNING

A. The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.09 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Items to be relocated which are damaged by the Contractor shall be repaired or replaced with new undamaged items as approved by the Owner's Representative at no additional cost to the Owner.

1.10 REQUIRED DATA

A. Prepare a Demolition Plan. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. State provisions that will be used for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by the Owner's Representative prior to the start of work.

1.11 ENVIRONMENTAL PROTECTION

A. Comply with the US Army Corps of Engineers' and SCDHEC applicable requirements to the work specified herein.

1.12 USE OF EXPLOSIVES

A. Use of explosives will not be permitted.

PART 2 - PRODUCTS

2.01 FILL MATERIAL

A. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to voids, depressions or excavations resulting from demolition or deconstruction of structures.

2.02 REMOVED MATERIALS

A. All material and debris, either existing or resulting from demolition and removal work, which are not designated to be salvaged or relocated, shall become the property of the Contractor and shall be removed from the property and disposed of off-site at an approved facility. The Contractor shall exercise care in performing demolition and removal work in order not to damage adjacent structures or materials to be reused or stored for future use as directed by the Owner's Representative.

PART 3 - EXECUTION

3.01 EXISTING FACILITIES TO BE REMOVED

A. Inspect and evaluate existing structures on site for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and prepared as specified, and stored or delivered to a collection point for

reuse, remanufacture, recycling, or other disposal, as specified. Unless stated otherwise, salvage materials or other reuse of materials shall be for temporary structures and utility services for temporary installations only, and in no case shall salvage materials be used in new construction for permanent facilities. Salvage materials are intended to be removed and disposed of by the Contractor and provided to recycling facilities to the greatest extent practical.

B. Structures

1. Remove existing structures indicated to be removed as shown in the Contract Drawings.

2. Demolish structures in a systematic manner from the top of the structure to the bottom elevations. Remove structural framing members and transport to grade by means of derricks, platforms hoists, or other suitable methods as approved by the Owner's Representative.

3. Locate demolition and deconstruction equipment throughout the structure and remove materials so as to not impose excessive loads to supporting piles, cap beams, framing or other structural elements.

C. Utilities and Related Equipment

1. General Requirements: Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Owner's Representative. Do not interrupt existing utilities serving facilities occupied and used by the Owner except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or deconstruction work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

2. Disconnecting Existing Utilities: Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Owner's Representative. When utility lines are encountered that are not indicated on the drawings, the Owner's Representative shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the Owner's Representative.

D. Paving and Slabs: Sawcut concrete and asphaltic concrete paving and slabs as indicated to full depth below grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Engineer. Pavement and slabs not to be used in this project shall be removed from the Site at Contractor's expense.

E. Concrete: Saw cut concrete structures along straight lines to full depth. Make each cut in structure perpendicular to the face and in alignment with the demolition limits shown on the contract drawings. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

F. Miscellaneous Metal: Recycle scrap metal as part of demolition and deconstruction operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

G. Sheet Pile Tie Rods: Do not cut existing sheet pile ties.

H. Carpentry: Salvage for recycle lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse, except stained, painted, or treated wood.

I. Patching: Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

1. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

J. Mechanical Equipment and Fixtures: Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Mechanical equipment and fixtures must be disconnected at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Owner’s Representative. Do not remove equipment until approved. Do not offer equipment for reuse; provide to recycling service for disassembly and recycling of parts.

1. Preparation for Storage: Water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, must be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

2. Piping: Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3. Ducts: Classify any removed duct work as scrap metal.

4. Fixtures, Motors and Machines: Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor.

K. Electrical Equipment and Fixtures: Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

1. Fixtures: Remove and salvage electrical fixtures. Salvage unprotected glassware from

the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

2. Electrical Devices: Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3. Wiring Ducts or Troughs: Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

4. Conduit and Miscellaneous Items: Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

L. Items with Unique/Regulated Disposal Requirements: Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.02 DISPOSITION OF MATERIAL

A. Title to Materials: Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from the Owner's property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Owner's Representative of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Owner's Representative to begin demolition and deconstruction. The Owner will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

B. Reuse of Materials and Equipment: Remove and store materials and equipment listed in the Demolition Plan to be reused or relocated to prevent damage and reinstall as the work progresses.

C. Salvaged Materials and Equipment: Remove materials and equipment that are listed in the Demolition Plan to remain the property of the Contractor or specified to remain the property of the Owner and deliver to a storage site as directed.

1. Store all materials salvaged for the Contractor as approved by the Owner's Representative and remove from the Owner's property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

2. Remove salvaged items to remain the property of the Owner in a manner to prevent damage and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers.

3.03 CLEANUP

A. Remove debris and rubbish from site. Remove and transport in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.04 DISPOSAL OF REMOVED MATERIALS

A. Regulation of Removed Materials: Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations. Storage of removed materials on the project site is prohibited.

B. Removal from Owner Property: Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Owner property for legal disposal. Dispose of waste soil as directed.

3.05 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

*****END OF SECTION 2 41 00*****

SECTION 03 31 29

MARINE CONCRETE

PART 1 - GENERAL

1.01 SUMMARY

A. The work covered by this Section includes the furnishing of all materials and equipment and the performing of all labor to complete marine concrete work associated with the waterside elements as shown on the Contract Drawings and as herein specified or directed by the Engineer. This work shall include but is not limited to deck concrete, retaining wall, gangway foundation and grout.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.

B. ACI INTERNATIONAL (ACI)

ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 121R	Quality Management System for Concrete Construction
ACI 201.2R	Guide to Durable Concrete
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214R	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 308R	Guide to Curing Concrete
ACI 309R	Guide for Consolidation of Concrete
ACI 311.4R	Guide for Concrete Inspection
ACI 318	Building Code Requirements for Structural Concrete and Commentary

ACI 347	Guide to Formwork for Concrete
ACI SP-15	Field Reference Manual: Standard Specifications for Structural Concrete with Selected ACI and ASTM References
ACI SP-2	ACI Manual of Concrete Inspection
ACI SP-66	ACI Detailing Manual

C. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO T 259	Resistance of Concrete to Chloride Ion Penetration

D. AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	Structural Welding Code - Reinforcing Steel

E. ASTM INTERNATIONAL (ASTM)

ASTM A 496/A 496M	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 82/A 82M	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 966/A 966M	Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM C 1017/C 1017M	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete
ASTM C 1064/C 1064M	Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107/C 1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

ASTM C 1116/C 1116M	Standard Specification for Fiber-Reinforced Concrete
ASTM C 1157	Standard Specification for Hydraulic Cement
ASTM C 1202	Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration
ASTM C 1218/C 1218M	Standard Specification for Water-Soluble Chloride in Mortar and Concrete
ASTM C 1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C 138/C 138M	Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143/C 143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150	Standard Specification for Portland Cement
ASTM C 1609/C 1609M	Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)
ASTM C 171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	Standard Test Method for 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	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 295	Petrographic Examination of Aggregates for Concrete
ASTM C 31/C 31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C 441	Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
ASTM C 469	Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
ASTM C 494/C 494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C 496/C 496M	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C 595	Standard Specification for Blended Hydraulic Cements
ASTM C 597	Pulse Velocity Through Concrete
ASTM C 618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 642	Density, Absorption, and Voids in Hardened Concrete
ASTM C 805	Rebound Number of Hardened Concrete
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM C 94/C 94M	Standard Specification for Ready-Mixed Concrete
ASTM C 989	Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1179	Fluoride Ion in Water
ASTM D 1190	Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1339	Sulfite Ion in Water
ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 3867	Nitrite-Nitrate in Water
ASTM D 512	Chloride Ion in Water
ASTM D 516	Sulfate Ion in Water
ASTM E 329	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

F. U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 572	Specifications for Polyvinylchloride Waterstops
COE CRD-C 61	Test Method for Determining the Resistance of Freshly Mixed Concrete to Washing Out in Water

G. U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-1614	(Rev A; Am 1) Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied, for Portland Cement and Tar Concrete Pavements
FS SS-S-200	(Rev E; Am 2) Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.03 DEFINITIONS

A. "Blending size" is an aggregate that complies with the quality requirements in ASTM C 33 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, and 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" (fcr) is the required compressive strength of concrete to meet structural and durability criteria. Determine (fcr) during mixture proportioning process.

1.04 SUBMITTALS

A. The Contractor shall submit the following in accordance with Contract Documents. Note that approval of the submittals by the Owner’s Representative shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

B. Shop Drawings

1. Reinforcing steel
2. Formwork
3. Construction joints
4. Reproductions of contract drawings are unacceptable.

C. Product Data

1. Waterstops
2. Materials for curing concrete
3. Joint sealants
4. Joint filler
5. Bonding compound
6. Synthetic reinforcing fibers
7. Non-shrink grout
8. Preformed joint filler
9. Reinforcement supports

D. Design Data

1. Mixture design

E. Test Reports

1. Concrete mixture proportions
2. Fly ash
3. Natural pozzolan
4. Ground iron blast-furnace slag
5. Aggregates
6. Admixtures
7. Cement
8. Water
9. Reinforcement and protective coating

F. Certificates

1. Curing concrete elements

2. Concrete placement and compaction

3. Quality assurance

4. Field testing technician and testing agency

5. Mixture designs

1.05 MODIFICATION OF REFERENCES

A. Accomplish work in accordance with ACI publications except as modified herein. 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 the "Architect/Engineer" to mean the Owner's Representative.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 and ASTM A 934/A 934M for job site storage of materials. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

1.07 QUALITY ASSURANCE

A. Concrete Mixture Design

1. At least 30 days prior to concrete placement, submit proportions for a concrete mixture for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, aggregate, fly ash, (or slag pozzolans), ground slag, polypropylene fibers, and applicable reference specifications. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submittal shall clearly indicate where each mixture will be used when more than one mix design is submitted. The mixture shall be prepared by an accredited laboratory experienced in this field and under the direction of a licensed/registered civil engineer, who shall sign all reports and designs.

B. Drawings

1. Reinforcing Steel: ACI SP-66. Provide 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 drawings will be accepted.

2. Formwork: ACI 347. 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. Include locations of inserts, pipework, conduit, sleeves, and other embedded items. Furnish drawings and descriptions of shoring and reshoring methods proposed for slabs, beams, and other horizontal concrete members.

C. Certificates

1. Curing Concrete Elements: Submit proposed materials and methods for curing concrete elements.

2. 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.

3. Quality Assurance: 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 installer. Maintain a copy of ACI SP-15 and CRSI Manual of Practice at the project site.

4. Field Testing Technician and Testing Agency

   a. Submit data on qualifications of proposed testing agency and technicians for approval by the Owner’s Representative prior to performing any work.

      (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 E 329.

      (3) Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C 1077.

5. Mixture Designs: Provide a detailed report of materials and methods used, test results, and the field test strength (fcr) for marine concrete required to meet durability requirements.

D. Test Reports

1. Concrete Mixture Proportions

   a. Submit copies of test reports by independent test labs conforming to ASTM C 1077 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.

b. 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.

2. Fly Ash and Natural Pozzolan: Submit test results in accordance with ASTM C 618. Submit test results performed within 6 months of submittal date.

3. Ground Iron Blast-Furnace Slag: Submit test results in accordance with ASTM C 989 for ground iron blast-furnace slag. Submit test results performed within 6 months of submittal date.

4. Aggregates: Submit test results for aggregate quality in accordance with ASTM C 33, and the combined graduation curve for grading proposed for use in the work and used in the mixture qualification, and ASTM C 295 for results of petrographic examination. Where there is potential for alkali-silica reaction, provide results of tests conducted in accordance with ASTM C 227 or ASTM C 1260. 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.

5. Admixtures: Submit test results in accordance with ASTM C 494/C 494M and ASTM C 1017/C 1017M for concrete admixtures, ASTM C 260 for air-entraining agent, and Manufacturer's literature and test reports for corrosion inhibitor and anti-washout admixture. Submitted data shall be based upon tests performed within 6 months of submittal.

6. Cement: Submit test results in accordance with ASTM C 150 portland cement and/or ASTM C 595 and ASTM C 1157 for blended cement. Submit current mil data.

7. Water: Submit test results in accordance with ASTM D 512 and ASTM D 516.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Durability and Strength: ACI 201.2R, ACI 211.1, ACI 318. For structural elements to be exposed in a marine environment (Low Chloride Class C2), adjust the concrete 28-day design strength to produce concrete of minimum design strength (f'c) as indicated in Table 1.

B. Contractor-Furnished Mixture Proportions

1. 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 C 39/C 39M. The specified compressive strength of the concrete (f'c) for each portion of the structure shall meet the requirements in the contract documents.

2. The 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. The requirements for durability consideration specified in Table 1 and subparagraph "Chloride Ion Penetration" shall be incorporated in the mixture proportions.

Table 1 – Concrete Quality Requirements

Member	Durability Exposure Class	Specified Strength (f'c, psi)	Maximum water to cement ratio	Nominal Max aggregate	Minimum Water-Soluble Chloride Ion Content
Travel Lift Pier	C2	5000	0.40	3/4"	0.15
Slab on Grade & Footings	C2	5000	0.40	1 ½"	0.15
Civil Drainage Structures	W1	4000	0.50	1 ½"	Not Applicable

3. Air Content: Concrete shall have a 4.5% (± 1.5%) air content. If the concrete is pumped, then the entrained air will be acceptable at 5.5% (± 1.5%) measured at the truck.

4. Slump: The concrete mixture shall be proportioned to have, at the point of deposit, a maximum slump of 4 inches as determined by ASTM C 143/C 143M. Where an ASTM C 494/C 494M, Type F or G admixture is used, the slump after the addition of the admixture shall be no less than 6 inches nor greater than 8 inches. Slump tolerances shall comply with the requirements of ACI 117.

5. Chloride Ion Penetration (Class C2 concrete only): To ensure the durability of concrete in marine environment, concrete shall be proportioned to have the chloride ion penetration test in accordance with ASTM C 1202, and be below 1500 coulombs for concrete specimens tested at 28 days. Alternatively, a ponding test in accordance with AASHTO T 259 may be performed to validate chloride ion penetration in accordance with ASTM C 1202. Alternative chloride ion penetration resistance testing program may be submitted to Owner's Representative for review and approval.

C. Required Average Strength of Concrete: The minimum compressive strength (fcr) of the selected mixture shall equal or exceed the strength required under ACI 301 for laboratory mixture designs and which passes the test indicated in the subparagraph entitled "Chloride Ion Penetration." The average compressive strength produced under field tests shall be the minimum compressive strength (fcr) required during construction.

2.02 MATERIALS

A. Cement: ASTM C 150, Type II and/or Type I/II ASTM C 595, Type IP(MS) or IS(MS) and ASTM C 1157, Type MS blended cement except as modified herein. The tricalcium aluminate (C3A) 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 C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground granulated blast-furnace slag. Use one Manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

1. Fly Ash and Pozzolan: ASTM C 618, 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: ASTM C 989, Grade 120.

B. Water: Water shall comply with the requirements of ASTM C 94/C 94M and the chloride and sulfate limits in accordance with ASTM D 512 and ASTM D 516. 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 SO4. 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: ASTM C 33, 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. Reports of individual aggregates shall include standard concrete aggregate sieve sizes including 1 1/2 inches, one inch, 3/4 inch, 1/2 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 C 227. Do not provide aggregates that react deleteriously with alkalies in cement. Refer to appendix, paragraph entitled "Test Method C227" of ASTM C 33 for expansion limits. Provide aggregate containing no deleterious material properties as identified by ASTM C 295.

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 Na2O plus .658 percent K2O). Provide a material such as fly ash or slag as specified to be effective in preventing harmful expansion due to alkali-aggregate reaction by ASTM C 441.

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 C 33 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. Nonshrink Grout: ASTM C 1107/C 1107M.

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. Provide minimum concentrations of corrosion-inducing chemicals as 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. For the concentration in grout for prestressing ducts, do not exceed 25 percent of the limits in Table 2.

Table 2 - Limits on Corrosion-Inducing Chemicals

Chemical*	Limits, Percent**	Test Method
Chlorides	0.10	ASTM D 512
Fluorides	0.10	ASTM D 1179
Sulphites	0.13	ASTM D 1339
Nitrates	0.17	ASTM D 3867

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

3. The total alkali content shall not increase the total sodium-oxide equivalent alkali content of the concrete by more than 0.5 lb/cy.

4. Air Entraining Admixture: Provide air entraining admixtures conforming to ASTM C 260. Provide the admixture of such a type and dosage that the total air content in the hardened concrete can be readily maintained within the limits specified.

5. Accelerating: ASTM C 494/C 494M, Type C.

6. Retarding: ASTM C 494/C 494M, Type B, D, or G.

7. Water Reducing: ASTM C 494/C 494M, Type A, E, or F.

8. High Range Water Reducer (HRWR): ASTM C 494/C 494M, Type F and ASTM C 1017/C 1017M.

9. Corrosion Inhibitor Admixture (Class C2 only): Calcium Nitrite Corrosion Inhibitor shall be added to the concrete mix. The admixture shall consist of Grace DCI® Corrosion Inhibitor or approved equal at a rate of 3.5 gallons per cubic yard.

   a. Any air-entraining, water-reducing, and/or set-controlling admixtures used in the production of concrete mixtures for concrete shall be compatible with calcium nitrite solutions.

   b. The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the admixture including storage, transportation, and method of mixing. The calcium nitrite, which acts as an accelerator, may be used in conjunction with the retarder to control the set of concrete, as per manufacturer's recommendation.

F. Materials for Forms: Provide wood, plywood, or steel. 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: PS-1, B-B concrete form panels or better. Steel form surfaces shall not contain irregularities, dents, or sags.

   1. 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 use is three times. Provide forms with a form treatment to prevent bond of the concrete to the form.

c. As an alternate to using an absorptive wood form contact face as a form liner, use "Zemdrain" or an approved equal in strict accordance with the Manufacturer's recommendations.

G. Reinforcement

1. Reinforcing Bars: ACI 301 unless otherwise specified. ASTM A 615/A 615M Grade 60

2. Mechanical Reinforcing Bar Connectors: ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

3. Wire: ASTM A 82/A 82M or ASTM A 496/A 496M.

4. Weldable Reinforcing Bars: All reinforcing steel to be welded shall conform to ASTM A 706.

5. Fiber-Reinforced Concrete: All cast-in-place concrete shall include micro-synthetic fibers in accordance with ASTM C 1116/C 1116M at a dosage rate of 0.5 lbs/yd^3. Fibers shall be MasterFiber® M 100 by BASF, PSI Fiberstrand F by Euclid Chemical, SikaFiber® PPM 150 by Sika, or approved equal. Fibers shall be added at the batch plant and uniformly dispersed in concrete mixture at a dosage rate recommended by the manufacturer.

H. Polyvinylchloride Waterstops: COE CRD-C 572.

I. Materials for Curing Concrete

1. Impervious Sheeting: ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2. Pervious Sheeting: AASHTO M 182.

J. Expansion/Contraction Joint Filler: ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

K. Joint Sealants

1. Horizontal Surfaces, 3 Percent Slope, Maximum

a. ASTM D 1190 or ASTM C 920, Type M, Class 25, Use T.

2. Vertical Surfaces Greater Than 3 Percent Slope

a. ASTM C 920, Type M, Grade NS, Class 25, Use T.

L. Bonding Compound: Bonding compound shall conform to ASTM C 1059, Type II.

PART 3 - EXECUTION

3.01 FORMS

A. ACI 301. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Forms submerged in water shall be watertight.

B. Provide formwork with clean-out openings to permit inspection and removal of debris. Formwork shall be gasketed or otherwise rendered sufficiently tight to prevent leakage of paste or grout under heavy, high-frequency vibration. Use a release agent that does not cause surface dusting. Limit reuse of plywood to no more than three times. Reuse may be further limited by the Owner's Representative 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.

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

D. 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. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

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

1. Special Requirements for Reduced Time Period

a. Forms may be removed earlier than specified if ASTM C 39/C 39M 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.

F. 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. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. 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." 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.

3.02 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

A. ACI 301. Remove rust, scale, oil, grease, clay, or foreign substances from reinforcing.

B. 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.

C. Splicing: As indicated. For splices not indicated, ACI 301. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. AWS D1.4/D1.4M.

D. Future Bonding: Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Bolt threads shall match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

E. Cover: Concrete cover for reinforcement is shown on the drawings. Placement tolerance is plus 1/4 inch. The cover to the principle reinforcing bars shall be not less than 2 times the nominal maximum aggregate size nor less than 1.5 times the effective diameter of the reinforcing bars.

F. Setting Miscellaneous Material and Anchorages: Place and secure anchors, bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb 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. 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.

G. Construction Joints: Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

H. Expansion Joints and Contraction Joints: Provide expansion joints where indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. 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. Place contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

I. Waterstop Splices: Fusion weld in the field.

J. Pits and Trenches: Place bottoms and walls monolithically or provide waterstops and keys.

3.03 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

A. ASTM C 94/C 94M, 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 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. 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. When a pozzolan is batched cumulatively with the cement, it shall be batched after the cement has entered the weight hopper.

B. Measuring

1. Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

2. 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: ASTM C 94/C 94M 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. 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. 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. If time of discharge exceeds time required by ASTM C 94/C 94M, submit a request along with description of precautions to be taken. 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: Comply with ACI 304R. 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 which has segregated in transporting and dispose of as directed.

3.04 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. 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. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs. At no time shall the concrete temperature exceed 150^{o}F.

B. Vibration

1. Comply with the requirements of ACI 309R and ASTM A 934/A 934M 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 beams, use a minimum of two vibrators with the first to melt down the mixture and the second to thoroughly consolidate the mass. Provide a spare vibrator at the casting site whenever concrete is placed. 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 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: ACI 304R and ACI 304.2R. 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. Take samples for testing at both the point of delivery to the pump and at the discharge end.

E. Cold Weather: ACI 306.1. 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: ACI 305R. 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. 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. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

G. Prevention of Plastic Shrinkage Cracking: Contractor shall develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Figure 2.1.5 of ACI 305R. In addition to the protective measures concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. When such water treatment is stopped, curing procedures shall be immediately commenced. The methods and materials to remove or repair areas affected by plastic shrinkage cracks shall be suggested by the Contractor, reviewed by the Engineer, and approved by the Owner. Cracks shall never be troweled over or filled with cement slurry.

3.05 SURFACE FINISHES

A. 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 which 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 347. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise indicated.

B. Formed Surfaces

1. Tolerances: ACI 117 and 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: 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 which will impair the texture of the concrete surface shall not be used. Patch tie holes and defects and completely remove fins.

C. Finish: ACI 301. 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. Finish exterior surfaces not otherwise specified with wood floats to even surfaces, and match adjacent finishes.

1. Floated: After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation.

2. Broomed: Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.06 CURING AND PROTECTION

A. ACI 301 and ACI 308R unless otherwise specified. Prevent concrete from drying by misting surface of concrete. Begin curing immediately following final set. 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. 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. 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. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

B. Wet cure all concrete using potable water for a minimum of 7 days. 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.

C. Moist 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. 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. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. 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.

D. 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 Owner's Representative.

3.07 FIELD QUALITY CONTROL

A. Evaluation of Mixture Designs

1. The adequacy of the mixture design to produce the minimum specified strength and durability shall be confirmed by testing field batches. Slump shall not exceed the slump proposed for the work. Cure the castings using the same methods as the associated concrete element.

2. Test the fresh concrete as follows:

a. Slump in accordance with ASTM C 143/C 143M.

b. Air content in accordance with ASTM C 231 or ASTM C 173/C 173M.

c. Unit weight in accordance with ASTM C 138/C 138M.

d. For strength, cast nine 6 by 12 inch cylinders in accordance with ASTM C 31/C 31M.

3. Test 6 by 12 inch cylinders 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 C 597.

c. Three at each age of 3, 7 and 28 days in accordance with ASTM C 39/C 39M.

4. Sampling and determination of water soluble chloride ion content in accordance with ASTM C 1218/C 1218M. 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 the limits of Table 5 below. Sampling and determination of chloride ion penetration (ponding test) in accordance with AASHTO T 259.

Table 5 - Maximum Chloride Ion Content for Corrosion Protection

Type of Member	Maximum water soluble chloride ion (Cl) in concrete, percent by weight of cement
Prestressed concrete	0.06
Reinforced concrete exposed to chloride in service	0.08
Reinforced concrete that will be dry or protected from moisture in service	0.15
Other reinforced concrete construction	0.30

5. Submit test results for evaluation and acceptance.

B. Sampling

1. ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M 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 Owner's Representative, if in his judgment, adequate evidence of satisfactory strength is provided.

C. Testing

1. Slump Tests: ASTM C 143/C 143M. Take concrete samples during concrete placement. 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 C 1064/C 1064M. When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40 degree s 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: ACI 214R tests for strength - conduct strength tests of concrete during construction in accordance with the following procedures:

a. Mold and cure six 6 by 12 inch cylinders from each sample taken in accordance with ASTM C 31/C 31M. Prevent evaporation and loss of water from the specimen.

b. Test cylinders in accordance with ASTM C 39/C 39M. Test one cylinder at 3 days, 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 Owner's Representative 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 (fcr) for durability, whichever is higher, by more the 500 psi, take a minimum of three core samples in accordance with ASTM C 42/C 42M, from the in-place work represented by the low test results. Locations represented by erratic core strengths shall be retested. 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.

e. Final reports shall be provided within 7 days of test completion.

4. Air Content: ASTM C 173/C 173M or ASTM C 231 for normal weight concrete. Where concrete will be exposed to deicing salts as indicated. 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. Perform additional tests as necessary for control. Take air content tests from planned composite samples or from samples taken in accordance with ASTM C 172 at the point of concrete placement.

5. Chloride Ion Concentration: ACI 318M. Determine water soluble chloride ion concentration. Perform test once for each mix design.

D. Non-Destructive Tests

1. Non-destructive tests - use of the rebound hammer in accordance with ASTM C 805, ASTM C 597, or other non-destructive processes may be permitted by the Owner's Representative in evaluating the uniformity and relative concrete strength in place, or for selecting areas to be cored.

2. Evaluate and validate test results conducted on properly calibrated equipment in accordance with standard ASTM procedures indicated

E. Core Tests

a. Obtain and test cores in accordance with ASTM C 42/C 42M. 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. If concrete in the structure will be more than superficially wet under service conditions, test the cores, after moisture conditioning, in accordance with ASTM C 42/C 42M.

b. 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. 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. The Owner's Representative 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 C 597. 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 (fcr) whichever is higher, and no individual strength test falls below the specified compressive strength (f'c) or the required field durability strength (fcr) 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 (fcr), 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 (fcr), whichever is higher, strength of concrete is satisfactory.

*****END OF SECTION 03 31 29*****

SECTION 05 50 13
METAL FABRICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. The work covered by this Section includes the furnishing of all material and equipment and the performing of all labor necessary to complete fabrication and installation of metal railings, fasteners, and miscellaneous metal fabrications as shown on the Contract Drawings and as herein specified or directed by the Owner's Representative and not referenced in other Sections of this Specification.

1.02 RELATED WORK

A. Basic Electrical Materials and Methods – Section 26 00 00

1.03 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.

B. ALUMINUM ASSOCIATION (AA)

AA ADM 1	Aluminum Design Manual
AA	Specifications for Aluminum Structures
AA 46	Standards for Anodized Architectural Aluminum
AA DAF-45	Designation System for Aluminum Finishes

C. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	Steel Buildings and Bridges

D. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	Square and Hex Bolts and Screws Inch Series
ANSI B18.2.2	Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ANSI B18.6.2	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ANSI B18.6.3	Machine Screws and Machine Screw Nuts
ANSI B18.22.1	Washers: Helical Spring-Lock, and Plain Washers (Inch Series)

E. ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 36/A 36M	Carbon Structural Steel
ASTM A 47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 53	Standard Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 687	Standard Specification for High-Strength Nonheaded Steel Bolts and Studs
ASTM A 780	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 992	Standard Specifications for Structural Steel Shapes
ASTM B 209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 308	Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM D 1187/D 1187M	Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

ASTM F 593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	Standard Specification for Stainless Steel Nuts
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F3125	Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength
ASTM F 436	Hardened Steel Washers
ASTM A 500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM F 593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	Stainless Steel Nuts

F. AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS QC1	AWS Certification of Welding Inspectors

G. FEDERAL SPECIFICATIONS (FS)

FS TT-P-664	(Rev. D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant

H. MILITARY SPECIFICATIONS AND STANDARDS

MIL-PRF-907	High Temperature Antiseize Thread Compound

I. STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC-SP 1	Solvent Cleaning
SSPC-SP 6	Commercial Blast Cleaning

1.04 SUBMITTALS

A. The Contractor shall submit the following in accordance with Contract Documents. Note that approval of the submittals by the Owner's Representative shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

B. Shop Drawings

1. Handrails
2. Pile Collars
3. Fender System
4. Edge Guide Angle
5. Specialized utility supports
6. Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.
7. Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the existing bulkhead construction. Provide drawings of any connections required that are not detailed. Indicate welded connection with AWS welding symbols. Indicate net weld lengths.

C. Product Data

1. Epoxy for adhesive anchors and dowels
2. Cleats, Ladders & Life Rings
3. Utility Supports
4. Threaded Fasteners

D. Statements

1. Welding procedure qualifications
2. Nondestructive examination (NDE) procedures
3. NDE personnel certification procedures
4. Inspector certification
5. Submit inspector certification and NDE personnel certification for record

E. Certificates and Records

1. Contractor shall submit to the Owner's Representative, certifications from manufacturers, suppliers, fabricators, etc., which attest that materials meet the requirements herein. Include submittals for:
    a. All steel framing and miscellaneous plates
    b. Bolts and connection hardware
    c. Galvanized steel or other materials specified to be corrosive resistant

2. Certified Welding Inspector: Submit qualifications of third party AWS Certified Welding Inspectors (CWI) proposed for welder qualifications and visual/NDE inspections. Inspectors shall be qualified and certified in accordance with the provisions of AWS QC1, Standard for Qualification and Certification of Welding Inspectors. Do not proceed with welder or welding operator qualifications prior to approval of CWI qualifications.

3. Specifications and Test Results: Submit copies of the welding procedure specifications, procedure qualifications, welder and welding operator qualifications test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds.

4. Certification: Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified in paragraph titled “Quality Assurance”. Do not start welding work prior to procedure, welder and welding operator qualification approval. The certification shall state the type of welding and positions for which each welding procedure welder and welding operator is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

5. Weld Identifications: Submit a list of the welder’s names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

1.05 QUALIFICATION OF WELDERS

A. Qualify welders in accordance with AWS D1.1 and AWS D1.2 and as specified herein. Use procedures, materials, and equipment of the type required for the work.

1.06 QUALITY ASSURANCE

A. Welding Procedures, Welders and Welder Qualifications

1. Develop and qualify procedures for welding metals included in the work. Do not start welding until welding procedures, welders, and welding operators have been qualified. Perform qualification testing by a Certified Weld Inspector (CWI) or testing laboratory approved by the Owner’s Representative. Notify the Owner’s Representative at least 24 hours in advance of the time and place of the tests. When practicable, perform the qualification tests at or near the work site. Maintain current records of the test results obtained in welding procedure, welder and welding operator performance qualifications, and nondestructive examination (NDE) procedures. These records shall be readily available at the site for examination by the Owner’s Representative. Qualify the procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses. The choice of welding process shall be the responsibility of the Contractor.

B. Performance: The Contractor shall be responsible for the quality of joint preparation, welding, and examination. Clearly identify and record materials used in the welding operations. The examination and testing defined in this Specification are minimum requirements. Provide additional examination and testing as necessary to achieve the quality required.

1. Welding Procedures Qualification

a. Qualification of the welding procedures for each group of materials to be welded is required as indicated in AWS D1.1 or AWS D1.2. Welding procedure qualifications shall be newly qualified procedures done and observed under the supervision of a Certified Weld Inspector (CWI) or approved independent testing laboratory, except as noted below. Record in detail and qualify the "Welding Procedure Specification" for every welding procedure proposed. Qualification for each welding procedure shall conform to the requirements of AWS Standards and to this Specification. The welding procedures shall specify end preparation for weld, including cleaning, alignments, and root openings. Preheat, inter-pass temperature control, and post-heat treatment of welds shall be as required by AWS, unless otherwise indicated or specified. Welding procedure qualifications shall be identified individually and referenced on the shop drawings or suitably keyed to the contract drawings.

2. Welder and Welding Operator Performance Qualification

a. Qualify each welder and welding operator assigned to work covered by this Section by performance tests using equipment, positions, procedures, base metals, and electrodes or bare filler wires from the same specification, classification, or group number that will be encountered on his assignment. All welders and welding operator shall be newly qualified for this project under AWS D1.1 or AWS D1.2 requirements and all performance qualifications and testing shall be under the observation of CWI or approved testing laboratory. Welders or welding operators who make acceptable procedure qualification tests will be considered performance-qualified for the welding procedure used. Determine performance qualification in accordance with AWS D1.1 or AWS D1.2 and as specified herein.

3. Qualification of Inspection and Nondestructive Examination (NDE) Personnel.

a. Shall be the responsibility of the Contractor.

4. Qualify Inspection and nondestructive examination personnel in accordance with the following requirements:

a. Inspector Certification

5. Qualify welding inspectors in accordance with AWS QC1.

a. NDE Personnel Certification Procedures

6. Certify NDE personnel and establish a written procedure for the control and administration of NDE personnel training, examination, and certification. Base procedures on appropriate specific and general guidelines of training and experience recommended by ASNT SNT-TC-1A, Supplement C-Ultrasonic.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Protection: Protect from corrosion, deformation, and other types of damage all metal fabrications before, during, and after installation and to protect the installed work and materials of all other trades. Store items in an enclosed area free from contact with soil and weather.

B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative and at no additional cost to the Owner.

C. Deliver filler metals, electrodes, fluxes, and other welding materials to the site in manufacturer's original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

1.08 ENVIRONMENTAL

A. Do not perform welding when the quality of the completed weld could be impaired by the prevailing work or weather conditions per AWS D1.1. The Owner's Representative will determine when the weather or working conditions are unsuitable for welding.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Carbon Steel: Structural Carbon Steel shall conform to ASTM A 992 or ASTM A 572, Grade 50 or as indicated on the drawings.

B. Structural Tubing: Structural tubing shall conform to ASTM A 500, Grade C.

C. Steel Pipe: Steel pipe shall conform to ASTM A 53, Type E or S, Grade B.

D. Anchor Bolts, Nuts and Washers: Anchor bolts, other than high strength and unless otherwise noted or specified, shall conform to ASTM A 193, Grade 8M, Class 1 or ASTM F 1554, Grade 55, as specified on the drawings. Galvanize all non stainless steel hardware.

1. Adhesive Anchor Bolts: Anchorage shall use a glass encapsulated vinylester or polyester adhesive resin to secure adhesive anchors. Minimum pull out and shear capacity of the adhesive system shall exceed the ultimate capacity of the anchor.

2. Adhesive Anchors or Dowels: Provide size indicated for adhesive anchors. Minimum concrete embedment shall be as specified. . Embedment and hole diameter shall be per Manufacturer's recommendations to development the anchor or dowel tensile capacity. Design value listed shall be tested according to ASTM E 488.

3. Expansion Anchors: Provide size indicated and should only be used for anchoring the timber sleepers. Minimum concrete embedment shall be as specified. Embedment and hole diameter shall be per Manufacturer's recommendations to development the anchor or dowel tensile capacity. Design value listed shall be tested according to ASTM E 488.

E. High Strength Bolts, Galvanized

1. High strength bolts shall conform to ASTM F3125, Grade A325

2. Nuts shall conform to ASTM A 563, Grade DH

3. Washers shall conform to ASTM F 436

F. Bolts, Nuts, Studs and Rivets: Provide ASME/ANSI B18.2.2 and ASTM A 687, or ASTM A 325 as indicated, Galvanized.

G. Screws: Type 316 Stainless Steel.

H. Stainless Steel Bolts

1. 1/4 inch to 5/8 inch nominal diameter bolts, inclusive, shall conform to ASTM F 593, Alloy 316, Condition CW1 or ASTM A193 Grade 8M, Class 1 or 2. Nuts shall conform to ASTM F 594, Alloy 316, Condition CW1.

2. 3/4 inch to 1-1/2 inch nominal diameter bolts, inclusive, shall conform to ASTM F 593, Alloy 316, Condition CW2. Nuts shall conform to ASTM F 594, Alloy 316, Condition CW2.

3. Washers shall be Alloy 316 meeting the dimensional requirements of ANSI B18.22.1, Type A Plain.

4. Washers: Provide plain washers to conform to ANSI B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ANSI B18.21.1.

I. Aluminum Tubes and Shapes: Alloy 6061-T6 conforming to ASTM B 308, or 6063-T6 conforming to the provisions in ASTM B 221.

J. Aluminum Plates: Alloy 6061-T6 conforming to ASTM B 209.

K. Fittings for Steel Pipe: Standard malleable iron fittings ASTM A 47/A 47M.

2.02 FABRICATION FINISHES

A. Galvanizing: Hot-dip galvanized items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A 123/A 123M, ASTM A 153/A 153M or ASTM A 653/A 653M, G90, as applicable.

B. Galvanize: Anchor bolts, bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

C. Repair of Zinc-Coated Surfaces: Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Owner’s Representative. Clean areas to be repaired and remove slag from welds. Heat surfaces to which sticks or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

D. Cleaning and Painting

1. Surface Preparation: Prepare surfaces to be coated in accordance with Coating Manufacturer’s Recommendations. Blast clean surfaces in accordance with SSPC-SP6. Clean surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents in accordance with SSPC-SP1. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative.

2. Pretreatment, Priming and Painting: Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

3. Painting Galvanized Surfaces: Coat all galvanized connection angles with an approved galvanized duplex system; which includes at a minimum, using zinc rich primer with a black acrylic topcoat. When possible, coat steel within 24 hours after galvanizing; otherwise, follow manufacturer's recommended procedure for preparing galvanized steel for coating.

    a. Cleaning and Painting: Prepare surfaces to be painted in accordance with coating manufacturer's recommendations. Wash cleaned surfaces, which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Apply primer and paint in accordance with manufacturer's printed instructions.

E. Nonferrous Metal Surfaces: Protect by plating, anodic, or organic coatings.

2.03 MISCELLANEOUS PLATES AND SHAPES

A. Provide for items that do not form a part of the structural steel framework, miscellaneous mountings and frames.

B. Provide angles and plates, ASTM A 36/A 36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A 123/A 123M.

2.04 WELDING MATERIALS

A. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 - EXECUTION

3.01 QUALITY CONTROL

A. Fabrication: Prior to shipment, all structural steel framing shall be examined by the fabricator and/or manufacturer for compliance with the appropriate requirements of this Section. Noncompliance with any specified requirement or presence of any defects preventing or lessening maximum efficiency shall constitute cause for rejection.

B. Control Inspection: The Contractor shall examine each structural steel fabrication prior to installation and note any damage or defects. Any rejected material shall be segregated and removed from the project site. Any material damaged during Contractor handling and installation shall be repaired in accordance with manufacturer's recommendations or replaced at no additional cost to the Owner.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Install items at locations indicated, according to manufacturer's instructions.

B. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing. Do not field cut or alter structural members, unless indicated to be altered, without approval of Owner's Representative. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete. Items listed below require additional procedures.

C. Field Measurements: Verify that field measurements are as shown on shop drawings. Verify all measurements and take all field measurements necessary before fabrication.

D. Provide exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water.

E. Erection Tolerances: Maximum Offset from True Alignment: 1/8 inch.

3.03 ANCHORAGE, FASTENINGS, AND CONNECTIONS

A. Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.04 BUILT-IN WORK

A. Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.05 WORKMANSHIP

A. Metalwork must be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching must produce clean true lines and surfaces. Continuously weld along the entire area of contact. Do not tack weld exposed connections of work in place. Grid smooth exposed welds. Provide smooth finish on exposed surfaces of work in place, unless otherwise approved. Where tight fits are required, mill joints. Cope or miter corner joints, well formed, and in true alignment. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.06 WELDING

A. Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1 or AWS D1.2 as applicable unless noted below. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation. Do not deviate from applicable codes, approved procedures and approved shop drawings without prior written approval from the Owner’s Representative. Materials or components with welds made off the site will not be accepted if the welding does not conform to the requirements of this Specification unless otherwise specified. Assign each welder or welding operator an identifying number, letter, or symbol that shall be used to identify his welds. Each welder or welding operator shall apply his mark adjacent to his weld using an approved rubber stamp or felt-tipped marker with permanent, weatherproof ink or other approved methods that do not deform the metal. For seam welds, place identification marks adjacent to the welds at 3-foot intervals. Confine identification by die stamps or electric etchers to the weld reinforcing crown, preferably in the finished crater. Perform welding in accordance with qualified procedures using qualified welders and welding operators.

B. Examination and Tests

1. Visual and nondestructive examinations shall be performed by a third party AWS Certified Welding Inspector (CWI) qualified and certified in accordance with the provisions of AWS QC1, Standard for Qualification and Certification of Welding Inspectors to detect surface and internal discontinuities in completed welds. Visual and ultrasonic examination shall be required as specified. When examination and testing indicates defects in a weld joint, a qualified welder shall repair the weld in accordance with the Paragraph “Corrections and Repairs” of this Section.

2. Visual Examination: Visually examine 100% of welds as follows:

   a. Before Welding: For compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.

   b. During Welding: For conformance to the qualified welding procedure.

   c. After Welding: For cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of filet welds.

3. Nondestructive Examination (NDE): All full penetration welds shall Ultrasonic Tested (UT) and certified by a CWI. NDE shall be in accordance with written procedures. Procedures for ultrasonic tests and methods shall conform to AWS D1.1 and for underwater welding procedures for ultrasonic tests and methods shall conform to AWS 3.6. In addition to the information required in AWS, the written procedures shall include:

   a. Timing of the nondestructive examination in relation to the welding operations

   b. Safety precautions

4. 10 Percent NDE: All steel welding shall be subjected to 10 percent NDE unless noted otherwise. Additional testing may be required if unsatisfactory results are obtained.

C. Acceptable Standards

1. Visual: The following indications are unacceptable:

   a. Cracks – external surface

   b. Undercut on surface which is greater than 1/32 inch deep

   c. Lack of fusion on surface

   d. Convexity of filet weld surface greater than 10 percent of longest leg plus 1/32 inch

   e. Concavity in fillet welds greater than 1/16 inch

   f. Fillet weld size less than indicated or greater than 1-1/4 times the minimum specified filet leg length

2. Ultrasonic Examination: Linear type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed 3/4-inch. Discontinuities interpreted to be cracks, lack of fusion, or incomplete penetration are unacceptable regardless of length.

D. Corrections and Repairs

1. Remove defects and replace welds as specified. Repair defects discovered between weld passes before additional weld material is deposited. Wherever a defect is removed, a repair by welding is required, and the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, reexamine the area by the same test methods which first revealed the defect to ensure that the defect has been eliminated. After rewelding, reexamine the repaired area by the same test methods originally used for that area. For repairs to base material, the minimum examination shall be the same as required for butt welds. Indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no unacceptable indications are present. The use of foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

3.07 FINISHES

A. Galvanize and paint items as indicated on the Contract Drawings and as specified herein. Surfaces shall be cleaned per the coating manufacturer's recommendations. Paint shall be applied at a thickness as recommended by the manufacturer for exposure to a marine environment.

B. Dissimilar Materials

1. Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action.

2. Where aluminum is in contact with concrete, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

C. Field Preparation: Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

D. Environmental Conditions: Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Owner's Representative.

E. Shop Cleaning and Painting

1. Surface Preparation: Blast clean surfaces in accordance with SSPC SP 6. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within friction-type joints, but coat with rust preventative applied in the shop.

3.08 BOLTED CONSTRUCTION

A. Field treat damaged galvanized finish with two coats of high zinc dust oxide paint, cold galvanizing compounds or approved equal conforming to the requirements of ASTM A 780. In addition, all exposed threaded surfaces shall be painted with two coats of high zinc dust oxide paint after installation of unit.

1. Anti-Seize Compound: The Contractor shall coat threads of all attachment bolts with an anti-seize compound, conforming to MIL-PRF-907, prior to applying washers and nuts. Recoat any bolt thread projection beyond nut after final tightening.

3.09 ADHESIVE ANCHORS AND DOWELS

A. Adhesive anchor and dowel embedment and hole diameter shall be per Manufacturer's recommendations to develop the anchor tensile capacity.

B. Follow epoxy Manufacturer's recommendations for installation.

C. Drilled holes shall be prepared in accordance with Manufacturer's requirements.

D. Contractor shall prepare a template and drill required holes.

E. Vacuum dust from bottom and sides of each hole suing a nozzle of small tubing that will reach the bottom of the hole. Inspect all holes with a light to make certain all dust is removed.

F. Follow Manufacturer's recommendations for mixing and application of epoxy.

3.10 FIELD QUALITY CONTROL

A. Perform field tests, and provide labor, equipment, and incidentals required for testing. The Owner's Representative shall be notified in writing of defective welds within 7 working days of the date of the weld inspection.

B. Welder Qualifications: All welding operators shall have been qualified as described in "Welding Operator Qualifications" of AWS D1.1 or AWS D1.2. Any welder found to be producing unsatisfactory work even though he has passed qualification tests shall be immediately recertified or shall be replaced.

C. Shop Inspection: The fabricator shall perform, at his expense, normal quality control procedures in accord with industry standards. The Designer or his representative shall be allowed access to all parts of the work at all times and shall be furnished such information and assistance by the Contractor and fabricator as may be required for a complete and detailed inspection.

D. Shop Inspection

1. Visual Inspection: AWS D1.1/D1.2. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet welds and returns.

2. After welds are completed, they shall be hand-or power-brushed and thoroughly cleaned before the inspector makes the inspection.

3. Dye-penetrant testing in accordance with ASTM E 165 may be used to augment the visual inspection.

E. Non-Destructive Testing: AWS D1.1/D1.2. Test locations shall be as indicated. If more than 20% of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Owner's Representative. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

F. Correction of Defective Welds: Weld areas which contain defects which exceed the standards of acceptance in AWS D1.1 or AWS D1.2 shall be repaired by the Contractor at his expense.

G. Adhesive Anchor and Dowel Testing: The Contractor shall conduct a pullout test on a maximum of three (3) of each type of adhesively anchored dowel/bolt in each structure. Contractor shall submit testing procedures for approval by the Owner's Representative. Load the reinforcement to 125% of its tension capacity to ensure proper load carrying capability. If an anchor fails, then all of the adhesively anchors in that element shall be tested at the Contractor's expense. Any that fail shall be replaced at the Contractor's expense. Two (2) additional tests shall be conducted on the new anchors. All additional work and testing shall be at the Contractor's expense.

*****END OF SECTION 05 50 13*****

SECTION 05 60 00

GANGWAY SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. The work covered by this Section consists of furnishing transportation, labor, materials, and equipment to design, fabricate and install the aluminum gangway and associated appurtenances. All components shall be considered part of the “gangway system”.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.

B. GENERAL DESIGN STANDARDS

Safety - Division of Occupational Safety and Health (OSHA) – Various Publications

Steel - American Institute of Steel Construction (AISC) "Steel Construction Manual – 13th Edition"

Aluminum - The Aluminum Association, Inc. (AA) "Aluminum Design Manual”

ADA - U.S. Department of Justice (DOJ) “Building Requirements for Accessible Design”

C. AMERICAN WELDING SOCIETY (AWS)

AWS D1.2	Structural Welding Code - Aluminum

D. ASTM INTERNATIONAL (ASTM)

ASTM A276	Stainless Steel Bars and Shapes
ASTM A666	Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM D4976	Polyethylene Plastics Molding and Extrusion Materials
ASTM F436	Hardened Steel Washers
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts

1.03 DESIGN REQUIREMENTS

A. Information presented in this Section is based upon the best estimate of those environmental and physical factors which reasonably can be expected to affect the design, performance, and durability of the proposed gangway system. These criteria shall be considered as minimum requirements. Final calculations for the gangway system, including all structural components of the systems, shall be designed for a minimum fifty-year life expectancy.

B. Final calculations shall demonstrate that the gangway is designed to withstand the required loading without damage throughout the specified design life using the criteria specified in this Section as a minimum standard. The load combinations and allowable stresses are described herein.

C. The project drawings show general layout and configuration of the gangway system as well as required dimensions. Complete dimensions, which conform to these requirements, specific site conditions, and OSHA Regulations will be required from the fabricator.

D. The vertical design load shall be the combination of the dead weight of the structure and either live load Case A or Case B, whichever governs.

1. Case A shall be a uniform live load of 100 pounds per square foot (psf) of deck surface area to be applied to the gangways.

2. Case B shall be a concentrated live load of 400 pounds applied anywhere on the deck surface.

E. The maximum allowable deflection under the vertical design load shall equal the span divided by 240.

F. The deck and structural components shall be designed with a minimum safety factor on working stress as specified in AA “Aluminum Design Manual” for bridge type structures. For non-aluminum structural components, similar safety factors shall apply.

G. The horizontal design load shall be a uniform wind load of 15 psf of profile area. The horizontal design load shall be applied in combination with the dead weight.

H. Design shall also consider stresses resulting from handling and installation, and provide notations on how to lift, unload and set in place.

I. The gangway systems design shall be coordinated with the float dock systems design. Provide sufficient flotation to support the superimposed load of the gangway plus any appurtenances to maintain required freeboard.

J. The completed gangway systems shall have a manufacturer’s label plate attached in a conspicuous location. This label plate shall be aluminum, brass or stainless steel. The following information shall be stamped or etched into this plate in letters not less than 1/4-inch-high filled with black enamel:

1. Manufacturer's Name

2. Date of Manufacture

3. Overall Length

4. Capacity (maximum live load)

K. The walking surface shall be provided with a non-skid surface.

L. The gangway systems shall have a guardrail and handrail on each side of the walking surface (not including the toe plate), designed in accordance with OSHA and South Carolina Building Code requirements. The rails shall be fabricated of aluminum pipe or tubing.

M. The gangway systems shall be designed to withstand float motions including a vertical change in elevation due to water level fluctuation as indicated on the project drawings and horizontal drift/movement of the floating dock without structure interference or overstress, including fatigue of gangway members and supports.

N. The gangway toe plate shall make a smooth, gap-free transition between the gangway walking surface and the float. The toe plate shall be a minimum 1/4-inch material with a non-skid surface and shall be attached to the gangway by means of a continuous pipe hinge. The plate shall be the full width of the gangway and have a maximum slope not exceeding the maximum slope of the gangway.

O. Wheels shall be installed at the float end of the gangway. The wheels shall have an allowable load rating greater than that required by the design loads. The gangway design shall allow the wheels to be supported by the floating dock at all times regardless of float motions.

P. Provide anchored bearing plate to allow roller to freely operate over the aluminum deck during variation in water level.

Q. The gangway connection shall be supported by a concrete foundation. The hinge shall be designed to permit rotation of the gangway in both the vertical direction and the horizontal direction due to lateral loads on the float and shall accommodate float motions for all environmental conditions.

R. The gangway connection shall make a smooth, gap-free transition between the gangway walking surface and the concrete foundation. The hinge cover plate shall be a minimum 1/4-inch material with a non-skid surface and shall be attached to the gangway by means of a continuous pipe hinge. The plate shall be the full width of the gangway.

S. The gangway system shall conform in all respects to design requirements of OSHA rules for marinas and local codes as applicable.

1.04 SUBMITTALS

A. The Contractor shall submit the following in accordance with Contract Documents. Note that approval of the submittals by the Owner's Representative shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

B. Shop Drawings

1. Gangway Systems: Prior to ordering materials, or starting fabrication of the gangway systems, submit shop drawings signed and sealed by a registered Professional Engineer in the State of South Carolina. The shop drawings shall indicate the proposed gangway system construction and connection details, and methods for attaching to the concrete. Submit shop drawings for all fabricated items and catalog sheets for all standard manufactured items that are to be incorporated into the gangway system.

C. Design Data

1. Design Computations: Prior to ordering materials or starting fabrication of the gangway systems, submit final design calculations signed and sealed by a registered Professional Engineer in the State of South Carolina. The calculations shall demonstrate that the gangway system, using the criteria specified herein as minimum requirements, is designed to withstand the specified loads without damage throughout the design life of the gangway system.

1.05 WARRANTY

A. The gangway systems shall carry a manufacturer's written warranty against defects in materials and workmanship with a minimum term of one (1) year from date of project acceptance. The warranty shall clearly state its conditions and any exclusions from coverage.

PART 2 - PRODUCTS

2.01 MISCELLANEOUS METAL

A. Stainless steel hardware shall be Type 316. Bolts shall be ASTM F 593, Group 2. Nuts shall be ASTM F 594, Group 2. Flat washers shall be cut from Type 316 stainless steel plate that conforms to the provisions in ASTM A 666.

2.02 GANGWAY SYSTEM

A. Aluminum shall be alloy 6061-T6 conforming to ASTM B 308, or 6063-T6 conforming to the provisions in ASTM B221. Welding of aluminum shall comply with AWS D1.2.

B. Gangway wheel assembly shall consist of UHMW polyethylene roller, conforming to ASTM D 4976. Axle shall be Type 316 stainless steel conforming to the provisions in ASTM A 276.

2.03 DISSIMILAR MATERIALS

A. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint to prevent galvanic action.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. All work shall conform to the approved shop drawings, project drawings and this specification. Construction details, finishing details and colors shall be consistent throughout. Work shall be accurately set to establish lines and elevations, and securely fastened in place. Cutting, drilling and punching shall produce clean true lines and surfaces. Exposed surfaces of work shall have a smooth finish.

3.02 GANGWAY SYSTEM INSTALLATION

A. Install in accordance with the manufacturer's instructions. Posts and vertical rails shall be plumb, and line rails level.

B. Contractor shall furnish all materials and equipment required for gangway system installation. The gangway shall not be dragged or skidded into place.

C. Contractor shall provide, install and remove when no longer required, all temporary supports used to secure the gangway in place during installation.

D. With the gangway secured in correct position, mark the location of the wheel guides and fasten in place.

E. Protect installed products until completion of project.

***** END OF SECTION 05 60 00 *****

SECTION 06 13 33

TIMBERWORK

PART 1 - GENERAL

1.01 SUMMARY

A. The work for this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals to provide marine timber work as indicated on the construction drawings, as specified in these specifications, and as directed by the Owner's Representative.

1.02 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.

B. American Wood Protection Association (AWPA)

AWPA M4	Standard for the Care of Preservative-Treated Wood Products
AWPA M6	Brands Used on Forest Products
AWPA U1	Use Category System

C. American National Standards Institute (ANSI)

ANSI B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI B18.2.2	Square and Hex Nuts (Inch Series)
ANSI B18.6.2	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws
ANSI B18.6.3	Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)
ANSI B18.21.1	Lock Washers (Inch Series)
ANSI B18.22.1	Plain Washers

D. ASTM International (ASTM)

ASTM A 123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 572	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 992	Standard Specifications for Structural Steel Shapes

E. U.S. Department Of Defense (DOD)

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

1.03 SUBMITTALS

A. The Contractor shall submit the following in accordance with Contract Documents. Note that approval of the submittals by the Owner's Representative shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

B. Shop Drawings

1. Fender Timberwork: Submit drawings of treated timber showing dimensions of cut, framed, or bored timbers.

C. Test Reports

1. Timber Preservative Inspection

2. Delivery Inspection List

D. Certificates

1. MSDS and CIS

1.04 DELIVERY AND STORAGE

A. 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. Close-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. Protect materials from weather. 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. Protect timber and hardware from damage.

1.05 QUALITY ASSURANCE

A. MSDS and CIS: Provide 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.

B. Timber Preservative Inspection: Submit the inspection report of an independent inspection agency, for approval by the Owner's Representative that offered products comply with applicable AWPA 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.

C. Delivery Inspection List: Field inspect and submit a verification list of each treated timber member and each strapped bundle of treated lumber indicating the wording and lettering of the quality control markings, the species and the condition of the wood. Do not incorporate materials damaged in transport from plant to site. Inspect all preservative-treated wood, visually to ensure there are no excessive residual materials or preservative deposits. Material shall be clean and dry or it will be rejected due to environmental concerns.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Solid Sawn Lumber and Timbers: Provide solid sawn lumber and timbers of stress-rated Southern Yellow Pine, with a stress rating as indicated on the drawings, and identified by the grade mark of a recognized association or independent inspection agency using the specific grading 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.

B. Preservative Treatment: Fabricate lumber and timbers before preservative treatment. Each piece of treated lumber or timber must be branded, by the producer, in accordance with AWPA M6. The type of preservative, retention, and penetration must be based on Use Category and species and in accordance with AWPA U1-18. The Contractor must be responsible for the quality of treated wood products. Lumber treatment requirements shall be as indicated on the drawings.

C. Hardware: Bolts with necessary nuts and washers, timber connectors, nails, screws, spikes, and other fastenings. Bolts and nuts shall conform to ASTM A 307. Provide cast-iron ogee, malleable iron washers, or plate or cut washers where indicated. Provide bolts with washers under nut and head. Provide timber connectors and other metal fastenings of type and size shown. Hot-dip galvanize all hardware, unless otherwise noted.

1. Timber Connections: Miscellaneous steel shapes for the connection of the timber members shall be in accordance with ASTM A 992 or ASTM A 572.

2. Lag Screws: ANSI B18.2.1, type and grade best suited for the purpose

3. Bolts, Nuts, and Studs: ANSI B18.2.2 and ASTM A 307 as indicated

4. Screws: ANSI B18.2.1, ANSI B18.6.2, and ANSI B18.6.3

5. Washers: Provide plain washers to conform to ANSI B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ANSI B18.21.1.

D. Zinc-Coating: Galvanize steel specified or indicated by the hot-dip process in accordance with ASTM A 123 or ASTM A 153, as applicable.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Cut, bevel, and face timbers prior to plant preservative treatment. Provide protective equipment for personnel fabricating, field treating, or handling materials treated with creosote or water-borne salts. Refer to paragraph entitled "MSDS and CIS."

B. Framing: Cut and frame lumber and timber so that joints will fit over contact surface. Secure timbers in alignment. Open joints are unacceptable. Shimming is not allowed. Bore holes for bolts with a bit 1/16 inch larger in diameter than bolt. 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. Counter bore for countersinking wherever smooth faces are indicated or specified.

C. Fastening: Vertical bolts shall have nuts on the lower end. Where bolts are used to fasten timber to timber or timber to steel, bolt members together when they are installed and retighten immediately prior to final acceptance of contract. Provide bolts having sufficient additional threading to provide at least 3/8 inch per foot thickness of timber for future retightening. Provide timber connectors of types indicated.

3.02 FIELD TREATMENT

D. Timberwork: Field treat cuts, bevels, notches, refacing and abrasions made in the field in timbers in accordance with AWPA M4, MSDS and CIS. Wood preservatives are restricted use pesticides and shall be applied according to applicable standards. Trim cuts and abrasions before field treatment. Paint depressions or openings around bolt holes, joints, or gaps including recesses formed by counterboring, with preservative treatment used for timber; and after bolt or screw is in place, fill with hot pitch or a bitumastic compound.

E. 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. Thoroughly clean the damaged areas by wire brushing and remove traces of welding flux and loose or cracked zinc coating prior to painting. 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.

F. Finishes: Galvanize and paint as indicated herein. Surfaces shall be cleaned per the coating manufacturer's recommendations and painted with a prime coat of zinc rich paint and a top coat of acrylic gloss enamel. The thickness shall be applied per manufacturer's recommendation for a marine environment. Do not clean or paint surfaces when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Designer.

*****END OF SECTION 06 13 33*****

SECTION 10 14 53
TRAFFIC SIGNAGE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Signs.

B. Posts.

C. Fabricating and installing traffic signs in accordance with details shown on construction plans. SCDOT Standards, and the Manual on Uniform Traffic Control Devices.

1.02 REFERENCES

A. ASTM A 123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. ASTM A 153 – Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. ASTM A 193 – Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

D. ASTM A 307 – Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

E. ASTM A 615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

F. ASTM B 209 – Aluminum and Aluminum-Alloy Sheet and Plate.

G. ASTM B 211 – Aluminum and Aluminum-Alloy Bar, Rod, and Wire.

1.03 SUBMITTALS

A. A sample section of all signs and posts to be placed shall be submitted to the Engineer for review prior to ordering.

1.04 QUALITY ASSURANCE

A. Material and equipment shall be the standard product of a manufacturer who has manufactured them for a minimum of 2 years and provides published data on quality and performance.

1.05 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

PART 2 - PRODUCTS

2.01 UNIFORMITY

A. All signs shall be uniform in shape, color, dimensions, legends, and illumination or reflectorization.

2.02 MATERIALS AND WORKMANSHIP

A. Signs: Shall be aluminum 0.08-inch minimum thickness and shall conform to ASTM B 209, Alloy 6061-T6 or 5053-H38. Finished sign shall be clear cut, the lines of all letters and details true, regular and free from waviness, unevenness, furry edges, or lines and shall be free from all scaling, cracking, blistering, pitting, dents, or blemishes of any kind.

B. Sign Posts: Shall be galvanized steel flanged "U" channel section with a minimum (before punching or drilling) of two (2) pounds per foot and shall conform to the minimum yield point and tensile strength specified in ASTM A 615 Grade 60. Galvanizing shall be in accordance with ASTM A 123. Length as specified on the plans. Holes may be punched or drilled 3/8 inch in diameter and spaced one (1) inch center to center beginning one (1) inch from the top and extending the full length of post.

C. Hardware: Bolts shall be 5/16-inch diameter with hexagonal heads and of sufficient length to extend at least 1/4 inch beyond the nut when installed. Nuts shall be hex nuts of the self-locking plastic insert type. The thread fit for nuts shall be ANSI, Class 2B. The washers shall be flat and 25/64-inch ID by 3/4 inch OD by 0.091 inch thick. These washers are to be placed between head of bolt and sign face. Bolts, nuts, washers and spacers may be aluminum, stainless steel or galvanized steel. Galvanized steel bolts and washers shall conform to ASTM A 307, galvanized in accordance with ASTM A 153. Aluminum shall conform to ASTM B 211, Alloy 2024-T4 for bolts, Alloy 2017-T4 for nuts, and ASTM B 209, Alloy 2024-T4 for washers. Stainless steel shall conform to ASTM A 193, Type B8.

2.03 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review and approve all products before they are ordered.

PART 3 - EXECUTION

3.01 GENERAL

A. Sign posts and their foundations and sign mountings shall be constructed to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

3.02 LOCATION

A. Signs are to be placed as shown on the plans. Signs shall conform to height and lateral locations as shown in the Manual on Uniform Traffic Control Devices.

3.03 ERECTION

A. Drive type posts may either be driven in place or placed in prepared holes. Driven posts will be limited to locations where the surrounding soil is firm and stable. When sandy or unstable soils are present, each drive post shall be placed in a prepared dry hole minimum six (6) inches in diameter. Whenever posts are placed in prepared holes, the holes shall be backfilled with a mixture of Portland Cement and sand. The resultant mixture shall be mixed with water to a moist consistency and placed around posts. All posts shall be erected in a vertical and plumb position to a depth of three (3) feet and at an angle to the roadway as shown on plans or directed by Engineer.

*****END OF SECTION 10 14 53*****

SECTION 26 00 00

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to all sections of Division 26 and 33, ELECTRICAL and UTILITIES, of this project specification unless specified otherwise in the individual sections. This section has been incorporated into, and thus, does not apply to, and is not referenced in the following sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be, single phase, three wire. Final connections to the power distribution system at the Fused Disconnect Switch shall be made by the Contractor.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Engineer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets. Adhesive mounting is not acceptable.

-- End of Section --

SECTION 26 27 29

MARINA ELECTRICAL WORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2013) Standard for Electrical Polyvinyl Chloride (PVC) Conduit

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 303	(2016) Fire Protection Standards for Marinas and Boatyards
NFPA 70	(2017; ERTA 1-2 2017; TIA 17-1; TIA 17-2; TIA 17-3; TIA 17-4; TIA 17-5; TIA 17-6; TIA 17-7; TIA 17-8; TIA 17-9; TIA 17-10; TIA 17-11; TIA 17-12; TIA 17-13; TIA 17-14) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018) UL Standard for Wire Connectors
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 510	(2017) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

UL 514B	(2012; Reprint Nov 2014) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Dec 2014) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint Jun 2016) UL Standard for Safety Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 67	(2018) UL Standard for Safety Panelboards
UL 83	(2017) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Engineer approval is required for all submittals with a "E" designation; submittals not having a "O" designation are for Contractor Quality Control approval for information only. When used, a designation following the "E" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Shop Drawings

Panelboards; E

Product Data

Receptacles

Disconnect switches; E

Conduit and fittings (each type)

Power center; E

Grounding and bonding equipment

Device plates

Wires and cables; E

Outlet boxes and covers

Splice and termination components

Cabinets, junction boxes,

Pull boxes; E

Mounting straps

Conduit support

Test Reports

600-volt wiring test; E

Grounding system test; E

Submit test results for approval in PDF format.

Submit coordination data as specified in paragraph entitled "Solar Power Station."

1.4 QUALITY ASSURANCE

1.4.1 Grounding System Tests

Submittal shall include written results of each test and indicate location of rods as well as resistance and soil conditions at the time measurements were made.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL where UL standards are established for those items, and requirements of NFPA 70 and NFPA 303.

2.2 CONDUIT AND FITTINGS

Galvanized rigid steel conforming to the following:

2.2.1 Rigid Nonmetallic Conduit

PVC Type EPC-80 in accordance with NEMA TC 2, or fiberglass conduit in accordance with NEMA TC 14.

2.2.Galvanized Rigid Steel

NEMA RN 1, Type 40 40 mils thick.

2.2.3 Fittings for Metal Conduit and Flexible Metal Conduit

UL 514B. Ferrous fittings shall be cadmium or zinc coated in accordance with UL 514B.

2.2.3.1 Fittings for Rigid Metal Conduit

Threaded type. Split couplings unacceptable.

2.2.4 Fittings for Rigid Nonmetallic Conduit

UL 514B and UL 651.

2.2.5 Expansion Joints

Provide conduit expansion joints having 6 inch expansion at each expansion joint in the pier and in each conduit run exceeding 250 feet. Provide expansion joints having 2 inch expansion in each conduit run of less than 250 feet.

2.3 POWER CENTER

A complete factory-assembled and prewired unit specifically constructed for marina applications. Power center shall be a two or four outlet pedestal mounted type having a separate circuit breaker for each outlet. Circuit breaker size shall be the same size as outlet to which it is connected. Power outlets shall be single, locking and grounding type, size and voltage as indicated on the drawings. Power center enclosure shall be fiberglass or foamed thermoplastic with polyurethane coating. Each individual outlet and circuit breaker enclosure shall have a separate gasketed weatherproof cover. Entire exterior surface of power center shall be nonmetallic design for exposure to saltwater environment.

2.3.1 Warning Sign

Provide permanently mounted waterproof warning sign at each power center. Sign shall have red letters on a white background with letters no less than .25 inch in height. Sign shall be worded as follows:

"WARNING
To minimize shock and fire hazards:
Turn off the boat's shore connection switch before connecting or disconnecting shore cable.
Connect shore power cable at the boat first.
Disconnect shore power cable at shore outlet first.
Close shore power inlet cover tightly.
DO NOT ALTER SHORE POWER CABLE CONNECTORS"

2.4 OUTLET BOXES AND COVERS

UL 514C.

2.5 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 200 cubic inches, UL 50, NEMA 4X type 316L stainless steel.

2.6 WIRES AND CABLES

Shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not provide wires and cables manufactured more than 12 months prior to date of delivery to site.

2.6.1 Conductors

No. 8 AWG and larger diameter shall be stranded; No. 10 AWG and smaller shall be solid, except that conductors for remote control, alarm, and signal circuits, Classes 1, 2, and 3, shall be stranded. Conductors shall be copper. Conductor sizes and ampacities shown are based on copper.

2.6.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG;

2.6.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored, except green, stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 120/240 volt, single phase: red and black

2.6.3 Insulation

Unless otherwise required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, except that grounding wire may be Type TW; remote-control and signal circuits shall be Type TW, THW, or TF. Conductors shall conform to UL 83. Where lighting fixtures require 90-degree C conductors, provide only conductors with 90-degree C insulation or better.

2.6.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.6.5 Splice and Termination Components

UL 486A-486B, for wire connectors, and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure type in accordance with UL 486A-486B, twist-on splicing connector. Provide solderless terminal lugs on stranded conductors.

2.6.5.1 Watertight Pin Connectors

Connectors shall be rated 600 volts, and individual pins shall have ampere rating equal to or greater than the cable to which they are joined. Connectors shall be molded-to-cable, quick-disconnect, polarized type having full male shroud so that when male and female assemblies are joined the shroud shall provide a completely sealed connection. Connector material shall be neoprene resistant to oil, dust, acids, and sunlight and shall be watertight.

2.7 DISCONNECT SWITCHES

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated greater than 240 volts, and for double-throw switches. Provide switches in NEMA 4X stainless steel enclosure in accordance with NEMA ICS 6.

2.8 PLUGS

Provide heavy-duty, rubber-covered three, four, or five-wire cord of required size, install plugs thereon, and attach to equipment. Provide UL listed plugs with receptacles, complete with grounding blades. Where equipment is not available, turn in plugs and cord assemblies to the Government.

2.9 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as specified on drawings. Panelboards shall be circuit breaker equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breakers. Key panelboard locks the same. Directories shall indicate load served by each circuit in panelboard and main source of service to panelboard, such as Panel PA served from Panel MDP. Type directories and mount in holder behind transparent protective covering.

2.9.1 Panelboard Buses

Copper. Support bus bars on bases independent of circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide isolated copper neutral bus in each panel for connection of circuit neutral conductors. Provide separate copper ground bus identified as equipment grounding bus in accordance with UL 67 for connecting grounding conductors; bond to steel cabinet.

2.9.2 Circuit Breakers

UL 489 thermal magnetic, bolt-on, type having a minimum short-circuit current rating equal to the short-circuit rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Plug-in circuit breakers and series rated circuit breakers are unacceptable.

2.9.2.1 Multipole Breakers

Provide common trip type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C respectively.

2.9.2.2 Circuit Breaker With GFCI

UL 943 and NFPA 70. Provide with push-to-test button, visible indication of tripped condition, and ability to detect and trip on current imbalance of 6 milliamperes or greater in accordance with UL 943 for Class A GFCI devices.

2.9.3 Panelboard Enclosure

NEMA 3R type 316L stainless steel. Hardware shall be stainless steel.

2.10 MOUNTING STRAPS

Fiberglass, two-hole type designed for rigid steel conduit support. PVC coating shall be between 20 and 40 mil thickness.

2.11 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.12 NAMEPLATES

Provide nameplates in accordance with Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service equipment to the power system connection.

3.1.2 Service Entrance Identification

Label or identify service entrance disconnect devices, switches, and enclosures.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid conduit, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated, green equipment grounding conductors for circuits installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low-voltage lighting and power circuits.

3.1.3.1 PVC Schedule 40 and PVC Schedule 80

a. Do not install PVC Schedule 40 in areas subject to physical damage.

b. Do not install PVC Schedule 80 in areas subject to severe physical damage.

c. Do not install in hazardous areas.

3.1.3.2 Underground Conduit Other Than Service Entrance

PVC, Type EPC-40, plastic-coated rigid steel, plastic-coated steel IMC, or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid or IMC steel conduit before rising through pier deck. Plastic coating shall extend minimum 6 inches above pier deck.

3.1.4 Conduit Installation

Run conduit exposed on side of pier structures. Install conduit parallel with or at right angles to structural members.

3.1.4.1 Conduit Support

Support conduit by nonmetallic pipe straps, wall brackets, hangers, or trapeze. Fasten by stainless steel wood screws to wood and by concrete inserts or expansion bolts on concrete. Threaded C-clamps may be provided on rigid steel conduit only. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. Where

conduit crosses expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.4.2 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or molded fittings. Make field-made bends and offsets with conduit-bending machine suitable for type of conduit used. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent dirt or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.3 Expansion Joints

Install as recommended by the manufacturer for the temperature conditions at time of installation.

3.1.4.4 Pull Wire

Install in empty conduits in which wire is to be installed by others. Pull wire shall be plastic having minimum 200 pound tensile strength. Leave minimum 12 inches of slack at each end of pull wire.

3.1.4.5 Telephone and Signal System Conduits

Install in accordance with specified requirements for conduit and with additional requirement that no length of run shall exceed 150 feet for trade sizes 2 inches and smaller and shall not contain more than two 90 degree bends or equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits one inch trade size and larger shall be minimum five times nominal diameter. Terminate conduit in terminal cabinet with two locknuts and plastic bushing.

3.1.4.6 Conduit and Cable Connections

Provide watertight connectors for conduit and cable connections to boxes and cabinets.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub type, and when specifically indicated. Boxes in other locations shall be nonmetallic boxes provided with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in a box. Provide gaskets for boxes. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature. Fasten boxes and supports with wood screws on wood and with bolts and expansion shields on concrete. Support boxes directly from structure or by nonmetallic or stainless steel hangers. Where nonmetallic or stainless steel bar hangers are provided, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, do not cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes shall be minimum 4 inches square, except that 4 by 2 inch boxes may be provided where only one raceway enters outlet. Telephone outlets shall be minimum of 4 inches square by 1 1/2 inches deep.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Furnish boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, circuit breakers, and disconnecting switches so maximum height of operating handle is 78 inches above finished structure. Mount receptacles a minimum of 18 inches above finished structure. In no case shall entire or part of panelboards, boxes, cabinets, receptacles, and other electrical devices be mounted below the electrical datum plane as defined in NFPA 303. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide within each enclosure where tap, splice, or termination is made. For conductor sizes No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductor sizes No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductor sizes No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductor sizes No. 8 AWG and larger diameter with solderless connector and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install gasketed plates with alignment tolerance of 1/16 inch.

3.1.10 Grounding and Bonding

NFPA 70. Ground-exposed, noncurrent-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. When flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70. Make ground connection to driven ground rods.

3.1.10.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 25 ohms under dry conditions. Where resistance obtained exceeds 25 ohms, contact Engineer for further instructions.

3.1.11 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section. Except as otherwise noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section, but shall be provided under the section specifying associated equipment.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel. Notify Engineer 7 working days prior to each test.

3.2.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volts and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Grounding System Test

Test grounding system to ensure continuity and resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

-- End of Section --

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Grading

B. Excavation

C. Backfilling

D. Compaction

E. Remove and Replace Topsoil

F. Dressing of Shoulders and Banks

G. Stone Drainage Filter

H. Water Control

I. Testing

1.02 REALTED SECTIONS

A. Section 01 45 00 – Quality Control

B. Section 01 45 23 – Testing and Inspecting Services

C. Section 31 10 00 – Site Clearing

1.03 REFERNCES

A. ASTM D 448 – Sizes of Aggregate for Road and Bridge Construction.

B. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ASTM D 2487 – Classification of Soils for Engineering Purposes (Unified Soil Classification System).

D. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

E. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

F. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

1.04 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Procedures for submittals.

B. Materials Source: Submit gradation analysis, proctor results, and soil classification for all borrow material.

1.05 QUALTIY ASSURANCE

A. Perform work in accordance with State of South Carolina standards, SCDOT, and GSWSA.

1.06 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. The testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours' notice prior to taking any of the tests.

E. Testing shall be Contractor's responsibility and performed at Contractor's expense by a commercial testing laboratory operating in accordance with subparagraph C above.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Borrow shall consist of sand or sand–clay soils capable of being readily shaped and compacted to the required densities, and shall be reasonably free of roots, trash, rock larger than 2 inches, and other deleterious material.

B. All soils used for structural fills shall have a PI (plastic index) of less than 10, and a LL (liquid limit) of less than 30. Fill soils shall be dried or wetted to appropriate moisture contents prior to compaction. Additionally, fill soils used for the top 2 feet of fill beneath roads and parking lots shall have no more than 15% passing the # 200 sieve. Fill soils used for house lots shall have no more than 25% passing the # 200 sieve.

C. Contractor shall furnish all borrow material.

D. Contractor shall be responsible for and bear all expenses in developing borrow sources including securing necessary permits, drying the material, haul roads, clearing, grubbing, excavating the pits, placing, compaction and restoration of pits and haul roads to a condition satisfactory to property owners and in compliance with applicable federal, state, and local laws and regulations.

2.02 SOURCE QUALITY CONTROL

A. If tests indicate materials do not meet specified requirements, change material and retest.

B. Provide materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.01 TOPSOIL

A. Contractor shall strip topsoil and stockpile on site at a location determined by the Owner at the Contractor's expense.

B. Topsoil shall be placed to a depth of 4 inches over all disturbed or proposed landscaped areas.

C. Topsoil shall be provided at Contractor’s expense if it is not available from site.

D. Any remaining topsoil will be hauled off site at the Contractors expense.

E. Do not excavate wet topsoil.

3.02 EXCAVATION

A. Suitable excavation material shall be transported to and placed in fill areas within limits of the work.

B. Unsuitable material encountered in areas to be paved and under building pads, shall be excavated 2 feet below final grade and replaced with suitable material from site or borrow excavations. Contractor shall notify Engineer if more than 2 feet of excavation is needed to replace unsuitable material.

C. Unsuitable and surplus excavation material not required for fill shall be disposed of off site.

D. Proper drainage, including sediment and erosion control, shall be maintained at all times. Methods shall be in accordance with the National Pollutant Discharge Elimination System standards and other local, state, and federal regulations.

E. Unsuitable materials as stated herein are defined as highly plastic clay soils, of the CH and MH designation, border line soils of the SC–CH description, and organic soils of the OL and OH description based on the Unified Soils Classification System. Further, any soils for the top two feet of pavement subbase shall have no more than 15% passing the # 200 sieve.

3.03 GROUND SURFACE PREPARATION FOR FILL

A. All vegetation, roots, brush, heavy sods, heavy growth of grass, decayed vegetable matter, rubbish, and other unsuitable material within the areas to be filled shall be stripped and removed prior to beginning the fill operation.

B. Sloped ground surfaces steeper than 1 vertical to 4 horizontal, on which fill is to be placed shall be plowed, stepped, or benched, or broken up as directed, in such a manner where fill material will bond with the existing surface.

C. Surfaces on which fill is to be placed and compacted shall be wetted or dried as may be required to obtain the specified compaction.

3.04 FILL

A. Shall be placed in successive horizontal layers 8 inches to 12 inches in loose depth for the full width of the cross–section and compacted as required.

3.05 FINISHED GRADING

A. All areas covered by the project including excavated and filled sections and adjacent transition areas shall be smooth graded and free from irregular surface changes.

B. Degree of finish shall be that ordinarily obtainable from either blade–grader or scraper operations, supplemented with hand raking and finishing, except as otherwise specified.

C. Unpaved areas to within 0.1 feet of elevations shown on the drawings provided such deviation does not create low spots that do not drain.

D. Paved Areas – Subgrade to within 0.05 feet of the drawing elevations less the compacted thickness of the base and paving.

E. Ditches and lagoon banks shall be finished graded, dressed, and seeded within 14 calendar days of work to reduce erosion and permit adequate drainage.

3.06 DISPOSAL OF WASTE MATERIAL

A. All vegetation, roots, brush, sod, broken pavements, curb and gutter, rubbish, and other unsuitable or surplus material stripped or removed from limits of construction shall be disposed of by the Contractor.

3.07 PROTECTION

A. Graded areas shall be protected from traffic, erosion, settlement, or any washing away occurring from any cause prior to acceptance.

B. Contractor shall be responsible for protection of below grade utilities shown on the drawings or indicated by the Owner at all times during earthwork operations.

C. Repair or re–establishment of graded areas prior to final acceptance shall be at the Contractors expense.

D. Site drainage shall be provided and maintained by Contractor during construction until final acceptance of the project. Drainage may be by supplemental ditching, or pumping if necessary, prior to completion of permanent site drainage.

3.08 DRAINAGE

A. Contractor shall be responsible for providing surface drainage away from all construction areas. This shall include maintenance of any existing ditches or those constructed in the immediate vicinity of the work. Contractor shall provide proper and effective measures to prevent siltation of wetlands, streams, and ditches on both the Owner’s property, and those properties downstream.

3.09 FIELD QUALITY CONTROL

A. Compaction testing shall be performed in accordance with ASTM D 6938. Where tests indicate the backfill does not meet specified requirements, the backfill shall be reworked or removed and replaced, and then retested at the Contractor’s expense.

B. Unpaved areas – at least 90% of maximum laboratory density within 2% optimum moisture content unless otherwise approved by the Engineer.

C. Paved Areas and Under Structures – top 6 inch layer of subbase to at least 98% of maximum laboratory density within 2% optimum moisture content. Layers below top 6 inches shall be compacted to 95% of maximum laboratory density within 2% optimum moisture content.

D. Rolling and compaction equipment and methods shall be subject to acceptance by the Engineer. Acceptance in no way relieves Contractor of the responsibility to perform in correct and timely means.

E. Number of Tests – Under paved areas, no less than one density test per horizontal layer per 5,000 square feet of subbase shall be made. In unpaved areas, no less than one density test per horizontal layer per 10,000 square feet of fill area shall be made. Under curb and gutter, no less than one density test per every 300 linear feet.

3.10 PROOF ROLLING

A. Shall be required on the subbase of all paved areas. Proof rolling shall take place after all underground utilities are installed and backfilled. The operation shall consist of rolling the subbase or base with a fully loaded 10– wheeled dump truck. A full load shall consist of 10 to 12 cubic yards of soil or rock. The dump truck shall be capable of traveling at a speed of two to five miles per hour and be in sound mechanical shape with no exhaust leaks or smoking from burning oil. The Engineer shall determine number of passes and areas rolled.

*****END OF SECTION 31 00 00*****

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Removal of surface debris.

B. Removal of paving, curbs, etc.

C. Removal of trees, shrubs, and other plant life.

D. Topsoil excavation.

1.02 REALTED SECTIONS

A. Section 31 00 00 – Earthwork.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable South Carolina DHEC, USACE and local code for environmental requirements, disposal of debris, burning debris on site, and use of herbicides.

B. Coordinate clearing Work with utility companies.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide tree protection materials as detailed on the construction drawings.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify existing plant life designated to remain is tagged or identified.

B. Identify a salvage area for placing removed materials.

3.02 PROTECTION

A. All trees outside of construction limits (slope stakes) will be saved except those marked specifically by the Owner's representative for removal during construction. No trees, including those marked for removal on site or any other tree, may be removed prior to the preconstruction conference. All trees not to be removed will be protected from injury to their roots and to their top to a distance three feet beyond the drip–line and no grading, trenching, pruning, or storage of materials may go in this area except as provided by an Owner's representative stakeout. Contractor will pay a penalty for any tree removed from the site that has not been marked specifically for removal. Contractor also will pay for any tree that dies due to damage during construction. This applies to all trees on site whether or not they are shown on the plans.

B. Contractor shall not be held accountable for damages to trees resulting from placement of fill or removal of soils where such action is required by the contract documents. Any tree, the trunk of which is within 10 feet of any footing or trench, shall be exempt from these penalties except Contractor shall exercise all reasonable precautions to preserve even these trees. Contractor agrees to pay fines as established below in the event he or any of his subcontractors causes loss or removal of trees designated to be saved under provisions of this contract.

The fines are as follows:

Caliper	Fine
1" – 2"	$150.00
2" – 3"	200.00
3" – 4"	250.00
4" – 5"	400.00
5" – 6"	500.00
6" – 7"	600.00
7" – 8"	750.00
8" – 11"	1,500.00
12" – 20"	2,000.00
21" & larger	$ 2,500.00

C. Trees shall be graded by Owner's representative as to variety, condition, and site importance, with above figures acting as a maximum fine. Lowest assessment amount shall be no less than one–half of the above fine figures.

D. Protect benchmarks, survey control points, and existing structures from damage or displacement.

E. Protect all remaining utilities.

F. Clearing operations shall be conducted to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and to provide for the safety of employees and others.

3.03 CLEARING

A. Clear areas required for access to site and execution of work. Clearing shall consist of felling and cutting trees into sections, and satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within area to be cleared. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be removed completely from the site, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within cleared areas shall be trimmed of dead branches 1–1/2 inch or more in diameter. Limbs and branches to be trimmed shall be neatly cut close to the trunk of the tree or main branches. Cuts more than 1–1/2 inches in diameter shall be painted with an accepted treewound paint. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations, by the erection of timber barriers or by such other means as circumstances require. Such barriers must be placed and be checked by the OWNER before construction observations can proceed (See 3.2). Clearing shall also include removal and disposal of structures obtruding, encroaching upon, or otherwise obstructing the work.

3.04 REMOVAL

A. Where indicated or directed, trees and stumps shall be removed from areas outside those areas designated for clearing and grubbing. Work shall include felling of such trees and removal of their stumps and roots. Trees shall be disposed of as hereinafter specified.

B. Remove debris, rock, and other extracted plant life from site.

3.05 DISPOSAL

A. Disposal of trees, branches, snags, brush, stumps, etc., resulting from clearing and grubbing shall be the Contractor's responsibility and shall be disposed of by removal from site, or a combination of both. All costs in connection with disposing of materials will be at the Contractor's expense. Material disposed of by burning shall be burned in a manner avoiding all hazards, such as damage to existing structures, construction in progress, trees, and vegetation. Contractor shall be responsible for compliance with all local and State laws and regulations relative to the building of fires. Disposal by burning shall be kept under constant attendance until fires have burned out or extinguished. All liability of any nature resulting from disposal of cleared and grubbed material shall become the Contractor's responsibility. Disposal of all materials cleared and grubbed will be in accordance with rules and regulations of the State of South Carolina. No material will be burned unless directed to do so by the OWNER. Contractor shall obtain a permit to burn on site from local fire department, before beginning the work.

3.06 GRUBBING

A. Grubbing shall consist of removal and disposal of stumps, roots larger than one inch in diameter, and matted roots from designated grubbing areas. This material, together with logs and other organic or metallic debris not suitable for building of pavement subgrade or building pads, shall be excavated and removed to a depth of not less than 18 inches below original surface level of the ground in embankment areas and not less than 2 feet below finished earth surface in excavated areas. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform to original adjacent ground.

*****END OF SECTION 31 10 00*****

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions apply to this section.

1.02 DESCRIPTION OF WORK

A. Extent of soil erosion control work includes all measures necessary to meet the requirements of this section.

Erosion and sediment control measures shall be installed prior to any construction activity.

Soil erosion and sediment control measures shall include all temporary and permanent means of protection and trapping soils of the construction site during land disturbing activity. Activity covered in this contract shall meet standards of NPDES General Permit for the state where work is performed.

1.03 PURPOSES

A. Contractor is to achieve the following goals:

1. Minimize soil exposure by proper timing of grading and construction.

2. Retain existing vegetation whenever feasible.

3. Vegetate and mulch denuded areas as soon as possible.

4. Divert runoff away from denuded areas.

5. Minimize length and steepness of slopes when it is practical.

6. Reduce runoff velocities with sediment barriers or by increasing roughness with stone.

7. Trap sediment on site.

8. Inspect and maintain erosion control measures.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in the manufacture of soil erosion control systems products of types and sizes required, whose materials have been in satisfactory use for not less than 5 years.

B. Codes and Standards: Comply with all applicable Local, State, and Federal Standards pertaining to soil erosion control.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instruction for soil erosion control materials and products.

PART 2 - PRODUCTS

2.01 GRASSING MATERIALS

A. Refer to Section 32 92 00 – Turf and Grasses And Sediment and Erosion Control Plans.

1. General: All grass seed shall be free from noxious weeds, grade A recent crop, recleaned and treated with appropriate fungicide at time of mixture. Deliver to site in original sealed containers with dealer's guarantee as to year grown, percentage of purity, percentage of germination and date of the test by which percentages of purity and germination were determined. All seed sown shall have a date of test within six months of the date of sowing.

2.02 SILT FENCE

A. Silt fence shall be a woven geotextile fabric sheet. Fabric shall be a synthetic polymer composed of at least 85% by weight propylene, ethylene, amide, ester, or vinylidene chloride, and shall contain stabilizer and/or inhibitors added to the base plastic to make filaments resistant to deterioration due to ultra–violet and/or heat exposure. Fabric should be finished so the filaments will retain their relative position with respect to each other. Fabric shall be free of defects, rips, holes, or flaws.

Fabric shall meet the following requirements:

Woven Fabrics	
Grab Strength	90 lbs.
Burst Strength	175 PSI
UV Resistance	80%

2.03 CHEMICALS FOR DUST CONTROL

A. Calcium Chloride, latex Emulsion or Resin–in–Water Emulsion may be used for dust control.

2.04 RIP-RAP

A. Shall be hard quarry or field stone of such quality the pieces will not disintegrate on exposure to water, sunlight, or weather. Stone shall range in weight from a minimum of 25 pounds to a maximum of 125 pounds. At least 50 percent of the stone shall weigh more than 60 pounds. The stone shall have a minimum dimension of 12 inches.

2.05 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products before they are ordered.

PART 3 - EXECUTION

3.01 GENERAL

A. All disturbed soil areas except those to support paving shall be graded and protected from erosion by grassing. Disturbed areas must be grassed within 14 days of work ending unless work is to begin again before 21 days. Storm water conveyance systems shall have sediment barriers installed at all entrances, intersections, change in direction and discharge points.

3.02 GRASSING

A. Refer to Section 32 92 00 – Turf and Grasses.

3.03 SEDIMENT BARRERS

A. Rock Ditch Check

1. Excavate a 6-inch-deep trench the width and length of proposed barrier. Install a non–woven geotextile fabric in the trench before placing rock for the ditch check.

2. The body of the ditch check shall be constructed of 12-inch rip–rap. The upstream face may be covered with 1–inch washed stone.

3. Ditch checks shall not exceed a height of 2 feet at centerline of the channel and have a minimum top flow length of 2 feet.

4. Rip–rap shall be placed over the channel banks to prevent water from flowing around ditch check. Rock must be installed by hand or mechanical placement (no dumping of rock) to achieve complete coverage of the ditch and ensure the center of the check is lower than the edges.

5. The maximum spacing between ditch checks shall be where the toe of the upstream check is at the same elevation as the top of the downstream check.

6. Contractor shall maintain ditch checks as required by State/SCDHEC regulations.

3.04 SILT FENCE

A. Silt fence shall be placed at approximate location shown and installed in accordance with the detail on the construction drawings. Contractor shall maintain silt fence as required by State/SCDHEC regulations.

3.05 DUST CONTROL

A. Dust raised from vehicular traffic will be controlled by wetting down access road with water or by the use of a deliquescent chemical, such as calcium chloride, if relative humidity is over 30%. Chemicals shall be applied in accordance with manufacturer's recommendations.

B. Contractor shall use all means necessary to control dust on and near the work, or off–site borrow areas when dust is caused by operations during performance of work or if resulting from the condition in which any subcontractor leaves the site.

Contractor shall thoroughly treat all surfaces required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of work on site.

3.06 SEDIMENT BASIN

A. The site will utilize the proposed stormwater pond for sediment control during construction. If temporary measures are required during construction to control sediment, the contractor shall develop a sediment basin equal in volume to 3,600 cubic feet per disturbed acre. The sediment basin/lagoon adjacent to the outfall for the site shall be constructed and stabilized prior to any additional land disturbed activity.

3.07 RIP-RAP

A. Rip–Rap shall be placed at the locations shown and installed in accordance with the detail on the construction drawings.

3.08 CONSTRUCTION EXIT

A. Construction exits shown on the drawings may be revised to suit the contractor's grading plan with Engineer's permission. The construction exit shall be constructed per detail on the construction drawings. Contractor shall maintain construction exits as required by State/SCDHEC regulations.

3.09 INLET PROTECTION

A. Install inlet protection per detail on the construction drawings. Contractor shall maintain inlet protection as required by State/SCDHEC regulations until all disturbed surfaces are stabilized.

*****END OF SECTION 31 25 00*****

SECTION 31 37 00

RIP-RAP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Material placed as bank protection and erosion control.

1.02 ALLOWABLE TOLERANCES

A. Depth of rip–rap blanket as shown on the drawings and in these specifications is a minimum depth.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stone Rip–Rap: Shall be hard quarry or field stone of such quality the pieces will not disintegrate on exposure to water, sunlight, or weather. Stone shall be solid and non–friable and range in weight from a minimum of 25 pounds to a maximum of 150 pounds. At least 50 percent of the stone pieces shall weigh more than 60 pounds. The stone pieces shall have a minimum dimension of 12 inches. Documents indicating stone analysis, source and other pertinent data (i.e. – filter fabric) shall be submitted for review by the Engineer prior to delivery.

B. Filter Fabric: Shall be a woven fabric of monofilament and multifilament yarn equivalent to Mirafi FW700. Fabric shall be finished so the filaments will retain their relative position with respect to each other. Fabric shall contain stabilizers and/or inhibitors added to make filaments resistant to deterioration due to ultraviolet and/or heat exposure. Fabric shall be free of flaws, rips, holes, or defects.

2.02 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products before they are ordered.

PART 3 - EXECUTION

3.01 PREPARATION

A. The surface to receive rip–rap shall be prepared to a relatively smooth condition free of obstruction, depressions, debris, rises, and soft or low density pockets of material. Contours and elevations on construction drawings are to the surface of rip–rap material.

3.02 PLACEMENT

A. Filter fabric shall be placed with the long dimension running up slope. The strips shall be placed to provide a minimum width of one foot of overlap for each joint. Fabric shall be anchored in place with securing pins of the type recommended by fabric manufacturer. Pins shall be placed on or within 3 inches of the over– lap. Place fabric so upstream strip will overlap the downstream strip. Fabric shall be placed loosely to give and avoid stretching and tearing during placement of the stones.

B. Minimum depth or thickness of stone blanket shall be 12 inches with no under tolerance. Stones shall be dropped no more than three feet during construction. Placing shall begin at bottom of slope. Provide a toe trench if required as detailed on the construction drawings. Entire mass of stone shall be placed to conform with lines, grades, and thickness shown on the plans. Rip–rap shall be placed to its full course thickness at one operation and in such a manner as to avoid displacing the underlying material. Placing of rip–rap in layers, or by dumping into chutes, or by similar methods likely to cause segregation, will not be permitted.

Larger stones shall be well distributed and the entire mass of stone shall conform to gradation specified. All material used in rip–rap protection shall be placed and distributed so there will be no large accumulations of either the larger or smaller sizes of stone.

It is the intent of these specifications to produce a fairly compact rip–rap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to secure the results specified.

*****END OF SECTION 31 37 00*****

SECTION 31 62 13

PRESTRESSED CONCRETE PILES

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The work under this Section consists of fabrication and installation of 18" square precast/prestressed concrete piles at the Bucksport Marine Industrial Park. Also included in this Section are requirements for Pile Dynamic Analysis (PDA) testing of select piles. The Contractor shall furnish all materials, labor, equipment, utilities, and incidental items necessary to complete the work as indicated on the project drawings and specified herein.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.

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

AASHTO T 259	Resistance of Concrete to Chloride Ion Penetration

C. American Concrete Institute (ACI)

ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214R	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 318/318R	Building Code Requirements for Structural Concrete and Commentary
ACI SP-66	ACI Detailing Manual

D. ASTM International (ASTM)

ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 416	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 31	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 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	Slump of Hydraulic Cement Concrete
ASTM C 150	Portland Cement
ASTM C 172	Sampling Freshly Mixed Concrete
ASTM C 260	Air-Entraining Admixtures for Concrete
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 666	Resistance of Concrete to Rapid Freezing and Thawing
ASTM C 1077	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1202	Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration
ASTM C 1218	Water-Soluble Chloride in Mortar and Concrete
ASTM C 1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM D 4945	High-Strain Dynamic Testing of Piles

E. American Welding Society (AWS)

AWS D1.4	Structural Welding Code - Reinforcing Steel

F. Precast/Prestressed Concrete Institute (PCI)

PCI JR-382	Design, Manufacture and Installation of Prestressed Concrete Piling
PCI MNL-116	Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI STD-112	Standard Prestressed Concrete Piles Square, Octagonal and Cylinder

1.3 SUBMITTALS

A. The Contractor shall submit the following in accordance with the Contract Documents. Note that approval of the submittals by the Designer shall not be construed as relieving the Contractor from responsibility for compliance with the specifications nor from responsibility of errors of any sort in the submittals.

B. Preconstruction Submittals

1. Installation Procedures: Submit information on the type of equipment proposed to be used, proposed methods of operation, pile driving plan (including proposed sequence of drilling and driving), and details of all pile driving equipment and accessories. Provide methods of handling and cutting off piles. Provide instructions and procedures on how the Contractor will perform the dynamic testing, and how the Contractor will inspect and monitor piles during installation and testing. Provide details of pile driving

equipment and a Wave Equation Analysis of pile drivability for selection of the hammer, along with a statement of driving procedures. The Wave Equation Analysis is to be completed by the Contractor's independent Geotechnical Engineer (see below) for each test pile location where different subsurface conditions exist and is to include the following information pertaining to the proposed pile driving equipment:

a. Complete pile and driving equipment data form for each proposed pile hammer and pile type combination.

2. Provide detailed procedures for conducting the dynamic load tests and equipment to be used for conducting the tests. The detailed description shall explain how specific information of pile performance will be evaluated.

3. Geotechnical Consultant Documentation: The Contractor shall employ the services of an independent Geotechnical Engineer, registered in South Carolina and experienced in soil mechanics and Pile Dynamic Analysis (PDA), to conduct a Wave Equation Analysis for pile drivability and perform PDA pile testing as indicated herein. The independent Geotechnical Engineer shall have at least five (5) years experience performing High-Strain Dynamic Pile Testing. The independent Geotechnical Engineer shall be in charge of PDA operation and of result interpretation, either on-site or by remote connection (PAL-R or PAX). The Geotechnical Engineer shall be independent of the Contractor and shall have no employee or employer relationship which would constitute a conflict of interest. The Contractor's independent Geotechnical Engineer shall be approved by the Owner's Representative prior to commencing the work.

4. Wave Equation Analysis: The Contractor shall follow the requirements specified in the following Paragraph "WAVE EQUATION ANALYSIS". The Contractor's independent Geotechnical Engineer shall perform a Wave Equation Analysis of pile drivability to assist the Contractor in selection of appropriate pile driving equipment and methods subject to further pile testing results. A copy of the Wave Equation Analyses shall be submitted to the Designer for review and documentation. The Wave Equation Analyses are to include the following information pertaining to the proposed pile driving equipment. The Contractor shall propose a new pile driving system, make modifications to the existing system, or develop new pile installation procedures should the pile installation stresses predicted by the Wave Equation Analyses or calculated by PDA testing exceed the allowable limits.

a. Copies of computer input and output sheets and graphs showing soil resistance versus blow count as well as maximum tension and compression stresses versus blow count. Analysis shall be run at the estimated tip elevation as well as other required elevations to define maximum stress levels in the pile during driving.

5. Precasting Manufacturer's Quality Control Procedures: Submit the precasting manufacturer's quality control procedures and inspection records established in accordance with PCI MNL-116.

C. Shop Drawings

1. Piles: Prepare shop drawings in accordance with ACI SP-66. Indicate placement of reinforcement including tendons. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. Provide details of steel pile stingers. Provide certification of a Professional Engineer, registered in South Carolina, that the layout and details of reinforcement and tendons conform to that shown on the project drawings.

D. Product Data

1. Pile Driving Equipment: Submit descriptions of pile driving equipment to be employed in the work to the Designer for review and documentation. Descriptive information includes drill and hammer manufacturer's make and model, type (i.e. diesel, air/steam, etc), capacity, rated energy, ram weight and stroke, rated speed, manufacturer's chart of blow count rate versus energy through the hammer, power packs, driving helmets, cap blocks, pile cushions, leads, extractors, and templates at least 30 days prior to commencement of work. Initial approval of the pile driving equipment will be based on the Wave Equation Analyses. Final approval of the pile driving equipment will be based on the pile test program as specified herein.

E. Design Data

1. Concrete Mix Design: Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete used for the piles. Certify, using an approved independent commercial testing laboratory, that proportioning of mix is in accordance with ACI 211.1 or ACI 318/318R for specified strength and is based on aggregate data which has been determined by laboratory tests during the last twelve months. Submit a complete list of materials including type; brand; source and amount of cement and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Designer. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of laboratory test reports by independent test labs conforming to ASTM C 1077, showing that the mix has been successfully tested to produce concrete with the properties specified and that the mix will be suitable for the job conditions. Obtain acknowledgement of receipt prior to concrete placement.

F. Statements

1. Pile Driving Plan: A pile placement plan, which shows the installation, procedures, sequence, and the methods proposed for controlling the location and alignment of piles (template) during driving, shall be developed and submitted.

2. Suitability of Pile Driving Equipment: Prior to driving piles, the Contractor shall provide

written certification from the drill & hammer manufacturer, or an authorized representative of the drill & hammer manufacturer, that the manufacturer has performed a detailed inspection of the hammer and that the pile hammer, compressors, and valves have been inspected and found to be in satisfactory working condition. The certification shall be performed within four (4) months of submittal. All parts of the hammer shall be properly lubricated at all times. Any indication of collapse of hoses, stripping of hose line, or any erratic action of the hammer shall be cause for immediate shutdown of pile driving until the problem has been resolved.

3. Calcium Nitrite Manufacturer's Representative: Provide a statement that the calcium nitrite manufacturer's representative has consulted with the plant to ensure the proper mix and batching method.

G. Test Reports

1. Aggregates

2. Concrete Cylinder Compressive Strength

3. Pile Dynamic Analysis (PDA): Submit a summary report of the dynamic testing of piles within 3 calendar days of completing field work.

H. Certificates

1. Aggregates

2. Admixtures

3. Prestressing Steel

4. Cement

I. Closeout Submittals

1. Pile Driving Records: The Contractors's on-site pile driving inspector shall submit complete and accurate records of pile driving operations as specified in the following Paragraph "PILE RECORDS", within 15 calendar days after completion of driving.

1.4 MODIFICATION OF REFERENCES

A. Accomplish work in accordance with ACI publications except as modified herein. 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 the "Architect/Engineer" to mean the Designer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Piles shall be stored, handled, and transported in accordance with PCI MNL-116 except as

follows. Methods used for handling and storage of piles shall be such that the piles are not subjected to excessive bending stress, cracking, spalling, or other damage. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Designer, will be rejected and shall be removed from the project site at no cost to the Owner. Piles containing cracks other than crazing, surface drying, shrinkage cracks, and end cracks will be rejected. The Contractor shall inspect piles for sweep and structural damage, such as cracking and spalling, before transporting them to the project site and immediately prior to placement in the driving leads. Sweep shall be limited to 2" over the length of the pile. Piles having excessive sweep will be rejected. Piles that develop cracks due to handling and/or installation will be rejected.

1.6 EXPERIENCE

A. Pile installation shall be performed by a general contractor or a specialty subcontractor specializing in the specified foundation system and having experience installing the specified foundation system under similar subsurface conditions.

1.7 SUBSURFACE DATA

A. Subsurface soil boring logs are shown on the project drawings. Soil boring information is provided for Contractor information only. The Owner makes no representations about subsurface conditions that may be encountered within the limits of the project. Soil borings represent subsurface information only at the location of the boring and is not intended to be considered typical beyond the limits of the boring. The Contractor, at his own expense, may make additional subsurface investigations as deemed necessary.

1.8 LUMP SUM PAYMENT

A. Base bids upon providing the number, size, capacity, and length of piles as indicated in the pile schedules on the project drawings. The contract price for piling shall include the cost of all necessary equipment, tools, material, labor, and supervision required to: deliver, handle, install, test, cutoff, dispose of any cutoffs, and meet the applicable contract requirements. The contract price shall also include mobilization and re-driving of any heaved piles. If in testing, driving, and re-driving it is found that piles are not of sufficient length to provide the capacity specified, notify the Designer, who reserves the right to increase or decrease the total length of piles to be furnished and installed by changing the pile locations or elevations, requiring the installation of additional piles, or directing the omission of piles from the requirements shown and specified. Should the total number of piles or number of each length vary from that specified as the basis for bidding, an adjustment in the contract price or time of completion, or both, will be made in accordance with the Contract Documents. Payment for piles will be based on successfully installing piles to the minimum tip elevation and required capacity identified on the project drawings. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles; any portion of a pile remaining above the cutoff elevation; back driving; cutting off piles; build-ups; any cutoff length of piles; or other excesses beyond the assumed pile length indicated for which the Contractor is responsible.

1.9 PILE REQUIREMENTS

A. Provide precast/prestressed concrete piles conforming to PCI JR-382. Production of piles shall be in accordance with PCI MNL-116. PDA pile tests shall be performed to verify pile capacities and drivability and shall be driven as the first production piles installed in locations as indicated on the project drawings.

1.10 PILE DRIVING RESTRICTIONS

A. Pile driving activities must be limited to 12 hours per day with a 12-hour rest period between pile driving activities to avoid potential cumulative noise impacts to Federally-listed Threatened and Endangered (T&E) species.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cementitious Materials: Cementitious materials shall be Portland cement conforming to the appropriate specifications listed below.

1. Cement: Cement shall comply with ASTM C 150, Type II with a minimum of six (6) sacks of cement per cubic yard and a maximum alkali content of 0.40 percent. If no satisfactory test results are available (made within the past six months) to prove that the cement alkali content is less than 0.40 percent, then it shall be assumed that the cement contains greater than 0.40 percent alkali. Cement certificates shall include test results in accordance with ASTM C 150, including equivalent alkalis indicated in the optional chemical requirements. Use cement with a tricalcium aluminate (C_3A) content of less than 8 percent. In addition to the above requirements, steam cured precast piles shall conform to the following requirements:

    a. The maximum percent of sulfur reported as sulfate (SO3) shall be less than 3 percent. Also, the molar ratio of sulfate to tricalcium aluminate shall be less than 0.3.

B. Water: Water shall be in accordance with ACI 318/318R and shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete or steel.

C. Aggregates: Aggregates shall conform to ASTM C 33, except as modified herein. Furnish aggregates from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement, nor in an amount sufficient to cause excessive expansion of concrete. Do not mix, store in same stockpile, or use fine aggregates from different sources of supply in same concrete mix or same structure without approval. The fineness modulus of fine aggregate shall be not less than 2.40 or greater than 3.0. For piles that will be exposed to freezing and thawing, fine and coarse aggregate subjected to five cycles of the sodium sulfate soundness test shall show a loss not greater than 10 percent. If the selected aggregates fail the soundness test, the Contractor may use the aggregate source, provided concrete specimens made with the aggregates to be used for the piles shall have a durability factor of not less than 80 based on 300 cycles of freezing and thawing when tested in accordance with ASTM C 666. Prior to pile fabrication, submit

certified test reports for the following tests specified in ASTM C 33:

1. Grading
2. Amount of material finer than No. 200 sieve
3. Organic impurities
4. Soundness
5. Clay lumps and friable particles
6. Coal and lignite
7. Weight of slag
8. Abrasion of coarse aggregate
9. Fineness modulus
10. Reactive aggregates
11. Freezing and thawing

D. Alkali-Silica Reactivity (ASR): Evaluate and test fine and coarse aggregates to be used in all concrete for alkali-aggregate reactivity in accordance with ASTM C 1260. Test both coarse aggregate size groups if from different sources. Evaluate the fine and coarse aggregates separately and in combination, which matches the Contractor's proposed mix design proportioning, utilizing the modified version of ASTM C 1260. Test results of the combination must have a measured expansion equal to or less than 0.08 percent at 16 days after casting. Modify ASTM C 1260 as follows to include the following option. If the option does not lower the expansion to less than 0.08 percent at 16 days after casting, reject the aggregate(s) and submit new aggregate sources for retesting. Submit the results of testing to the Designer for evaluation and acceptance.

E. Admixtures: Admixtures shall conform to ASTM C 494; Type A for water reducing and Type B for retarding. Do not use calcium chloride admixtures.

1. Air-Entraining: Provide air-entraining admixtures conforming to ASTM C 260.

F. Prestressing Steel: Use seven-wire low relaxation strand conforming to ASTM A 416, Grade 270. Use prestressing steel free of grease, oil, wax, paint, soil, dirt, and loose rust. Do not use prestressing strands or wire having kinks, bends, or other defects.

G. Reinforcing Steel: Reinforcing steel shall conform to ASTM A 615, Grade 60, unless otherwise specified. Any reinforcing steel that requires welding shall conform to ASTM A 706, Grade 60. Weld reinforcing steel in accordance with AWS D1.4.

H. Ties and Spirals: Reinforcing steel spirals shall conform to ASTM A 82 and reinforcing steel

ties shall conform to ASTM A 615.

I. Steel Pile Stingers: All plates and HP shapes associated with steel pile stingers shall conform to the material requirements of ASTM A 572, Grade 50.

J. Anchorages and End Fittings: Anchorages and end fittings shall conform to ACI 318/318R.

K. Grout: Provide cementitious grout for prestressed piles using materials conforming to requirements stipulated herein for concrete mixes. Use admixtures, if required, known to have no injurious effects on steel or concrete. Do not use calcium chloride.

2.2 CONCRETE MIX DESIGN

A. Concrete mix design shall conform to ACI 211.1 or ACI 318/318R, Chapter 4. Concrete shall have a minimum compressive strength of 7000 psi at 28 days and a maximum size aggregate of 1". Concrete shall be air entrained with a minimum of 4.5 percent and a maximum of 7 percent. For marine exposure, ensure a dense concrete free of shrinkage cracks, with a minimum degree of permeability. The maximum water cement ratio shall be 0.40.

B. Calcium Nitrite Corrosion Inhibitor: An approved calcium nitrite corrosion inhibitor (30 percent solids) shall be added to the concrete mix at the batch plant. The minimum rate of calcium nitrite application shall be 3.0 gallons per cubic yard. The Contractor shall furnish one concrete cylinder for every 50 cubic yards of concrete produced in order to verify the concentration of calcium nitrite in hardened concrete (CHEM C-20.0 "Determination of Nitrite in Hardened Concrete") for concrete that fails the plastic test method. Concrete failing to contain calcium nitrite at the required concentration as tested shall be subject to rejection. Use only air-entraining, water-reducing, and/or set-controlling admixtures in the production of concrete mixtures that are compatible with calcium nitrite solutions. The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the admixtures including storage, transportation, and method of mixing. The calcium nitrite, which acts as an accelerator, may be used in conjunction with a retarder to control the set of concrete, as per the manufacturer's recommendation.

2.3 FABRICATION

A. Formwork: Formwork and dimensional tolerances shall be in accordance with PCI MNL-116, and as specified herein. Provide forms of metal, braced and stiffened against deformation, accurately constructed, watertight, and supported on unyielding casting beds. Forms shall permit movement of pile without damage during release of prestressing force. Form precast dowel holes with galvanized flexible metal conduit or provide dowel holes as otherwise indicated on the project drawings.

B. Pretensioning: Pretensioning shall be performed in accordance with PCI MNL-116, and as specified herein. Use gage calibrated within last 6 months by a laboratory approved by the Designer. Provide means for measuring elongation of steel to nearest 1/8". Give tensioning steel a uniform prestress prior to being brought to design prestress. Induce same initial prestress in each unit when several units of prestressing steel in a pile are stretched simultaneously.

C. Casting

1. Conveying: Convey concrete to formwork in accordance with PCI MNL-116, and as specified herein. Clean conveying equipment thoroughly before each run. During concrete placement, make any free vertical drop of the concrete less than 3'-0". Remove concrete which has segregated in conveying or placing.

2. Placing and Casting: Perform concrete casting within 3 days after pretensioning steel; however, do not deposit concrete in forms until placement of reinforcement and anchorages have been inspected and approved by pile manufacturer's quality control representative. Produce each pile of dense concrete, straight with smooth surfaces, and with reinforcement retained in its proper position during fabrication. Use vibrator with heads smaller than the minimum distance between steel for pretensioning. Make surface of pile ends perpendicular to the axis of pile. Chamfer ends of piles and corners of square piles a minimum of 3/4".

D. Curing of Piles: Cure piles using moist or accelerated curing. Curing of piles shall be in accordance with PCI MNL-116, except as follows.

1. Moist Curing: Moist cure using moist burlap coverings, plastic sheeting, or membrane curing compound until minimum strength to detension is achieved.

2. Accelerated Curing: After placement, moist cure concrete for a period of 4 hours. Accelerated cure until concrete has reached specified release strength. Enclose casting bed for accelerated curing with a suitable enclosure. During application of heat, increase the air temperature at a rate not to exceed 60 degrees F per hour. Cure at a maximum temperature of 165 degrees F until concrete has reached specified release strength. Reduce temperature at a rate not to exceed 60 degrees F per hour until a temperature of 20 degrees F above ambient air temperature is reached. After accelerated curing, moist cure using either water or membrane curing until a total accelerated and moist curing time of 72 hours is achieved.

3. Steam Curing: Immediately after each pile has been cast and finished, it shall be placed in a curing chamber, curing box, or under a tight enclosure which will protect the pile from wind and drafts. Such chambers and enclosures shall be sized to allow full circulation of steam around exposed surfaces of the pile. Install exterior recording thermometers and interior temperature probes with enclosures and power source along with wiring. Each pile shall be instrumented with either one exterior thermometer or one interior probe. Exterior thermometers and interiors probes shall be installed in an alternating sequence. Parallel casting beds shall have the instrumentation placed in a staggered and alternating pattern along the piles. The thermometer and the probe shall be installed close to the middle of the pile, not closer than 5'-0" and not farther than 10'-0" from the orifice where the steam is introduced. The exterior thermometer shall be located at the side where the steam is introduced. The interior probe shall be located more than 8" and less than 10" from the surface of the piles. Under no circumstances are the interior probes permitted to touch the jet tube. Do not commence concrete placement until temperature recording devices have been checked to the satisfaction of the Owner's Representative. A uniform curing temperature shall

be maintained throughout the entire length of the piles. Submit prints of the automatic readout daily. Commencing not earlier than three (3) hours and not later than five (5) hours after completion of concrete placement, the piles shall be subjected to the continuous action of steam. Care shall be exercised to see that heat is introduced gradually to avoid thermal shock to the concrete. During the heating, the temperature rise shall not exceed 25 to 35 degrees F per hour. The interior temperature of the piles shall be held at a target temperature of 150 degrees F with an upward tolerance of 10 degrees F. A single pile reaching an interior temperature of more than 160 degrees F or less may be accepted at the option of the Designer. A run of several piles with an interior exceeding 160 degrees F will be rejected. Cooling shall follow the steaming cycle. Care shall be exercised to protect the piles from rapid drops in temperature, mechanical injury and other conditions likely to cause damage or loss of strength. During the cooling, the temperature drop shall not exceed 35 degrees F per hour until a temperature of 20 degrees F above ambient air temperature is reached. The cool down procedures shall be as follows. After steam curing, moist curing shall be utilized until a total steam and moist curing time of seven (7) days is achieved.

a. Steam shall be turned off following the steam cycle.

b. The sides of the tarps shall be folded to the top of the form.

c. Transfer breaks shall be performed to confirm that the required strength at transfer has been reached.

d. The tarps shall be completely removed, the top doors will be opened, and the strands will be released.

E. Detensioning: Detensioning shall be performed in accordance with PCI MNL-116, and as specified herein. Gradually release tension in strands from anchorage. Detension after approval by pile manufacturer's quality control representative. Perform transfer of prestressing force when concrete has reached a minimum compressive strength of 5600 psi.

2.4 PRODUCT QUALITY CONTROL

A. Where piling is manufactured in a plant with an established quality control program as attested to by a current certification in the PCI "Certification Program for Quality Control", perform product quality control in accordance with PCI MNL-116. Where piling is manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program", provide a product quality control system in accordance with PCI MNL-116, and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory in accordance with the following. Submit test results to the Designer.

B. Aggregate Tests: Take samples of fine and coarse aggregate at concrete batch plant and test. Perform mechanical analysis (one test for each aggregate size) in accordance with ASTM C 136. Tabulate results of tests in accordance with ASTM C 33.

C. Slump and Strength Tests: Sample concrete in accordance with ASTM C 172 at the time

concrete is deposited for each production line. Perform slump tests in accordance with ASTM C 143. Mold cylinders in accordance with ASTM C 31. Mold at least six cylinders per day or one for every 20 cubic yards of concrete placed, whichever is greater. Cure cylinders in same manner as piles and for accelerated curing, place at coolest point in casting bed. Perform strength tests in accordance with ASTM C 39. Test two cylinders of each set at 7 days or 14 days, or at a time for establishing transfer of prestressing force (release strength), and removal of pile from forms. Test remaining cylinders of each set 28 days after molding.

D. Changes in Proportions: If after evaluation of strength test results, compressive strength is less than specified compressive strength, make adjustments in proportions and water content and changes in temperature, moisture, and curing procedures as necessary to secure specified strength. Submit changes in mix design to Designer in writing.

E. Compressive Strength Test Results: Evaluate compressive strength test results at 28 days in accordance with ACI 214R, using a coefficient of variation of 10 percent. Evaluate strength of concrete by averaging test results of each set of standard cylinders tested at 28 days. Not more than 10 percent of the individual cylinders tested shall have a compressive strength less than the specified design strength.

F. Chloride Ion Concentration: Sampling and determination of water soluble chloride ion content in accordance with ASTM C 1218. 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 0.06 percent by weight of cement.

1. Chloride Ion Penetration Test: To ensure the durability of concrete in a marine environment, concrete shall be proportioned to have the chloride ion penetration test in accordance with ASTM C 1202, and be below 1500 coulombs for concrete specimens tested at 56 days. Alternatively, a ponding test in accordance with AASHTO T 259 may be performed to validate chloride ion penetration in accordance with ASTM C 1202.

PART 3 - **EXECUTION**

3.1 **PRELIMINARY WORK**

A. Wave Equation Analysis: Prior to driving any pile, the Contractor shall employ the services of an independent Geotechnical Engineer, registered in South Carolina and experienced in Wave Equation Analysis of piles driven into similar soils, to perform the preliminary work. The Geotechnical Engineer shall be independent of the Contractor and shall have no employee or employer relationship which would constitute a conflict of interest. The Contractor's independent Geotechnical Engineer shall be approved by the Owner's Representative prior to commencing the work. The independent Geotechnical Engineer shall perform an initial Wave Equation Analysis (GRLWEAP Version 1998 or newer) for each size pile that accurately reflects the Contractor's proposed driving system. The Wave Equation Analyses shall be submitted to the Designer at least one (1) week prior to test pile installation. The analyses shall consider, at a minimum, the following based on static capacity analysis with consideration of driving gain/loss factors. Only one (1) specific model of pile hammer may be used for each pile type and capacity.

1. Hammer impact velocity
2. Hammer energy
3. Hammer ram weight
4. Hammer ram stroke
5. Driving helmet and pile cushion
6. Hammer cushion or cap block
7. Pile size, weight, and length
8. Character of subsurface material to be encountered
9. Effective pile prestress
10. Pile stresses during driving (compression and tension)
11. Pile penetration
12. Pile design load
13. Ultimate pile capacity

B. The Wave Equation Analysis shall demonstrate that the piles will not be damaged during driving, shall indicate that the driving stresses will be maintained within the limits below, and shall indicate the blow count necessary to achieve the required ultimate static pile capacities. The required ultimate bearing capacity shall be equal to the design load for each size pile indicated multiplied by a factor of safety of 2.5.

1. Allowable Driving Stresses (Concrete Piles):

    a. Compression – ($0.85f'_c$ – UPL)

    b. Tension – ((3 x square root of f'_c) + UPL)

    Where f'_c = compressive strength of concrete, psi
    UPL = Unit Prestress after Losses, psi (obtain values from the pile manufacturer)

C. Upon completion of the dynamic testing programs outlined in this Section, a refined Wave Equation Analysis shall be performed for each size pile taking into consideration the evaluated capacities, gain/loss factors and recommended production pile lengths. Production pile driving criteria shall be developed based on the results of the refined Wave Equation Evaluations. All pile driving equipment furnished by the Contractor shall be subject to the approval of the Contractor's independent Geotechnical Engineer. The cost of performing the Wave Equation Analysis shall be paid for by the Contractor and included in the bid price.

D. Pile Length Markings: The Contractor shall mark each pile prior to driving with horizontal lines at 1'-0" intervals, and the number of feet from pile tip at 5'-0" intervals. At the direction of the Contractor's Geotechnical Engineer, driving of test piles shall pause long enough to mark shorter lines at 1" intervals to measure the driving resistance per inch for the last 1'-0" of driving.

3.2 PILE DRIVING EQUIPMENT

A. Select the proposed pile driving equipment, hammers, and other required items, and submit complete descriptions of the proposed equipment in accordance with the previous Paragraph "SUBMITTALS". The pile driving hammer, driving helmets, cushion blocks, and other equipment shall be the same as those used in the Wave Equation Analyses and during the installation of test piles. Changes in the selected pile driving equipment will not be allowed without written permission of the Designer. If the selected pile driving equipment is changed, a new Wave Equation Analysis shall be performed at no additional cost to the Owner. No additional contract time will be allowed for Contractor proposed changes in the equipment. Changes to the pile driving equipment will be approved only after the performance of a revised Wave Equation Analysis and an additional dynamic pile test as required by the Designer. The cost of performing revised Wave Equation Analyses and additional dynamic pile tests, due to changes in pile driving equipment, shall be paid for by the Contractor. Acceptance of the pile driving system does not relieve the Contractor of the obligation of properly installing the piles and to provide the necessary equipment, materials, labor, and accessories to complete the installation. Approval of the pile hammer relative to driving stress damage shall not relieve the Contractor of the responsibility for piles damaged because of misalignment of the leads, failure of cap block or cushion material, malfunctioning of the pile hammer, or other improper construction methods.

B. Pile Hammers: Pile hammers shall be steam, air, or diesel powered of the single-acting, double-acting, or differential-acting type. A variable energy hammer shall be used to drive concrete piles. Diesel hammers shall be capable of providing a selection of at least three (3) energy or fuel settings that produce reduced strokes. The size or capacity of the pile driving hammer shall be as recommended by the hammer manufacturer to drive piles to the indicated tip elevation and ultimate pile capacity considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross section, length, and total weight of pile; and character of subsurface material to be encountered. The striking part of the hammer shall in all cases be of sufficient and proper size to drive all piles to the required depth and/or penetration resistance and load capacity, without damage to the pile. The pile hammer used for driving shall be the same type, operated at the same rate, and in the same manner as that used for driving test piles. Operate hammer at the rate(s) recommended by the manufacturer throughout the entire driving period. The Contractor shall repair damage to piling caused by use of a pile hammer with excess delivered force or energy. Boiler, compressor, or engine capacity shall be sufficient to operate hammers continuously at the full rated speed. Hammers shall have a gage to monitor hammer bounce chamber pressure for diesel hammers or pressure at the hammer for air and steam hammers. This gage shall be operational during the driving of piles and shall be mounted in an accessible location for monitoring by the Contractor and the pile driving inspector. Driving energy, except for diesel hammers, shall be obtained by use of a heavy ram and a short stroke with a low impact velocity, rather than a light ram and a long stroke with high impact velocity. At final

driving, operate pile hammer in accordance with manufacturer's recommendation for driving either end bearing piles or friction piles as applicable. At final driving, operate diesel-powered hammers at rate recommended by manufacturer for hard driving. Maintain pressure at steam or air hammers so that: (1) for double-acting hammer, the number of blows per minute during and at completion of driving of a pile is equal approximately to that at which hammer is rated; (2) for single-acting hammer, there is a full upward stroke of the ram; and (3) for differential type hammer, there is a slight rise of hammer base during each upward stroke. The weight of the striking parts of air and steam hammers shall not be less than 1/3 of the weight of helmet and pile being driven.

1. Hammer Skirt: If a diesel hammer is utilized, it must be equipped with a skirt or sleeve to prevent fuel spray during operation.

C. Driving Helmets and Cushion Blocks: Driving helmets and cushion blocks shall be the same as those used in the Wave Equation Analyses and during the installation of test piles. Modifications or substitutions will not be allowed without written permission of the Designer.

1. Driving Helmets or Caps and Pile Cushions: Use a steel driving helmet or cap including a pile cushion between top of pile and driving helmet or cap to prevent impact damage to pile. Use a driving helmet or cap and pile cushion combination capable of protecting pile head, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly and consistently over the top of pile during the entire driving period. Provide driving helmet or cap that fits sufficiently loose around top of pile so that the pile may be free to rotate without binding within driving helmet. During test pile installation, demonstrate to the satisfaction of the Designer that equipment to be used on the project performs specified function. Use a pile cushion of solid wood or of laminated construction using plywood, softwood, or hardwood boards with grain parallel to the end of pile. Provide pile cushion with thickness of 6" minimum and the thickness shall be increased so as to be suitable for the size and length of pile, character of the subsurface material to be encountered, hammer characteristics, and the required driving resistance. Replace pile cushion at the start of driving of each pile and when it becomes highly compressed, charred or burned, or has become spongy or deteriorated in any manner. Show details of driving helmets, cap blocks, and pile cushions. Submit two (2) weeks prior to test pile installation.

2. Hammer Cushion or Cap Block: Use a hammer cushion or cap block between driving helmet/cap and hammer ram consisting of aluminum and micarta (or equal) discs stacked alternately in a steel housing or a suitable polymer designed for this specific purpose as indicated by the hammer manufacturer. Use steel plates at top and bottom of cap block. Replace aluminum, micarta, or polymer discs that have become damaged, split, or deteriorated in any manner. Do not use small wood blocks, wood chips, rope, asbestos, or other materials that permit excessive loss of hammer energy.

D. Pile Driving Leads: Except as otherwise specified, pile driving equipment shall have fixed leads at the top and bottom. Piles shall be held in leads during driving. Pile leads shall be constructed in a manner which affords freedom of movement to the hammer and ensures proper support of the pile during installation and concentric impact for each blow. Semi-

fixed leads or swinging leads shall not be used unless approved in writing by the Designer. The Contractor shall submit for approval, a detailed justification, including procedures and methods to establish that fixed leads cannot be used and why semi-fixed leads or swinging leads are necessary. Piles shall be constrained in a structural frame, such as a template, to maintain proper alignment.

E. Pile Driving Templates: The Contractor shall provide an adequate fixed template to maintain the pile in proper position and alignment during driving. Floating templates (attached to a barge) will not be allowed unless otherwise approved by the Designer. The template shall be placed so that the pile can be driven to cutoff elevation before the template is removed. Free hammers shall not be utilized.

F. Pile Extractors: Pile extractors may be vibratory and/or impact pile driving hammers. Impact hammers are required for pulling piles not extractable with vibratory hammers.

3.3 INSTALLATION

A. Inspect piles when delivered and when in the leads immediately before driving. Provide hearing protection when noise levels exceed 140 dB. Piles or pile sections shall not be handled or moved in any manner that would result in cracking or permanent damage to the concrete or to the grout surrounding the prestressing cables. Piles may be driven without pile guides or leads, provided a hammer guide frame is used to keep the pile and hammer in alignment. Piles shall not be driven within 100'-0" of concrete less than 7 days old. Piles may be driven when the specified 28-day concrete strength has been achieved but not less than 7 days after casting. Cut piles at cutoff elevation by an approved method. The final position of the each pile is as shown on the project drawings.

B. Pile Driving: Notify the Owner's Representative and the Designer 10 calendar days prior to driving of test piles and performing PDA tests so that appropriate personnel can witness the driving, testing, and recording procedures of the piles. Drive piles to tip elevations as indicated on the project drawings. During initial driving and until pile tip has penetrated beyond layers of very soft soil, use a reduced driving energy of the hammer as required to prevent pile damage. Production and test piles shall be driven with hammers of the same model and manufacturer, same energy and efficiency, and using the same driving system. Hammers shall be operated at all times at the speed and under the conditions recommended by the manufacturer. Where heave is anticipated, the sequence of installation shall be such that pile heave is minimized by starting pile driving at the center of the group and proceeding outward where practicable. Prior to driving and with the pile head seated in the hammer, each pile shall be checked to ensure that it has been aligned correctly. Once pile driving has begun, conditions such as alignment shall be kept constant. Each pile shall be driven continuously and without interruption until the required tip elevation has been attained. Deviation from this procedure will be permitted only when driving is stopped by causes that reasonably could not have been anticipated. A pile that cannot be driven to the required depth because of an obstruction, as indicated by a sudden unexplained change in blow count and drifting, shall be pulled and redriven as directed. After piles are driven, they shall be cutoff as shown to the indicated cutoff elevation. If, in driving, it is found that a pile is not of sufficient length to provide the required capacity or that a pile cannot achieve the tip elevation specified, notify the Designer and perform

corrective measures as directed.

C. Protection of Piles: Take care to avoid damage to piles during handling, placing pile in leads, and during pile driving operations. Support piles laterally during driving, but allow rotation in the leads. Square the top of pile to the longitudinal axis of pile. Maintain axial alignment of pile hammer with that of the pile. If the Contractor elects to use a pile head with projecting strands or mild steel reinforcement, prevent direct impact forces from being transmitted through the reinforcement, by using a special driving head.

D. Protection of Adjacent Work: The Contractor shall protect adjacent existing and new structures, utilities, and other facilities from damage during pile driving operations. Repair items damaged during performance of the work to their original condition and to the satisfaction of the Owner's Representative, or replace with new at no additional cost to the Owner.

E. Pile Placement and Tolerances in Driving: A pile placement plan, which shows the installation sequence and the methods proposed for controlling the location and alignment of piles (template) during driving, shall be developed and submitted in accordance with the previous Paragraph "SUBMITTALS". Piles shall be placed accurately in the correct location and alignments, both laterally and longitudinally, and to the vertical lines indicated. The Contractor shall establish a permanent base line to provide for inspection of pile placement by the pile driving inspector during pile driving operations. The base line shall be established prior to driving test and production piles and shall be maintained during the installation of all piles. Tolerances specified are not mutually exclusive. All piles shall be driven within all of the specified tolerances. Drive piles with a variation of not more than 2 percent from vertical for plumb piles or more than 4 percent from required angle for batter piles. Maintain and check axial alignment of pile and leads at all times. If subsurface conditions cause pile drifting beyond allowable axial alignment tolerance, notify Designer and perform corrective measures as directed. Final driven condition of pile butts at cutoff elevation shall be within 2" of the horizontal location indicated. Manipulation to move piles up to 2" into position will be permitted only if the pile is within the aforementioned tolerance in order to return the pile to the design location; however, piles shall not be manipulated more than 1 percent of the exposed length above the mudline surface. A vertical deviation of not more than 1" from the correct cutoff elevations shown will be permitted. The correct relative position of all piles shall be maintained by the use of templates or by other approved means. Piles damaged, not located properly, exceeding the maximum limits for lateral and vertical deviation, and/or variation in alignment shall be pulled and new piles redriven as directed at no additional cost to the Owner. Additional work required due to improper location of piles will be the responsibility of the Contractor. In addition to specified tolerances, maintain a location to provide a clear distance of at least 5" from the pile butt to edge of concrete face. If clear distance cannot be maintained, then notify the Designer.

F. Rejected Piles: Piles damaged, impaired for use during handling or driving, mislocated, or driven out of alignment beyond the maximum tolerance, shall be withdrawn and replaced by new piles or shall be cutoff and abandoned and new piles driven as directed without additional cost to the Owner. Excess cutoff from piles and unacceptable piles shall be removed from the work site. All work in connection with withdrawing and removing

rejected piles from the site shall be done at no additional cost to the Owner. The Owner's Representative may require that any pile be pulled for inspection. Piles pulled and found to be in suitable condition may be redriven as directed. Piles pulled as directed and found to be damaged shall be replaced by new piles at the Contractor's expense.

G. Heaved Piles: When driving piles in clusters or under conditions of relatively close spacing, observations shall be made to detect heave of adjacent piles. Piles found to have heaved more than 1/4" shall be back driven to original tip elevation without additional cost to the Owner.

H. Jetting: Jetting of precast/prestressed concrete piles is not permitted.

I. Pre-Drilling: Pre-drilling concrete piles is not permitted.

J. Splicing: Splicing of precast/prestressed concrete piles will not be permitted.

K. Build-Ups: Where required, pile section may be extended to cutoff elevation by means of a cast-in-place reinforced concrete build-up. Make build-up in accordance with PCI STD-112. Construct build-ups made after completion of driving in accordance with detail "Build-Up without Driving". Make build-ups to be driven in accordance with detail "Build-Up with Driving". Have details of means for protecting joints by a suitable mortar or epoxy approved by the Designer. Where build-ups are exposed to water, protect cast-in-place section from water during curing period. Concrete in build-up shall have a minimum compressive strength of 5000 psi. Build-ups will not be permitted on more than 10 percent of total number of piles. If this percent figure is exceeded, or if in the judgment of the Designer, the clustered location of build-ups is undesirable, withdraw piles of insufficient length and replace with longer piles.

L. Pile Cutoff: Cut off piles with a smooth level cut using pneumatic tools, sawing, or other suitable methods approved by the Designer. The tops of all piles shall be cut off at the elevations indicated on the project drawings and on a plane perpendicular to the axis of the pile, unless otherwise noted. Use of explosives for cutting is not permitted. Cutoff sections of piles shall become the property of the Contractor and shall be properly disposed of off site.

M. Lifting Devices: Prior to driving piles, remove lifting devices near top of pile or burn off embedded lifting devices 1" below surface of pile. Patch remaining holes using epoxy adhesive.

N. Pile Obstructions: If obstructions restrict driving a pile to the specified elevation, the obstruction shall be probed at 2'-0" on center until the extents of the obstruction are determined. The Contractor shall notify the Designer as each obstruction is encountered and provide location, size, shape, depth, and evaluation of composition. The Designer shall direct the Contractor with the appropriate corrective measures. If obstructions are encountered, an adjustment in the contract price and/or time of completion will be made as necessary.

3.4 FIELD QUALITY CONTROL

A. Test Piles: Use test piles of the type indicated, and drive as specified for piling elsewhere in this Section. Length of test piles shall be as designated on the project drawings (longer than production piles). Drive test piles at the locations and to the estimated pile tip elevation as shown on the project drawings. The additional test pile length shall be driven only at the direction of the Designer. The Designer will utilize test pile data to determine any required modifications to piles or pile lengths. Use test piles, if located properly and offering adequate driving resistance, in finished work. A pile dynamic analyzer shall be provided and operated as specified in the following Paragraph "PILE DYNAMIC ANALYSIS" during the driving of each test pile. Modify driving as required based upon recommendation of Contractor's independent Geotechnical Engineer and approval of the Designer.

B. Pile Dynamic Analysis: Dynamic testing shall be performed during driving of select production piles as indicated on the project drawings. The purpose of dynamic testing is to provide supplemental information for evaluating pile hammer performance, driving stresses, and bearing capacities. Dynamic testing shall be conducted during the entire time piles are initially driven or redriven and during pile restrike testing. All PDA test piles required for the project shall be driven within the first 10 percent of production piles installed and in locations as indicated on the project drawings. Use test piles of the type indicated. Equipment to obtain dynamic measurements, record, reduce, and display its data shall be furnished and meet the requirement of ASTM D 4945. The equipment shall have been calibrated within 12 months thereafter throughout the contract duration. Drive test piles at the locations indicated on the project drawings. The Contractor shall employ the services of an independent Geotechnical Engineer experienced in the pile driving process, monitoring of test pile installation, and in the use of the Pile Driving Analyzer and its related equipment. In addition, field data shall be collected by an Intermediate PDA Tester and reports shall be signed by an Advanced PDA Signatory certified in High-Strain Dynamic Pile Testing jointly by the Pile Driving Contractors Association and Foundations QA (PDCA/FQA). The only acceptable alternative to an Advanced PDA Signatory will be a professional engineer registered in the South Carolina with a minimum of 15 years experience in high-strain dynamic pile testing. Pile dynamic analysis shall be performed as follows:

1. Each pile dynamic analysis shall be performed in two steps. The first step is to check the hammer, pile and soil performance, and to determine the suitability of the proposed hammer for the size, length, and type of pile being installed for the soil types encountered as the piles are driven. This initial monitoring shall determine whether efficiency of the hammer relative to specified efficiency, effectiveness of cushion, level of compressive and tensile stress in pile, and extent/location of any pile damage caused by the initial driving. With each blow of the pile the information listed below shall be electronically recorded and analyzed by the Pile Driving Analyzer:

    a. Blow number

    b. Blow rate per minute and/or stroke

    c. Input and reflected values of force and velocity

    d. Value of upward and downward traveling force wave with time

e. Maximum and final transferred energy to pile, hammer system efficiency

f. Maximum compressive stress, velocity, acceleration, and displacement

g. Maximum tensile stress in pile

h. Pile structural integrity, damage detection, extent and location

i. Bearing capacity of pile by Case method

2. If the pile, hammer, and soil performance evaluation recommends changes to the hammer stroke, cushioning, or any other aspect for the pile driving operation, these changes shall be incorporated into production pile driving in an effort to control excessive stresses and pile damage. Test piles damaged or broken during installation shall be replaced, incorporating driving modifications as determined by the Contractor's independent Geotechnical Engineer and reviewed and approved by the Designer. This procedure shall be repeated until allowable tensile and compressive stresses are achieved in the pile and/or pile damage is minimized. Selected initial driving records shall be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and estimation of anticipated gain/loss factors.

3. Upon completion of initial test pile driving, the piles shall be allowed to setup for at least 7 days. After evaluation of pile, hammer, and soil performance by the Contractor's independent Geotechnical Engineer, the second step of the pile dynamic analysis may proceed. This portion of the evaluation requires striking the setup piles a minimum of 10 times, or as directed by the Contractor's independent Geotechnical Engineer, using the same hammer which was used for the test pile driving and which will be used for production pile driving. The hammer shall be "warmed up" and in optimal readiness prior to restriking, in order to avoid capacity losses during evaluation of restrike data. Maximum hammer energy shall be applied during restrike in order to fully mobilize the soil resistance. However, care should be exercised as to not overstress the pile. In addition to those items listed above, selected restrike driving records (as directed by the Contractor's independent Geotechnical Engineer) are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and plot of applied load versus average pile displacement based on the calculated soil properties.

4. Performance Report: Upon satisfactory completion of each dynamic load test, a Pile Performance Report shall be submitted by the Contractor's independent Geotechnical Engineer to the Designer for review and documentation. The report shall be prepared and sealed by a Professional Engineer registered in South Carolina and shall be made within five (5) working days of the completion of the dynamic load test. The report for the Pile Dynamic Analysis shall contain the following information:

   a. Bearing capacity of pile from Case: Pile Wave Analysis Program (CAPWAP) information resulting from analysis of a selected restrike blow

b. Maximum and final transferred energy, hammer system efficiency during pile installation

c. Maximum compressive stress, velocity, acceleration, and displacement

d. Maximum tensile stress in pile

e. Pile structural integrity, damage detection, extent, and location

f. Blows per minute and blow number

g. Input and reflection values of force and velocity upward and downward traveling force wave with time

h. Pile skin friction and toe resistance distribution

i. Maximum energy transferred to pile

5. The maximum allowable pile design load will be proposed by the Contractor's independent Geotechnical Engineer based upon the results of a satisfactory pile dynamic load test conducted on a pile driven as specified herein, and shall include the effects of load transfer to the soil above the foundation stratum.

6. All services of the Contractor's independent Geotechnical Engineer shall be paid for by the Contractor. The Contractor's independent Geotechnical Engineer shall be available throughout the pile driving operation to consult with the Designer when required. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Driving Analysis, shall be at the Contractor's expense. The Contractor's independent Geotechnical Engineer shall furnish all equipment necessary for the PDA pile testing including: gages, cables, drills, power source, etc.

7. The equipment to be used for dynamic testing of the pile hammer and soil performance, and for dynamic load testing of the test piles shall be either a model PAK, PAL, or PAX Pile Driving Analyzer as manufactured by Pile Dynamics, Inc., of Cleveland Ohio or approved equivalent.

C. Pile Inspection: The Contractor will provide an independent on-site inspector to monitor the installation of both test and production piles. The inspector shall work under the direct supervision of a Professional Engineer, who is registered in South Carolina, and who specializes in soil mechanics and foundation engineering. The charges for services provided by the on-site inspector will be paid for by the Contractor. Installation of all piles (test and production) shall be performed in the presence of the on-site inspector. The on-site inspector will keep a record of each pile driven to be provided to the Designer within 48 hours of installation. The on-site inspector shall notify the Designer immediately if any problems arise during pile installation or testing. The records shall include information indicated in the following Paragraph "PILE RECORDS". The Contractor shall provide any assistance required by the on-site inspector in monitoring test and production pile installation operations. All direction as required by the pile driving operation shall be the sole responsibility of the Contractor.

D. Pile Inspection by Contractor: During pile driving operations, and before the pile driving equipment is removed from the job site, the Contractor shall determine if all piles are installed as indicated in the Contract Documents. Failure to do so may require subsequent return of pile driving equipment to the project site to drive additional piles at no additional cost to the Owner.

E. Pile Records: For each pile, the Contractor's on-site pile driving inspector will compile a complete and accurate record of the pile driving operation and will submit these records to the Designer for review. Driving records for each pile shall include: date driven; pile identification number; cross section shape and pile dimensions; location; deviations from design location; original length; ground elevation; top elevation; tip elevation; type and size of hammer used; type and dimensions of driving helmet, hammer cushion (cap block), and pile cushion used; number of blows required for each foot of penetration throughout the entire length of the pile and for the final 6" of penetration; total driving time in minutes and seconds; retap data; and any other pertinent information as required or requested such as unusual driving conditions, interruptions, or delays during driving, damage to pile resulting from driving, heave in adjacent piles, redriving, weaving, obstructions, and depth and description of voids formed adjacent to the pile. Additional data required to be recorded for impact hammers include the rate of hammer operation and stroke or equivalent stroke for diesel hammers. The following preprinted forms shall be used for recording pile driving data.

*****END OF SECTION 31 62 13*****

SECTION 32 11 23

AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

1.02 RELATED SECTIONS

A. Section 01 45 00 – Quality Control

B. Section 31 00 00 – Earthwork

C. Section 32 12 16 – Asphalt Paving

1.03 REFERENCES

A. ASTM C 131 – Resistance to Degradation of Small–Size Course Aggregate by Abrasion and Impact in the Lost Angeles Machine.

B. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

C. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

D. ASTM D 3740 – Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

E. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

1.05 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

E. Testing shall be Contractor’s responsibility and performed at Contractor‘s expense by a commercial testing laboratory operating in accordance with subparagraph C above.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Graded Aggregate Base: Shall be base course material composed of crushed stone, excluding marine limestone, filled and bound with screenings, free from vegetable matter, sand, lumps or balls of clay, or other deleterious matter and conforming to Section 305 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

B. Prime Coat: Shall be EA–P Special, Emulsified asphalt, conforming to Section 407 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify subbase has been tested, is dry, and slopes and elevations are correct.

B. ON SITE OBSERVATIONS OF WORK: Owner's Representative or Engineer will have the right to require any portion of the work be completed in their presence. If the work is covered up after such instruction, it shall be exposed by Contractor for observation at no additional cost to the Owner. However, if Contractor notifies Owner such work is scheduled, and the Owner fails to appear within 48 hours, Contractor may proceed. All work completed and materials furnished shall be subject to review by the Owner, Engineer, or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

3.02 PREPARATION

A. Subbase shall be graded and shaped conforming to the lines, grades, and cross sections required and cleaned of all foreign substances prior to constructing base course. Do not place base on soft, muddy or frozen surfaces. Correct irregularities in subbase slope and elevation by scarifying, reshaping, and recompacting.

B. At the time of base course construction, subbase shall contain no frozen material.

C. Surface of subbase shall be checked by the Engineer or Project Representative for adequate compaction and surface tolerances. Ruts or soft yielding spots appearing in areas of subbase course having inadequate compaction, and areas not smooth or which vary in elevation more than 3/8 inch above or below required grade established on the plans, shall be corrected to the satisfaction of the Engineer or Project Representative. Base material shall not be placed until subbase has been properly prepared and test results have so indicated.

3.03 AGGREGATE PLACEMENT

A. Aggregate shall be placed in accordance with South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition) Section 305 and in accordance with all terms included in these specifications.

B. Level and contour surfaces to elevations and slopes indicated.

C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

F. While at optimum moisture (± 1–1/2%), compact base course with rollers capable of obtaining required density. Vibratory, flatwheel, and other rollers accepted by the Engineer may be used to obtain required compaction. Rolling shall continue until base is compacted to 98% of the maximum laboratory dry density as determined by ASTM D 1557. In–place density of the compacted base will be determined in accordance with ASTM D 6938.

3.04 PRIME COAT

A. Bituminous material for the prime coat shall be applied uniformly and accurately in quantities of not less than 0.15 gallons per square yard nor more than 0.30 gallons per square yard of base course. All irregularities in the base course surface shall be corrected prior to application of prime coat. Clean the base course of all mud, dirt, dust, and caked and loose material.

B. Do not apply prime to a wet surface nor when temperature is below 40°F in the shade. Do not apply prime when rain threatens nor when weather conditions prevent proper construction and curing of prime coat.

C. The primed base should be adequately cured before the binder or surface course is laid. In general, a minimum of 48 hours should be allowed for complete curing. Ordinarily, proper surface condition of the prime is indicated by a slight change in the shiny black appearance to a slightly brown color.

3.05 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with an acceptable 10–foot straight edge.

B. Scheduled Compacted Thickness: Within 3/8 inch.

C. Variation from Design Elevation: Within 3/8 inch.

D. Depth measurements for compacted thickness shall be made by test holes through the base course. Where base course is deficient, correct such areas by scarifying, adding base material, and recompacting as directed by the Engineer.

3.06 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control: Field observation.

B. Density and moisture testing will be performed in accordance with ASTM D 1557 and ASTM D 6938.

C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests:

1. Base Density and Thickness – One test per 5,000 square feet.

*****END OF 32 11 23*****

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface Course

B. Binder Course

1.02 RELATED SECTIONS

A. Section 01 45 00 – Quality Control

B. Section 31 00 00 – Earthwork

C. Section 32 11 23 – Aggregate Base Courses

1.03 REFERENCES

A. ASTM D 946 – Penetration–Graded Asphalt–Cement for Use in Pavement Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock Used in Engineering Design and Construction.

D. ASTM D 2726 – Bulk Specific Gravity and Density of Non–Absorptive Compacted Bituminous Mixtures.

E. ASTM D 2950 – Density of Bituminous Concrete in Place by Nuclear Methods.

F. ASTM D 1188 – Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples.

G. ASTM D 1754 – Effect of Heat and Air on Asphaltic Materials (Thin–film Oven Test).

1.04 QUALITY ASSURANCE

A. Perform work in accordance with South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

B. Mixing Plant: Conform to South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt mixture when ambient air temperature is less than that indicated in the Table nor when the surface is wet or frozen.

Lift Thickness	Min. Air Temperature, Degrees F.
1" or Less	55
1.1" to 2"	45
2.1" to 3"	40
3.1" to 4.5"	35

B. Mixture shall be delivered to the spreader at a temperature between 250 degrees F and 325 degrees F.

1.06 GUARANTEE

A. Contractor shall guarantee the quality of materials, equipment, and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by the Contractor at no cost to the Owner.

1.07 TESTING

A. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer

B. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48 hours notice prior to taking any tests.

C. Testing shall be Contractor's responsibility and shall be performed at Contractor's expense by a commercial testing laboratory operating in accordance with subparagraph A above.

D. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 - PRODUCTS

2.01 TACK COAT

A. Shall consist of asphalt binder (asphalt cement) or emulsified asphalt, conforming to Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction. Asphalt binder shall be PG64–22. The acceptable grades of emulsified asphalt are RS–1, MS–1, MS–2, HFMS–1, HFMS–2, SS–1, CRS–1, CRS–2, CMS– 2, and CSS–1.

2.02 ASPHALT BINDER AND ADDITIVES

A. Shall be PG64–22 and conform to Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

B. Anti–Stripping: Shall conform to requirements of Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

2.03 AGGREGATES

A. General: Mineral aggregate shall be composed of fine aggregate or a combination of fine and coarse aggregate. Coarse aggregate shall be that portion of the material retained on a No. 4 sieve.

Fine aggregate shall be considered that portion passing the No. 4 sieve. Fine aggregate, coarse aggregate, and any additives in combination with the specified percentage of asphalt cement shall meet the requirements of tests specified, before acceptance may be given for their individual use. Marine (Fossiliferous) limestone shall not be used.

B. Fine Aggregate: Shall conform to the requirements of Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

C. Coarse Aggregate: Shall be granite stone and conform to the requirements of Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

D. Surface Course: The surface course shall consist of fine and coarse aggregate and mineral filler uniformly mixed with hot asphalt binder in an acceptable mixing plant. The plant shall conform to South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction. The gradations, asphalt content and air voids shall be the following: Intermediate or Binder Course:

TYPE C	
Square Sieve	% Passing
3/4 inch	100
1/2 inch	97 – 100
3/8 inch	83 – 100
No. 4	58 – 80
No. 8	42 – 62
No. 30	20 – 40
No. 100	8 – 20
No. 200	3 – 9
% Asphalt Binder	5.0 – 6.8
Air Voids, %	3.5 – 4.5

E. The mineral aggregates and asphalt binder shall be combined in such proportions the composition by weight of the finished mixture shall be within the following range limits:

TYPE B	
Sieve Designation	Percentage by Weight Passing
1 inch	100
3/4 inch	90 – 100
1/2 inch	75 – 90
3/8 inch	64 – 80
No. 4	38 – 54
No. 8	22 – 36
No. 30	8 – 22
No. 100	3 – 10
No. 200	2 – 8
% Asphalt Binder	4 – 6
Air Voids, %	3.5 – 4.5

2.04 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 – Quality Control and Section 01 45 23 – Testing and Inspecting Services.

B. Submit proposed mix design for review prior to beginning of work.

C. Test samples in accordance with the requirements of these specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

A. On–Site Observations: Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence. If work is covered up after such instruction, it shall be exposed by the Contractor for observation at no additional cost to Owner. However, if Contractor notifies Engineer such work is scheduled, and Engineer fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials, which do not conform to requirements of specifications, shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

   Contractor shall give the Owner, Project Engineer or Project Representative a minimum of 48 hours notice for all required observations or tests.

B. Contractor shall verify base has been tested, is dry, and slopes and elevations are correct.

3.02 PERPARATION

A. Apply tack coat in accordance with Section 401 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction. Rate of application shall be 0.05 to 0.15 gallons per square yard of surface.

B. Work shall be planned so no more tack coat than is necessary for the day's operation is placed on the surface. All traffic not essential to the work should be kept off the tack coat.

C. Apply tack coat to contact surfaces of curbs and gutters. Apply in manner so exposed curb or gutter surfaces are not stained.

D. Coat surfaces of manhole frames and inlet frames with oil to prevent bond with asphalt pavement. Do <u>not</u> tack coat these surfaces.

3.03 PLACEMENT

A. Construction shall be in accordance with Sections 401, 402, and 403 of the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

B. Asphaltic concrete shall not be placed on a wet or frozen surface.

C. Compaction shall commence as soon as possible after the mixture has been spread to the desired thickness. Compaction shall be continuous and uniform over the entire surface. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks. Compaction rolling shall be complete before material temperature drops below 175° F.

D. Areas of pavement with deficient thickness or density shall be removed and replaced at no additional cost to the Owner.

3.04 TOLERANCES

A. General: All paving shall be subject to visual and straightedge evaluation during construction operations and thereafter prior to final acceptance. A 10–foot straightedge shall be maintained in the vicinity of the paving operation at all times for the purpose of measuring surface irregularities on all paving courses. The straightedge and labor for its use shall be provided by the Contractor. The surface of all courses shall be checked with the straightedge as necessary to detect surface irregularities. Irregularities such as rippling, tearing or pulling, which in the judgment of the Engineer indicate a continuing problem in equipment, mixture or operating technique, will not be permitted to recur. The paving operation shall be stopped until appropriate steps are taken by the Contractor to correct the problem.

B. Flatness: All irregularities in excess of 1/8 inch in 10 feet for surface courses and 1/4 inch in 10 feet for intermediate courses shall be corrected.

C. Variation from Design Elevation:

1. General Paving: Less than 1/4 inch.

2. Accessible Routes: Shall not exceed 1/4 inch. However, accessible routes shall not exceed maximum ADA allowable slopes. Contractor shall remove and replace any and all portions of the accessible route that exceed maximum ADA allowable slopes.

D. Scheduled Compacted Thickness: Within 1/4 inch per lift.

E. Pavement Deficient in Thickness: When measurement of any core indicates the pavement is deficient in thickness, additional cores will be drilled 10 feet either side of the deficient core along the centerline of the lane until the cores indicate the thickness conforms to the above specified requirements. A core indicating thickness deficiencies is considered a failed test. Pavement deficient in thickness shall be removed and replaced with the appropriate thickness of materials. If the Contractor believes the cores and measurements taken are not sufficient to indicate fairly the actual thickness of the pavement, additional cores and measurements will be taken, provided the Contractor will bear the extra cost of drilling the cores and filling the holes in the roadway as directed.

3.05 FIELD QUALITY CONTROL

A. Acceptance of the in–place density of the binder and surface courses shall be in accordance with the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

B. Density Testing: Performed in accordance with ASTM D–2726 and ASTM D–2950. Core samples for each day's operation shall be taken, tested and results reported to the Engineer the following day. The areas sampled shall be properly restored by the Contractor at no additional cost to the Owner. Nuclear gauge tests shall be taken during the asphaltic concrete placement.

1. The pavement core and nuclear gauge densities shall range between 94% and 96% of the theoretical maximum density.

C. Temperature:

1. Asphaltic concrete shall not exceed 325 degrees F at any time.

2. Asphaltic concrete shall not be placed once the temperature of the mix falls below 250 degrees F or the delivered temperature is more than 15 degrees F below the batch plant's delivery ticket.

3. Temperature at time of loading shall be recorded on the truck delivery ticket.

D. Frequency of Tests:

1. Asphaltic Concrete – One test for each 250 tons placed.

a. Asphalt extraction and gradation test.

b. Core Sample

2. Field determination of density by nuclear method every 5,000 square feet during construction of the asphaltic concrete binder/surface course.

*****END OF 32 12 16*****

SECTION 32 16 19

SIDEWALKS and MISCELLANEOUS CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Sidewalks, Slabs on Grade, Trench Drains and Miscellaneous Concrete

1.02 REFERENCES

A. AASHTO M 182 – Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

B. ASTM A1064/A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

C. ASTM A615/A615M – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

D. ASTM C 1116/C 1116M – Standard Specification for Fiber-Reinforced Concrete

E. ASTM C143/C143M – Standard Test Method for Slump of Hydraulic-Cement Concrete

F. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete

G. ASTM C 172/C172M – Standard Practice for Sampling Freshly Mixed Concrete

H. ASTM C173/C173M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

I. ASTM C231/C231M – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

J. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

K. ASTM C31/C31M – Standard Practice for Making and Curing Concrete Test Specimens in the Field

L. ASTM C920 – Standard Specification for Elastomeric Joint Sealants

M. ASTM C94/C94M – Standard Specification for Ready-Mixed Concrete

N. ASTM D1751 – Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

O. ASTM D1752 – Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

P. ASTM D5893/D5893M – Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

Q. ICC A117.1 COMM – Standard and Commentary Accessible

1.03 QUALITY ASSURANCE

A. Perform work in accordance with the South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition).

1.04 EQUIPMENT, TOOLS AND MACHINES

A. Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Owner access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. Prepare and protect the underlying material so that it is entirely free of frost when the concrete is deposited. Heat ingredients as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating must be approved. Use only aggregates that are free of ice, snow, and frozen lumps before entering the mixer. Provide covering or other means as needed to maintain the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

B. The temperature of the concrete as placed must not exceed 85 degrees F except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 95 degrees F at any time.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Provide concrete conforming to the applicable requirements of South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition) Sections 701, 702, and 703 except as otherwise specified. Concrete must have a minimum compressive strength of 5000 psi at 28 days. Size of aggregate must not exceed 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

1. Air Content: Use concrete mixtures that have an air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2. Slump: Use concrete with a slump of 3 inches plus or minus 1 inch for hand placed concrete or 1 inch plus or minus 1/2 inch for slip formed concrete as determined in accordance with ASTM C143/C143M.

3. Reinforcement Steel: Use reinforcement bars conforming to ASTM A615/A615M. Use wire mesh reinforcement conforming to ASTM A1064/A1064M.

4. Fiber-Reinforced Concrete: All cast-in-place concrete shall include micro-synthetic fibers in accordance with ASTM C1116/C1116M at a dosage rate of 1.5 lbs/yd3. Fibers shall be MasterFiber® M 100 by BASF, PSI Fiberstrand F by Euclid Chemical, SikaFiber® PPM 150 by Sika, or approved equal. Fibers shall be added at the batch plant and uniformly dispersed in concrete mixture at a dosage rate recommended by the manufacturer.

2.02 CONCRETE CURING MATERIALS

A. Impervious Sheet Materials: Use impervious sheet materials conforming to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

B. Burlap: Use burlap conforming to AASHTO M 182.

C. White Pigmented Membrane-Forming Curing Compound: Use white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.03 CONCRETE PROTECTION MATERIALS

A. Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.04 JOINT FILLER STRIPS

A. Contraction Joint Filler for Curb and Gutter: Use hard-pressed fiberboard joint filler for curb and gutter.

B. Expansion Joint Filler, Premolded: Unless otherwise indicated, use 1/2-inch-thick premolded expansion joint filler conforming to ASTM D1751 or ASTM D1752.

2.05 JOINT SEALANTS

A. Use cold-applied joint sealant conforming to ASTM C920 or ASTM D5893/D5893M.

2.06 FORM WORK

A. Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

1. Wood Forms: Use forms that are surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.

2. Steel Forms: Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 10 feet and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

3. Sidewalk Forms: Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

4. Biodegradable Form Release Agent: Use form release agent that is colorless and biodegradable and that is composed of at least 87 percent biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

PART 3 - EXECUTION

3.01 SUBGRADE PERPARATION

A. Construct subgrade to the specified grade and cross section prior to concrete placement.

1. Subgrade: Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

2. Maintenance of Subgrade: Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.02 FORM SETTING

A. Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil or biodegradable form release agent each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

1. Set forms with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10-foot-long section. After forms are set, grade and alignment must be checked with a 10-foot straightedge. Do not remove side forms less than 12 hours after finishing has been completed.

3.03 CONCRETE PLACEMENT AND FINISHING

A. Formed concrete: Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

B. Concrete Finishing: After straight edging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

C. Edge and Joint Finishing: Finish all slab edges, including those at formed joints, with an edger having a radius of 1/8 inch. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

D. Surface and Thickness Tolerances: Finished surfaces must not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.04 JOINTS

A. Construct joints to divide the surface into rectangular areas. Space transverse contraction joints as indicated on the drawings or per typical construction standards if not indicated. Joints shall be continuous across the slab. Construct longitudinal contraction joints along the centerline of all slabs as indicated. Construct transverse expansion joints as shown.

1. Contraction Joints: Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 1/8-inch blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

2. Expansion Joints: Form expansion joints using 1/2-inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 1/8 inch. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 50 degrees F. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces. Incorporate waterstop and joint filler into a continuous joint where noted.

3.05 CURING AND PROTECTION

A. General Requirements

1. Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

a. Mat Method: Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 6 inches. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

b. Impervious Sheeting Method: Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. Use sheeting that is not less than 18-inches wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

c. Membrane Curing Method: Apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Do not allow concrete surface to dry before application of the membrane. If drying has occurred, moisten the surface of the concrete with a fine spray of water and apply the curing compound as soon as the free water disappears. Apply curing compound in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. Apply the second coat in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied by the method and at the coverage specified above. Respray areas where the curing compound is damaged by subsequent construction operations within the curing period. Take precautions necessary to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. Tightly seal the top of the joint opening and the joint groove at exposed edges before the concrete in the region of the joint is resprayed with curing compound. Use a method used for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Adequately protect concrete surfaces to which membrane-curing compounds have been applied during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

2. Backfilling: After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3. Protection: Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

4. Protective Coating: Apply a protective coating of linseed oil mixture to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Moist cure concrete to receive a protective coating.

a. Application: Complete curing and backfilling operation prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Spray apply at a rate of not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

b. Precautions: Do not heat protective coating by direct application of flame or electrical heaters and protect the coating from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Do not apply material at ambient or material temperatures lower than 50 degrees F.

3.06 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

A. General Requirements: Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

B. Concrete Testing

1. Strength Testing: Take concrete samples in accordance with ASTM C172/C172M not less than once a day nor less than once for every 250 cubic yards of concrete placed. Mold cylinders in accordance with ASTM C31/C31M for strength testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

2. Air Content: Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Use ASTM C231/C231M with concretes and mortars made with relatively dense natural aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing foreman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3. Slump Test: Perform two slump tests on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

C. Thickness Evaluation: Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

D. Surface Evaluation: Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.07 SURFACE DEFICIENCIES AND CORRECTIONS

A. Thickness Deficiency: shall be in accordance South Carolina Department of Transportation Standard Specifications for Highway Construction (Latest Edition) Section 702.

B. Appearance: Exposed surfaces of the finished work will be inspected by the Owner and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.

*****END OF 32 16 19*****

SECTION 32 17 23

THERMOPLASTIC PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Striping shall consist of furnishing and applying traffic line thermoplastic markings in accordance with the contract drawings and specifications, and the requirements of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

1.02 QUALITY ASSURANCE

A. Material and equipment shall be standard product of a manufacturer who has manufactured them for a minimum of 2 years and who provides published data on quality and performance of the product.

1.03 GUARANTEE

A. Contractor shall guarantee the quality of materials and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

PART 2 - PRODUCTS

2.01 THERMOPLASTIC

A. Thermoplastic material shall be in conformance with Section 627 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

2.02 EQUIPMENT

A. The traveling traffic stripe equipment shall be adaptable to traveling at a uniform, predetermined rate of speed both uphill and downhill in order to produce a uniform application of material. Machine shall be of the extrusion type, capable of satisfactorily applying material with a uniformity of feed to provide a uniform thickness. Each tank shall be equipped with a mechanical agitator. Each machine shall be equipped with satisfactory cutoff valves which will apply broken or skip lines automatically. Each applicator shall have a mechanical bead dispenser operating simultaneously and distribute beads in a uniform pattern at the rate specified. Each applicator shall also be equipped with suitable line guides consisting.

2.03 GLASS BEADS

A. Glass beads shall be in conformance with Section 627 of the South Carolina Department of Transportation 2007 Standard Specifications for Highway Construction.

2.04 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

PART 3 - EXECUTION

3.01 STRIPING

A. Cleaning of Surface – Surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and other foreign matter before application of the stripe.

B. Alignment – Traffic stripes shall be of the length, width and placement specified. On sections where no previously applied markings are present, Contractor shall establish control points, satisfactory to Engineer, spaced at intervals insuring accurate locations of the stripe.

C. Application – Traffic Stripe shall be applied by machine except for special areas and markings not adaptable to machine application, in which case, hand application will be permitted.

D. Protective Measures – When marking is completed around traffic, Contractor shall furnish and place all warning and directional signs necessary to direct, control, and protect traffic during the striping operations. Warning signs shall be set up before the beginning of each operation and extra signs shall be kept well ahead of equipment. When necessary, a pilot car shall be used to protect both traffic and the operation. The freshly applied stripe shall be protected by cones or other satisfactory devices. All stripe damaged by traffic, or pavement marked by traffic crossing wet material, shall be repaired or corrected as specified below.

E. Tolerance and Appearance – No stripe shall be less than the specified width. No stripe shall exceed the specified width by more than 1/2 inch. Alignment of the stripe shall not deviate from intended alignment by more than one inch on tangents and on curves up to and including one degree. On curves exceeding one degree, alignment of the stripe shall not deviate from the intended alignment by more than 2 inches.

Continued deviation from stated dimensions will be cause for stopping the Work and removing nonconforming stripe.

All stripes and segments of stripes shall present a clean cut, uniform and workmanlike appearance. All markings which fail to have a uniform, satisfactory appearance, either day or night, shall be corrected at the Contractor’s expense.

F. Corrective Measures – All traffic stripe which fails to meet the Specifications, permissible tolerances and appearance requirements, or is marred or damaged by traffic or from other causes, shall be corrected at Contractor's expense. In all instances, when it is necessary to remove marking, it shall take place by means satisfactory to Engineer, which will not damage the underlying surface of pavement. When necessary to correct a deviation which exceeds permissible tolerance in alignment, the portion of stripe so affected shall be removed plus an additional 25 feet in each direction, and a new stripe then marked in accordance with these specifications.

G. Acceptance – All sections of marked stripe, words and symbols which have dried to the extent marking will not be picked up or marred by tires of vehicles, and which have been placed in reasonably close conformity with Plans and Specifications, will be accepted, and Contractor will be relieved of responsibility of maintenance on such sections.

*****END OF 32 17 23*****

SECTION 32 92 00
TURF AND GRASSES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Seeding, planting grass, and fertilizing graded areas behind the structures, pipeline rights–of–way, roadway shoulders, and other disturbed areas.

B. Seed protection.

C. Maintaining seeded areas until final acceptance.

1.02 RELATED WORK

A. Civil and Landscape plans and specifications.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed in original containers showing analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, and location of packaging. Damaged packages are not acceptable. Store in cool, dry locations away from contaminants.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Damaged bags are not acceptable. Store in cool, dry locations away from contaminants.

C. Deliver sod on pallets.

D. All material shall be acceptable to Engineer prior to use.

1.04 PLANTING DATES

A. This specification provides for establishment of a permanent grass cover between the dates of March 1 and September 30. If finished earth grades are not completed in time to permit planting and establishment of permanent grass during the favorable season between dates specified above unless otherwise accepted, Contractor will be required to plant a temporary cover to protect new graded areas from erosion and to keep windborne dust to a minimum. The temporary cover shall be planted between October 1 and February 28 unless otherwise permitted.

1.05 MEASUREMENT AND PAYMENT - SPECIAL

A. When the season or stage of project is such results of grassing work cannot be determined, conditional acceptance will be made on work completed. When conditional acceptance is made for items of work covered, Contractor shall be entitled to 50% of bid price for the actual work placed and shall receive remaining 50% of bid price when final acceptance is made. Conditional acceptance shall not apply to the remaining items of work, and full bid price payment shall be made when work is acceptably placed and completed in accordance with specifications.

B. Payment for grassing will be made at contract lump sum price for Turf and Grasses and such payment shall constitute full compensation for furnishing and placing seed and fertilizer or sod where directed and protecting and maintaining seed and sod in all graded and disturbed areas.

PART 2 - PRODUCTS

A. Contractor shall submit source and species certification documents to Engineer and Owner's Representative for review prior to installation. Supply complete information on all analysis/test methodologies and results; laboratory certifications, manufacturer's specifications, and agency approvals to the Landscape Architect/Project Engineer prior to placement of soil mixtures. In addition, provide the Landscape Architect/Project Engineer with thoroughly mixed sample of soil mixes for acceptance prior to placement. Landscape Contractor shall make modifications and improvements to soil mixes deemed necessary by the soil analysis to meet requirements specified here in before, and to ensure proper growing medium for plant material.

2.02 SEED

A. All seed shall conform to State Laws and requirements and regulations of the State Department of Agriculture.

B. The varieties of seed, as specified in Section 2.2, shall be individually packaged or bagged, and tagged to show name of seed, net weight, origin, germination, lot number, and other information required by the State Department of Agriculture.

C. Engineer reserves the right to test, reject, or accept all seed before seeding.

2.03 SEEDING SCHEDULE

A.

SEED	RATE	PLANTING DATES
Bermuda	15–lbs/acre	March 1 – September 30
Rye	75–lbs/acre	October 1 – February 28

2.04 FERTILIZER

A. Commercial fertilizer of accepted type, conforming to State fertilizer laws at the rate as recommended by soils test.

2.05 LIME

A. Agricultural grade, ground limestone at the rate as recommended by soils test.

2.06 SOD

A. Sod shall be premium grade, densely rooted, good quality grass of the species and certified variety as shown on the plans, free from noxious weeds with no surface soil being visible. The sod shall be obtained from areas where the soil is reasonably fertile. Sod of specified species shall be grown from seed or sprig with not less than 95 percent germination, 85 percent pure seed, and not more than 0.5 percent weed seed. The sod shall be machine cut to a uniform soil thickness that shall contain practically all of the dense root system and not be less than 1– inch thick.

B. Before cutting, sod shall be mowed to a height of not less than 1–1/2-inches or more than 2-inches. Sod shall be cut in minimum uniform widths of 12-inches and lengths of 24 inches.

C. Sod shall be delivered to site in a fresh, moist condition with healthy green foliage. It shall be unloaded from delivery trucks on pallets or in rolls and placed in final position within 24 hours of delivery. Sod shall be protected from wind and sun and shall not be allowed to dry out before planting.

D. Sod shall be strong enough to support its own weight and retain its size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.

2.07 ACCESSORIES

A. Straw Mulch: Oat or wheat straw, reasonably free from weeds, foreign matter detrimental to plant life, and in dry condition.

B. Excelsior Mulch: Excelsior mulch shall consist of wood fibers cut from sound, green timber. The average length of fibers shall be 4 to 6 inches. Cut shall be made in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood to cause splintering of fibers when weathering in order to provide adherence to each other and to soil.

C. Wood cellulose fiber shall be made from wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer. It shall remain in uniform suspension in water under agitation and blend with grass seed and fertilizer to form a homogenous slurry. Mulch fibers shall intertwine physically to form a strong moisture holding mat on the ground surface and allow rainfall to percolate into underlying soil. The mulch shall be heat processed to contain no germination or growth-inhibiting factors. It shall be dyed (non-toxic) an appropriate color to facilitate metering of material.

2.08 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

PART 3 - EXECUTION

3.01 PREPARATION

A. Areas to be seeded shall be made smooth and uniform and shall conform to the finished grade indicated on plans.

B. Remove foreign materials, plants, roots, stones, and debris from surfaces to be seeded.

C. Grassing areas, if not loose, shall be loosened to a minimum depth of 3 inches before fertilizer, seed or sod is applied.

D. Amendments to soils shall be incorporated into loosened 3-inch top soil layer as recommended by soils tests.

E. Contractor shall provide Topsoil Analysis Tests performed by a State Agricultural Experiment Station, Soil and Water Conservation District, State University, or other qualified private testing laboratory, as acceptable to Landscape Architect/Project Engineer. Soils test shall identify existing pH and nutrient levels, as well as recommended adjustments based on the type of grass to be installed.

3.02 STAND OF GRASS

A. Before acceptance of seeding, sodding, or sprigging is performed for the establishment of permanent vegetation, Contractor will be required to produce a satisfactory stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and winter weather and be capable of re- establishment in spring.

B. Before acceptance of seeding is performed for the establishment of temporary vegetation, Contractor will be required to produce a stand of grass sufficient to control erosion for a given area and length of time before the next phase of construction or establishment of permanent vegetation is to commence.

3.03 SEEDING DATES

A. Seeding and sprigging shall be performed during periods and at rates specified in their respective schedules. Seeding and sprigging work may, at discretion of Contractor, be performed throughout the year using schedule prescribed for given period. Seeding and sprigging work shall not be conducted when the ground is frozen or excessively wet. Contractor will be required to produce a satisfactory stand of grass regardless of the period of year work is performed.

3.04 APPLYING LIME AND FERTILIZER

A. Following advance preparation and placing selected material for shoulders and slopes, lime and fertilizer, if called for based on soil tests, shall be spread uniformly over the designated areas, and shall be thoroughly mixed with the soil to a depth of approximately 2 inches. Fertilizer and lime shall be applied at the rate recommended by required soils test. Unless otherwise provided, lime will not be applied for temporary seeding. In all cases where practicable, acceptable mechanical spreaders shall be used for spreading fertilizer. On steep slopes subject to slides and inaccessible to power equipment, the slopes shall be adequately scarified. Fertilizer may be applied on steep slopes by hydraulic methods as a mixture of fertilizer and seed. When fertilizer is applied with combination seed and fertilizer drills, no further incorporation will be necessary. The fertilizer and seed shall be applied together when Wood Cellulose Fiber Mulch is used. Any stones larger than 2-1/2 inches in any dimension, larger clods, roots, or other debris brought to the surface shall be removed.

3.05 SEEDING

A. Seed shall be sown within 24 hours following application of fertilizer and lime and preparation of the seedbed as specified in Section 3.4. Seed shall be uniformly sown at rate specified by the use of acceptable mechanical seed drills. Rotary hand seeders, power sprayers or other satisfactory equipment may be used on steep slopes or on other areas inaccessible to seed drills.

B. Seeds shall be covered and lightly compacted by means of cultipacker or light roller if the drill does not perform this operation. On slopes inaccessible to compaction equipment, the seed shall be covered by dragging spiked chains, by light harrowing or by other satisfactory methods.

C. Apply water with fine spray immediately after each area has been sown.

D. Do not sow seed when ground is too dry, during windy periods or immediately following a rain.

E. If permitted by the special provisions, wood cellulose fiber mulch or excelsior fiber mulch may be used.

3.06 SEED PROTECTION (STRAW MULCH)

A. All seeded areas seeded with permanent grasses shall be uniformly mulched in a continuous blanket immediately following seeding and compacting operations, using at least 2 tons of straw per acre.

3.07 SEED PROTECTION (EXCELSIOR MULCH)

A. Seed shall be sown as specified in Section 3.5. Within 24 hours after covering of seed, excelsior mulch shall be uniformly applied at the rate of 2 tons per acre. The mulch may be applied hydraulically or by other acceptable methods. Should the mulch be placed in a dry condition, it shall be thoroughly wetted immediately after placing. Engineer may require light rolling of the mulch to form a tight mat.

3.08 SEED PROTECTION (WOOD CELLULOSE FIBER MULCH)

A. After the lime has been applied and ground prepared as specified in Section 3.4, wood cellulose fiber mulch shall be applied at a rate of 1,500 pounds per acre in a mixture of seed and fertilizer. Hydraulic equipment shall be used for application of fertilizer, seed, and slurry of the prepared wood pulp. This equipment shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed, and water. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which will provide an even distribution of slurry on various areas to be seeded. The slurry tank shall have a minimum capacity of 1,000 gallons.

Seed, fertilizer, wood pulp mulch, and water shall all be combined into the slurry tank for distribution of all ingredients in one operation by hydraulic seeding method specified herein. Materials shall be combined in a manner recommended by the manufacturer. The slurry mixture shall be regulated so amounts and rates of application shall result in a uniform application of all materials at rates not less than amount specified. Using the color of wood pulp as a guide, equipment operator shall spray prepared seedbed with a uniform visible coat. The slurry shall be applied in a sweeping motion, in an arched stream to fall like rain, allowing wood fibers to build upon each other until an even coat is achieved.

3.09 SODDING

A. Sod shall be placed between March 1st and December 1st. However, if sod is to be placed during periods of temperatures over 90 degrees F., the Contractor shall take extra care for quick placement of sod with adequate, consistent watering necessary to ensure sod thrives as planted.

B. Sod shall be placed within 24 hours of cutting.

C. Place top elevation of sod 1/2 inch below adjoining paving or curbs.

D. All areas to be sodded shall be brought to the proper line grade or cross section as was existing prior to construction. Sod shall be placed so, upon completion, edges of sodded areas will be smooth and will conform to the proposed finished grade. Sod shall be laid smooth, edge to edge, with staggered joints. Sod shall be immediately pressed firmly into contact with the sod bed by tamping or rolling, to eliminate any air pockets. A true and even surface shall be provided, to insure knitting without displacement of the sod or deformation of the sodded areas surfaces. Do not stretch or overlap sod pieces. Following compaction, screened soil of good quality shall be used to fill all cracks. Excess soil shall be worked into the grass with rakes or other suitable equipment. On slopes steeper than 3 to 1, sod shall be fastened in place with suitable wood or metal pins to hold the sod in place. Any damage by erosion or other causes occurring after completion of grading operations shall be repaired, before commencing with the sodding operations.

E. Immediately before sodding, moisten topsoil with a fine spray to a minimum 1- inch depth. Sod shall not be laid on dry or powdery soil.

F. Sod shall be moist when laid and placed on moist ground. The sod shall be carefully placed by hand, beginning at the toe of slopes and working upwards. The length of strips shall be at right angles to flow of surface water. All joints shall be tightly butted and end joints shall be staggered at least 12 inches. Sod shall be immediately pressed firmly into the ground by tamping or rolling. Fill all joints between strips with fine screened soil. Sod on slopes shall be pegged with sod pegs to prevent movement.

G. Within two hours after sod has been placed, thoroughly water to a minimum depth of 4-inches. After sod and soil have dried, roll sodded areas to ensure good bond between sod and soil and to remove depressions and irregularities. Roll sodded areas with a roller not exceeding 150 lbs. per foot of roller width.

PART 4 - MAINTENANCE, WARRANTY AND ACCEPTANCE

4.01 MAINTENANCE

A. Maintain grassed surfaces until final acceptance. Maintenance shall consist of providing protection against traffic, watering to ensure uniform seed germination and to keep surface of soil damp, and repairing any areas damaged as a result of construction operations or erosion. Maintenance shall also include, but is not limited to, watering, weeding, cultivating, removal of dead material, lawn mowing, fertilizing, and other necessary operations.

B. The Contractor shall maintain all proposed plantings until the date of substantial completion issued by the Owner.

4.02 WARRANTY

A. All grassed areas shall be guaranteed by Contractor to be alive and healthy for a one-year period from date of substantial completion issued by the Owner. A final walk through with the Owner shall be conducted at end of warranty period to determine if any areas require replanting. At end of warranty period, sod shall show evidence of rooting to underlying soil and shall have no competitive weed growth from either the sod or from between sod joints.

B. Any grassed area which is dead or not showing satisfactory growth shall be replaced at Contractor's expense at the end of warranty period. All replacement shall be of original quality. Replacement required because of vandalism, excessive use, or other causes beyond the control of Contractor are not part of this contract.

4.03 ACCEPTANCE

A. Before acceptance of seeding performed for the establishment of permanent vegetation, Contractor will be required to produce a stand of perennial grass whose root system shall be developed sufficiently to survive dry periods and winter weather and be capable of reestablishment in spring.

B. A minimum coverage of 80% density over 100% of the disturbed area is required for seeded areas before project acceptance. Sprig and sod areas shall have 95% coverage over 100% of the disturbed area prior project acceptance.

*****END OF 32 92 00*****

SECTION 33 05 10

MARINA PIPING AND EQUIPMENT SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. MARINA PIPING AND EQUIPMENT SYSTEMS consists of furnishing transportation, labor, materials, and equipment to furnish, install, and test the dock potable water, fire water and sewer pump out system(s), including piping, valves, hose bibbs, fire hose and fire extinguisher cabinets, gangway piping, hose connections, and sewage equipment as specified and as indicated on the mechanical Drawings for the docks.

1.2 RELATED WORK

A. Marina Electrical Work - Section 26 27 29

B. Aluminum Floating Dock Systems - Section 35 51 14

C. Gangway System - Section 05 60 00

D. Marina Piping and Equipment Systems - Section 33 05 10

1.3 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.

B. American National Standards Institute (ANSI)

C. American Society for Testing and Materials (ASTM)

1.	ASTM A351/A31M	Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
2.	ASTM A403/A403M	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
3.	ASTM C 547	Standard Specification for Mineral Fiber Pipe Insulation
4.	ASTM C 533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
5.	ASTM C 591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
6.	ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
7.	ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

D. American Water Works Association (AWWA)

1. AWWA C651 Disinfecting Water Mains

E. Factory Mutual (FM)

F. Manufacturers Standardization Society of The Valve And Fittings Industry

1. MSS SP-58 Pipe Hangers and Supports – Materials, Design and Manufacture

2. MSS SP-69 Pipe Hangers and Supports – Selection and Application

G. National Fire Protection Association (NFPA)

1. NFPA 14 Installation of Standpipe and Hose Systems

2. NFPA 303 Marinas and Boatyards

H. Reference Specifications (Rs) Are The 2009 Edition of the “Greenbook”, Standard Specifications For Public Works Construction

I. Underwriters Laboratories Incorporated (UL)

1.4 SUBMITTALS

A. Provide manufacturer's data including but not limited to drawings, connection details, manuals, UL listings, FM approvals, disinfection reports, bacteriological reports, installation instructions and/or catalog cut sheets for the following:

1. Pipe, fittings and valves

2. Joints and couplings

3. Hoses and hose connections

4. Fire extinguisher cabinets

5. Fire extinguishers

6. Pipe hangers and supports

7. Pipe insulation and jacketing

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspect materials delivered to site for damage. Unload and store with minimum handling. Keep inside of pipes, fittings and equipment free of dirt and debris.

B. Pipes:

1. Store pipe in stock piles built on a flat base.

2. Keep rubber gaskets from excessive heat and free from oil and grease.

C. Store fittings, cabinets, pump out units, sewer hydrant equipment, and valves on wooden platforms above ground.

D. Handle pipe, fitting, valves, and other accessories in such manner as to ensure delivery to the docks and installation location in a sound undamaged condition.

PART 2 - PRODUCTS

2.1 WATER SYSTEMS MATERIALS

A. The materials and equipment to be furnished under this Section shall be standard products of the manufacturer. Where two or more units of the same equipment are required, units shall be the product of a single manufacturer. Materials shall be delivered to the jobsite new and unused. All materials shall be weatherproof and suitable for a corrosive marine environment. No ferrous materials shall be used unless specified or indicated on the plans.

B. Hangers, straps, brackets, fasteners, and appurtenances shall be 316 stainless steel or galvanized steel as indicated on the Drawings.

C. Potable Water Piping: The pipe material for installation is noted on Drawings. Fittings, flanges, and appurtenances shall be compatible with the pipe.

1. Stainless Steel (SS) Piping:

    a. SS piping shall be Schedule 40, Type 316 Stainless Steel.

2. Cross-linked Polyethylene (PEX) Piping:

    a. PEX piping shall be cross-linked polyethylene with Sea Tech fittings or approved equal.

    b. Shut off valves in dock potable water system shall be Sea Tech ball valves or as noted above in "Potable Water Piping".

    c. Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation for potable water service.

3. High Density Polyethylene (HDPE) Piping:

    a. HDPE piping shall be SDR-9 or SDR-11, per ASTM D3035 and ASTM F714 as noted.

    b. Joints shall be butt fuse welded.

4. Flexible Hose:

    a. Flexible Hose and fitting materials shall be compatible with potable water and suitable for 24-hour contact with chlorine sterilization solution in the hose interior, and with seawater and sunlight on the hose exterior.

    b. Factory assembled lengths with 150 psi working pressure and marine stainless steel couplings each end.

5. Hose Bibbs:

    a. Dock hose bibb stations shall be 3/4-inch Arrowhead "Arrow-Breaker" with integral

vacuum breaker or approved equal.

D. Firewater Piping: The pipe material for installation on the docks is noted on Drawings. Fitting, flanges, and appurtenances shall be compatible with the pipe.

1. High Density Polyethylene (HDPE) Piping:

a. HDPE piping shall be SDR-9, per ASTM D3035 and ASTM F714.

b. Joints shall be butt fuse welded.

2. Stainless Steel (SS) Piping:

a. SS piping shall be Schedule 40, Type 316 Stainless Steel.

3. Flexible Hose:

a. Flexible Hose and fitting materials shall be compatible with firewater and suitable for 24-hour contact seawater and sunlight on the hose exterior.

b. Factory assembled lengths with 250 psi working pressure and marine stainless steel couplings each end.

E. Fire Extinguishers and Cabinets:

1. Fire extinguishers shall be as noted on the Drawings.

F. Fire Hose Standpipe:

1. Fire hose standpipe valve shall be Potter Roemer 4065 or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Material and equipment shall be worked into a complete, convenient, and economical system or systems; all apparatus, parts, materials, and accessories which are necessary to accomplish this result shall be furnished and worked into place. Manufacturer's instructions, written or otherwise, shall be followed, unless superseded herein.

B. Piping shall follow the general arrangement shown on Drawings. Provision for expansion and contraction of pipe lines shall be made where necessary. Piping shall be run essentially as indicated on Drawings, care being taken to avoid interference with other piping, conduit, or equipment. The location of piping to be run on gangway and dock shall be carefully coordinated with electrical conduits specified, other utility piping and equipment location. Before jointing and erection of piping, thoroughly clean interiors of pipe, and components. Before making final equipment connections, blow out each system with compressed air at 100 psig or more.

C. The fire water system material, equipment and installation shall comply with NFPA 14 and NFPA 303. Signage for the fire department connections shall be as indicated on the Drawings and as approved by the Engineer and the Fire Marshal.

D. Pipe, fittings, valves, and accessories will be carefully inspected by the Contractor before and after installation and those found defective shall be replaced. Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories and maintain in a clean condition. Cut pipe accurately to measurements established at the site and work into place without springing or forcing. Replace by one of the proper dimension any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Provide proper facilities for positioning piping into installation location. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of piping.

3.2 FIELD TESTS AND INSPECTIONS

A. The potable water, firewater and sewer systems shall be subjected to hydrostatic test. The over-water and in-ground sewer systems shall be tested. Each system may be tested as a unit or in sections, subject to approval by the Engineer. Prior to application of the test pressure, install a calibrated test pressure gage in each system to indicate any loss in pressure occurring during the test. Apply and maintain the test pressure as noted on the Drawings and in conformance with the agencies having jurisdiction, during which time there shall be no evidence of leakage as detected by a reduction in test pressure. Should a reduction occur, leaks shall be located and repaired, and the test repeated. Test pressure shall be as stated on Drawings. All equipment and apparatus required for the tests shall be furnished by the Contractor.

B. The Engineer will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in the utility applicable section. Contractor shall be able to produce evidence, when required, that each item of work has been constructed in accordance with the Drawings and Specifications.

3.3 STERILIZATION OF POTABLE WATER SYSTEMS

A. A solution of chlorine and water containing not less than 50 parts per million of free chlorine shall be injected into the potable water system in such a manner as to ensure that the entire system is completely filled with the solution. Disinfection shall be in conformance with AWWA C651. After injection, the system shall be isolated, and the solution held in retention for a minimum period of 24 hours. After satisfactory sterilization has been effected, the system shall be flushed with fresh water until the chlorine level is within acceptable limits as determined by the Health Department. The Contractor shall arrange for sampling and testing water for sterilization/chlorination and system flush with the Health Department. It shall be the Contractor's responsibility to ensure that the water in the system is not used for human consumption during the sterilization process.

B. Chlorine solution shall not be injected into the fire water system.

END OF SECTION 33 05 10

SECTION 33 11 00

UTILITY SYSTMES – WATER/SEWER

PART 1 - GENERAL

1.01 DESCRIPTION

A. The water and sewer utility systems shall be constructed in accordance with the specifications of the operating utility. For this project, Grand Strand Water and Sewer Authority (GSWSA) is the operating utility. GSWSA has developed specifications and details for their systems. The specifications cover materials, installation methods, and general requirements. The GSWSA specifications related to the Water System and Sanitary Sewer System which govern these systems are included in the appendix.

1. The GSWSA 2019 Water System Standards and Specifications includes all items and appurtenances required to construct a complete water system. The system includes transmission, distribution and service lines and appurtenances. GSWSA will provide certain items as noted in the specs and drawings such as meters. The contractor shall follow the GSWSA specifications in the appendix, the standards and special details in the plans.

2. The GSWSA 2019 Sewer System Standards and Specifications includes all items and appurtenances required to construct a complete sewer system. The system includes gravity and force main piping, pump stations, and appurtenances. The contractor shall follow the GSWSA specifications in the appendix, the standards and special details in the plans.

1.02 REFERENCES / SUBMITTALS / QUALITY CONTROL / HANDLING

A. See GSWSA specification in the appendix.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials for piping, valves, fittings, and components for the water system shall follow GSWSA specifications in the appendix.

PART 3 - EXECUTION

3.01 PREPARATION

A. The system shall be constructed in accordance with GSWSA specifications in the appendix.

*****END OF SECTION 33 11 00*****

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction of pipes, drainage inlets, manholes, headwalls, and various drainage structures.

1.02 RELATED SECTIONS

A. Section 32 16 19 – Sidewalks and Miscellaneous Concrete Structures

B. Section 33 30 00 – Utility Systems – Water / Sewer

1.03 OPTIONS

A. Where manufacturers of material or equipment are named in the specifications, Contractor may use equipment or materials of other manufacturers provided they are reviewed and accepted by Engineer as equivalent to those specified.

1.04 REFERENCES

A. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ASTM C 76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

D. ASTM C 443 – Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

E. ASTM B 745/B 745M – Corrugated Aluminum Pipe for Sewers and Drains.

F. ASTM D 1056 – Flexible Cellular Materials – Sponge or Expanded Rubber.

G. ASTM F 2306/F 2306M – 12 to 60–Inch (300 to 1,500 mm) Annular Corrugated Profile–Wall Polyethylene (PE) Pipe and Fittings for Gravity–Flow Storm Sewer and Subsurface Drainage Applications.

H. ASTM D 1751 – Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non–extruding and Resilient Bituminous Types).

I. ASTM D 1752 – Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.

J. ASTM D 2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.

K. ASTM C 150 – Portland Cement.

L. ASTM C 144 – Aggregate for Masonry Mortar.

M. ASTM C 207 – Hydrated Lime for Masonry Purposes.

N. ASTM C 62 – Building Brick (Solid Masonry Units Made from Clay or Shale).

O. ASTM C 55 – Concrete Brick.

P. ASTM C 478 – Precast Reinforced Concrete Manhole Sections.

Q. ASTM C 1433 – Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.

R. ASTM D 1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

S. ASTM D 6938 – In Place Density and Water Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth).

T. ASTM F 405 – Corrugated Polyethylene (PE) Tubing and Fittings.

U. ASTM C 913 – Precast Concrete Water and Wastewater Structures.

V. ASTM D 3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

W. ASTM F 477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

X. AASHTO M 294 – Corrugated Polyethylene Pipe, 300 to 1500–mm Diameter.

Y. ASTM F667 – Large Diameter Corrugated Polyethylene Pipe and Fittings.

1.05 QUALITY ASSURANCE

A. Material Review – Contractor will furnish the Engineer and Owner a description of all material before ordering. Engineer will review the Contractor's submittals and provide in writing an acceptance or rejection of material.

B. Manufacturer – Material and equipment shall be standard products of a manufacturer who has manufactured them for a minimum of 2 years and provides published data on their quality and performance.

C. Subcontractor – A subcontractor for any part of the work must have experience on similar work, and if required, furnish Engineer with a list of projects and Owners or Engineers who are familiar with their competence.

D. Design – Devices, equipment, structures and systems not designed by Engineer and Contractor wishes to furnish, shall be designed by either a Registered Professional Engineer or by someone the Engineer accepts as qualified. If required, complete design calculations and assumptions shall be furnished to the Engineer or Owner before ordering.

E. Testing Agencies – Soil tests shall be taken by a testing laboratory operating in accordance to ASTM D–3740 and E–329 and be acceptable to the Engineer prior to engagement. Mill certificates of tests on materials made by manufacturers will be accepted provided the manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests, spot checked by an outside laboratory and furnishes satisfactory certificates.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Material shall be unloaded in a manner avoiding damage and shall be stored where it will be protected and will not be hazardous to traffic. Contractor shall repair any damage caused by the storage. Material shall be examined before installation. Neither damaged nor deteriorated material shall be used in the work.

1.07 SEQUENCING AND SCHEDULING

A. Contractor shall arrange work so sections of pipes between structures are backfilled, checked, pavement replaced and the section placed in service as soon as reasonable after installation.

1.08 ALTERNATIVES

A. If Contractor suggests alternate material, equipment or procedures will improve results at no additional cost, the Engineer and Owner will examine suggestion, and if accepted, it may be used. The basis upon which acceptance of an alternate will be given is its value to Owner and not for Contractor's convenience.

1.09 GUARANTEE

A. Contractor shall guarantee quality of materials, equipment and workmanship for a minimum period of 12 months or as required by the local governing agency after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

1.10 EXISTING UTILITIES

A. All known utility facilities are shown schematically on the construction drawings and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown, will not relieve the Contractor of responsibility under this requirement. "Existing Utilities Facilities" means any utility existing on the project in its original, relocated or newly installed position. Contractor will be held responsible for cost of repairs to damaged underground facilities; even when such facilities are not shown on the drawings.

B. The Contractor shall call for underground utility locations before starting work. Underground utilities location service can be contacted at 1–888–721–7877 or 811.

1.11 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 1556 or ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. Testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48–hours notice prior to taking any tests.

E. Testing shall be the Contractor's responsibility and shall be performed at Contractor's expense by a commercial testing laboratory operating in accordance with subparagraph C above.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

PART 2 - PRODUCTS

2.01 PIPE

A. Concrete Pipe – Shall be reinforced Class III, Class IV, or Class V and shall conform to ASTM Specification C–76. Pipe less than 48 inch inside diameter shall be manufactured without lifting holes. Joints shall be 'O' ring watertight flexible rubber.

1. 'O' Ring Joints – Shall be water tight flexible rubber gasket and shall meet ASTM Specification C–443.

2. Tongue and groove joints shall utilize mastic sealant and the exterior shall be wrapped with geotextile material.

2.02 DRAINAGE STRUCTURES

A. Details – See plans.

B. Concrete – Reinforced and non–reinforced.

1. Minimum compressive strength = 3,000 p.s.i. at 28 days.

2. Reinforcing shall be covered by a minimum 1 inch of concrete for top slabs and 1–1/2 inches for walls and bases and 3 inches where concrete is deposited directly against the ground.

3. Expansion joint filler materials shall conform to ASTM D 1751 or D 1752.

C. Mortar – Connection of pipe and drainage structures shall be composed of one part by volume of Portland cement and two parts of sand. The Portland cement shall conform to ASTM C–150, Type I or II. The sand shall conform to ASTM C–144 and shall be of an accepted gradation. Hydrated lime may be added to the mixture of sand and cement in an amount equal to 25% of cement volume used. Hydrated lime shall conform to ASTM C–207, Type S. Quantity of water in the mixture shall be sufficient to produce a workable mortar, but shall in no case exceed 7 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies and organic impurities. The mortar shall be used within 30 minutes from time ingredients are mixed with water.

D. Brick Masonry – Brick shall conform to ASTM Specification C–62, Grade SW or C–55, Grade S. Mortar for jointing and plastering shall consist of one part Portland cement and two parts fine sand. Lime may be added to the mortar in an amount not more than 25% of the cement volume used. Joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of structure. Brick structures shall be plastered with 1/2 inch of mortar over entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course, and for round structures, brick shall be laid radially with every sixth course a stretcher course.

E. Precast – Shall be constructed in accordance with ASTM C–478, C–913, or C–1433 and conform to details on the project drawings.

1. Joints – Shall be tongue and groove sealed with flexible gaskets or mastic sealant. Gaskets shall be O–Ring or Type A or B “Tylox” conforming to ASTM C443 and mastic shall be “Ram–nek” or equivalent with primer. Primer shall be applied to all contact surfaces of manhole joints at the factory in accordance with manufacturer’s instructions.

2. Steps – Shall be polypropylene equivalent to M.A. Industries, Type PS–1 or PS–1–PF. Steps shall be installed at the manhole factory and in accordance with recommendations of step manufacturer. Manholes will not be acceptable if steps are not installed accordingly.

3. Leaks – No leaks in the manhole will be acceptable. All repairs made from inside the manhole shall be made with mortar composed of one-part portland cement and two parts clean sand; mixing liquid shall be straight bonding agent equivalent to “Acryl 60.”

F. Frame, cover & grating shall conform to details shown on the project drawings. Grates in pavement and in other flush–mounted type surfaces shall be of a "bicycle–safe" configuration consisting of 45-degree diagonal bars or slotted grates with a maximum clear opening of 1 inch and a maximum length of 9–inches. In any case, the long dimension of openings should be located transverse to direction of traffic when possible.

2.03 FILTER FABRIC

A. Shall be a non–woven heat–bonded fiber of polypropylene and nylon filaments equivalent to Mirafi 140 N. The fabric shall be finished so filaments will retain their relative position with respect to each other. Fabric shall contain stabilizers and/or inhibitors added to the base plastic to make filaments resistant to deterioration due to ultraviolet and/or heat exposure. The product shall be free of flaws, rips, holes, or defects.

2.04 TRACING WIRE

A. Tracing wire shall be #12 gauge insulated single strand copper wire.

2.05 SOIL AND STONE AGGREGATES

A. Stone aggregate shall be clean crushed granite or concrete meeting the gradation requirements of grade No. 57.

B. Soils used for bedding, haunching, and initial backfill shall be as shown in the following table and shall meet requirements and classifications of ASTM D2321 and ASTM D2487.

Class	Type	Soil Group Symbol D 2487	Description	Percentage Passing Sieve Sizes		
				1–1/2 inch (40 mm)	No. 4 (4.75 mm)	No. 200 (0.075 mm)
IB	Manufactured, Processed Aggregates; dense–graded, clean.	None	Angular, crushed stone (or other Class 1A materials) and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines.	100%	≤50%	<5%
II	Coarse – Grained Soils, clean	GW	Well–graded gravels and gravel–sand mixtures; little or no fines.	100%	<50% of "Coarse Fraction"	<5%
		GP	Poorly–graded gravels and gravel–sand mixtures; little or no fines.			
		SW	Well–graded sands and gravelly sands; little or no fines.		>50% of "Coarse Fraction"	
		SP	Poorly–graded sands and gravelly sands; little or no fines.			
	Coarse–Grained	Eg.	Sands and gravels that are	100%	Varies	5%

2.06 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. Engineer will review all products by the submittal of shop drawings before they are ordered.

PART 3 - EXECUTION

3.01 ON SITE OBSERVATIONS OF WORK

A. The line, grade, deflection, and infiltration of storm sewers shall be tested by Contractor under direction of Engineer. Owner's Representative or Engineer will have the right to require any portion of work be completed in their presence and if work is covered up after such instruction, it shall be exposed by Contractor for observation. However, if Contractor notifies Engineer such work is scheduled and the Engineer fails to appear within 48–hours, Contractor may proceed. All work completed and material furnished shall be subject to review by the Engineer or Project Representative. All improper work shall be reconstructed. All materials not conforming to requirements of specifications shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Project Engineer or Project Representative a minimum of 48–hours notice for all required observations or tests. Storm sewers shall be dry for observation by the Engineer. Lines under water shall be pumped out by Contractor prior to observation, at no additional cost to the Owner.

It will also be required of Contractor to keep accurate, legible records of the location of all storm sewer lines and appurtenances. These records will be prepared in accordance with paragraph on "Record Data and Drawings" in the Special Conditions. Final payment to the Contractor will be withheld until all such information is received and accepted.

3.02 EXCAVATION FOR PIPE AND STRUCTURES

A. Excavated material shall be piled a sufficient distance from the trench banks to avoid overloading to prevent slides or cave–ins.

B. Remove from site all material not required or suitable for backfill.

C. Grade as necessary to prevent water from flowing into excavations.

D. Remove all water accumulating in the excavation, from surface flow, seepage, or otherwise, by pumping or other acceptable method.

E. Sheeting, bracing or shoring shall be used as necessary for protection of the work and safety of personnel.

3.03 TRENCHING FOR PIPE

A. Trenching for Pipe – The width of trenches at any point below top of pipe shall be not greater than outside diameter of pipe plus 4 feet to permit satisfactory jointing and thorough bedding, haunching, backfilling and compacting under and around pipes. Sheeting and bracing where required shall be placed within the trench width as specified. Care shall be taken not to over–excavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures shall be necessary. Cost of this re–design and increased cost of pipe or installation shall be borne by Contractor without additional cost to the Owner. When installing pipe in a positive projecting embankment installation, the embankment shall be installed to an elevation of at least 1 foot above top of pipe for a width of five pipe diameters on each side of pipe before installation of pipe.

B. Removal of Unsuitable Material – Where wet or otherwise unstable soil, incapable of supporting the pipe is encountered in bottom of trench, such material shall be removed to depth required and replaced to proper grade with stone or sand foundation as determined by Engineer. This foundation shall be compacted to 95% modified proctor.

3.04 PROTECTION OF UTILITY LINES

A. Existing utility lines shown on drawings or locations of which are made known to the Contractor prior to excavation, and are to be retained, as well as utility lines constructed during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired at Contractor's expense. If the Contractor damages any existing utility lines not shown on drawings or locations of which are not known to Contractor, report thereof shall be made immediately. If Engineer determines repairs shall be made by Contractor, such repairs will be ordered under the clause in GENERAL CONDITIONS of contract entitled "CHANGES." When utility lines to be removed are encountered within the area of operations, Contractor shall notify Engineer in ample time for necessary measures taken to prevent interruption of service.

3.05 FOUNDATION AND BEDDING

A. Stone Foundation – Where the subgrade of pipe is unsuitable material, Contractor shall remove unsuitable material to a depth determined by Engineer or Geotechnical Consultant and furnish and place stone foundation in trench to stabilize subgrade.

B. Sand Foundation – Where the character of soil is unsuitable, even though dewatered, additional excavation to a depth determined by Engineer or Geotechnical Consultant shall be made and replaced with clean sand furnished by Contractor.

C. Bedding for pipe shall provide a firm surface of uniform density throughout the entire length of pipe. Before laying pipe, trench bottom shall be de–watered by the use of well points. Where well points will not remove the water, Contractor shall construct sumps and use pumps to remove all water from bedding surface. Pipe shall be carefully bedded in stone accurately shaped and rounded to conform to lowest 1/3 outside portion of circular pipe, or lower curved portion of arch pipe for the entire length of pipe. Bell holes and depressions for joints shall be only of such length, depth, and width as required for properly making the particular type joint.

D. Concrete Pipe:

1. Materials for bedding concrete pipe shall be either Class II, Class III, or Class IB if processed, to minimize migration of adjacent material.

2. Depth of bedding shall be equal to 1/24 the outer diameter of pipe or 3 inches, whichever is greater.

3. Bedding area under the center of pipe, for a width 1/3 outer diameter of pipe, known as middle bedding, shall be loosely placed. Remainder of bedding for full width of the trench shall be compacted to a minimum density of 85% for Class II bedding and 90% for Class III bedding as determined by ASTM D1557.

3.06 HAUNCHING, INITIAL BACKFILL, AND FINAL BACKFILL

A. Haunching – After the bedding has been prepared and pipe is installed, Class II or Class III soil shall be placed along both sides of pipe, in layers not exceeding 6 inches in compacted depth. Care shall be taken to insure thorough compaction and fill under haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers and rammers. Haunching shall extend up to the spring line of pipe and be compacted to following densities:

1. RCP: Minimum density shall be 90% as determined by ASTM D1557.

B. Initial Backfill – Reinforced concrete pipe does not specifically require initial backfill. Initial backfill for reinforced concrete pipe can be the same as final backfill.

C. Final Backfill – For all pipes, it should extend to the surface and shall be select materials compacted to a minimum of 98% as determined by ASTM D1557 if pipe is under pavement. If pipe is in grassed areas final backfill may be native materials compacted to a minimum density of 90% as determined by ASTM D1557.

3.07 PLACING PIPE

A. Each pipe shall be carefully examined before being laid, and defective or damaged pipe shall not be used. Pipe lines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe be laid in water, and no pipe shall be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. All pipe in place shall have been checked before backfilling. When storm drain pipe terminates in a new ditch, headwall or end section, together with ditch pavement, if specified, shall be constructed immediately as called for on the plans. Ditch slopes and disturbed earth areas shall be grassed and mulched as required. Contractor will be responsible for maintaining these newly constructed ditches and take immediate action subject to acceptance, keeping erosion of the ditch bottom and slopes to a minimum during life of contract. No additional compensation will be given to Contractor for the required diversion of drainage and/or dewatering of trenches. Grassing the trench backfill shall conform to requirements of Section 32 92 00 – "Turf and Grasses."

B. Concrete Pipe: Laying shall proceed upgrade with spigot ends of bell and spigot pipe and tongue ends of tongue and groove pipe pointing in the direction of flow. Place pipe in trench with the invert conforming to required elevations, slopes and alignment. Provide bell holes in pipe bedding in order to insure uniform pipe support. Fill all voids under the pipe by working in backfill material.

C. Tracing Wire – Tracing wire will be installed on all storm sewers and subgrade drain directly on top of the pipe. The wire shall be secured to pipe with tape or other acceptable methods at spacings of no more than 36 inches apart. Where subgrade drains branch off from main lines, the wire insulation shall be stripped so bare wires can and shall be jointed securely together and wrapped with a rubberized insulation tape. The insulated wire must maintain electrical continuity. The tracing wire shall also be stubbed up into each drainage structure. This tracing wire system shall be checked and tested by Contractor, in presence of Engineer, prior to acceptance of the installation. All equipment, meters, detectors, etc., needed for testing shall be furnished by the Contractor.

3.08 JOINTS IN PIPES

A. Concrete Pipe – Joints in concrete pipe shall be 'O' ring watertight flexible. Maintain pipe alignment and prevent infiltration of fill material at joints during installation.

1. 'O' ring joints shall meet the requirements of ASTM C443. Joint shall utilize either a rubber gasket with a circular cross section or a rectangular cross section. Gaskets shall have no more than one splice, except two splices of the gasket will be permitted if nominal diameter of pipe exceeds 54 inches. Manufacturer's recommendations and requirements shall be followed.

3.09 FIELD QUALITY CONTROL

A. Soil and density tests shall be made by a testing laboratory acceptable to the Engineer. Laboratory tests of the soil shall be made in accordance with ASTM D 1557. In–place density tests shall be made in accordance with ASTM D 6938. Results of tests shall be furnished to the Engineer.

The minimum number of tests required shall be:

Haunching and Initial

Backfill in all areas…. 1 per 100–linear feet of pipe, minimum of one per run of

pipe for both the haunching and initial backfill zones.

Final Backfill over pipe in traffic areas…….. 1 per 100–linear feet or less for each 4–feet of depth or portion thereof.

Final Backfill over pipe in non–traffic areas….. 1 per 500–linear feet or less for each 6–feet of depth or portion thereof.

The minimum percent of compaction of the backfill material (in accordance to ASTM D1557) shall be the following:

In traffic Areas. . . . . 98% of maximum laboratory density.

In non–traffic Areas . . . 90% of maximum laboratory density, unless otherwise accepted by the Engineer.

B. 50% of pipes under roadways shall be televised and video recorded. The video observation shall include a complete pan view of each joint. If the video observation indicates problems, further televising may be required. Additional televising and video recording will be at no additional cost to the Owner.

3.10 DRAINAGE STRUCTURES

A. Drainage structures shall be constructed of materials specified for each type and in accordance with details shown on the drawings.

3.11 REMOVE AND REPLACE PAVEMENT

A. Pavement shall only be removed after prior written authorization by the Owner. Pavement removed and replaced shall be constructed in accordance with latest specifications of the State Department of Transportation. Traffic shall be maintained and controlled per State Department of Transportation regulations.

3.12 CONNECT PIPE TO EXISTING STRUCTURES

A. Contractor shall connect pipe to the existing structure where indicated. For brick or precast structures, a hole not more than 4 inches larger than outside diameter of new pipe shall be cut or cored neatly in the structure, new pipe laid so it is flush with inside face of structure, and annular space around pipe filled with a damp, expanding mortar or grout to make a watertight seal.

*****END OF 33 40 00*****

SECTION 35 20 23

DREDGING

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. The work consists of furnishing plant, labor, materials, and equipment to perform dredging of the Waccamaw River and associated dredge material disposal work as required by these specifications and contract drawings for the Bucksport Marine Industrial Park in Horry County, South Carolina. The depth, bottom widths and lengths to be dredged as shown on the drawings are based on the bottom conditions existing on the date of the contract survey and are subject to change based on the bottom conditions at the time of the pre-dredge survey. The Contractor must remove sufficient material to clear the design template and side slopes shown on the drawings. The project includes a 1-foot overdredge tolerance to enable the Contractor to position the dredge equipment in such a manner to clear the material from the design template.

1.2 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless otherwise indicated, the most recent edition of the publication, including any revisions, shall be used.

B. USACE Engineering Manuals

EM 385-1-1	Safety and Health Requirements Manual
EM 1110-2-1003	Hydrographic Surveying Manual;
EC 1130-2-210	Hydrographic Surveying

1.3 PLANT

A. Plant and equipment employed on the dredging work shall be in satisfactory operating condition, capable of safely and efficiently performing the work as indicated. Equipment and machinery, including dredge(s), pipelines and supporting plant to be employed on the work, shall be kept in good condition at all times.

B. A listing of all dredging equipment and machinery utilized to accomplish the work, shall be submitted and subject to inspection and approval by the Owner, Engineer, or approved representatives and kept in good condition at all times. The listing shall include year and manufacturer, operational capacities, safety features, operating and licensing requirements for operators, and a description where and how the item of equipment or plant will be employed in the work.

C. All floating plant and working platforms shall be equipped with walkways and guardrails conforming to Corps of Engineers Manual EM 385-1-1 and meet OSHA requirements for worker safety. Any leaks or deficiencies shall be promptly and properly repaired. No reduction in the capacity of the plant, once inspected and approved by the Owner, Engineer, or approved Representative to be sufficient for employment on the work, shall be made except by written permission of the Engineer.

D. Minimum Plant Requirements and Required Certifications

1. At the commencement of work through contract completion, the Contractor's dredge must have a current Certificate of Inspection issued by the U.S. Coast Guard. The Certificate issued must be displayed on board in accordance with all applicable laws and regulations. In addition, the vessel shall have on board documentation from the manufacturer verifying the vessel is suitable for location of intended use. The Contractor shall submit with his bid signed and notarized certificates that verify his plant to be used on the scheduled work meets all of the safe operating and production capacity requirements as specified. The signed and notarized certifications shall be accompanied by verifiable documentation indicating the plant to be employed on the work has been used in similar conditions to dredge similar material at a production rate sufficient to accomplish the work as scheduled for this contract.

E. Certification of Attendant and Auxiliary Plant

1. In addition to the requirements of EM 385-1-1, all supporting floating plant for dredging operations shall have a current marine survey inspection certificate. The only exceptions to this requirement include support pontoons or floats and outboard skiffs less than 20 feet in length. The certification shall have been issued by an accredited marine surveyor within the previous 12 months. The marine surveyor must be accredited by either the National Association of Marine Surveyors or the Society of Accredited Marine Surveyors. Attendant plant that does not have a valid certification and is greater than 20 feet in length shall not be used on this contract. The certifications and inspection shall be appropriate for the intended use of the plant in all locations specified in this contract.

1.4 CHARACTER OF MATERIALS

A. The Contractor shall anticipate encountering fine grain materials, sands, and clayey slits with some organic content. Bidders are expected to examine the site of work and history of similar work in the area and decide for themselves the character of the materials and the measures necessary to perform the work within the required schedule as well as safeguard their personnel, equipment and the public. Local minor variations in the subsurface materials are to be expected and, if encountered, will not be considered as being materially different. If rock is encountered during dredging under this contract, the Contractor is not required to remove it. The location and top of rock elevation must be recorded on the Daily Report. \

B. The Contractor shall control his/her dredge equipment to prevent excavation from outside or below the authorized limits (include the overdredge tolerance) as shown on the plans. **The** Contractor shall be liable for any excavation occurring outside of the authorized dredge limits, (as defined in the project plans and permits) except as can be expected by material sloughing along the side slopes. Payment shall only be made for material removed from within the design template (including the overdredge tolerance) as determined from the pre- and post-dredge surveys of the navigation channel. No payment shall be made for material excavated from outside or below the design template (including the overdredge tolerance).

1.5 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00, "SUBMITTAL PROCEDURES":

1. Pre-construction Submittals;

a. Pre-Dredging Survey: Submit a Pre-Dredging Survey meeting requirements of 3.5 and it’s subparagraphs. This survey should be submitted to the Owner at least one

week (7 days) prior to dredge work commencing so that the Owner can direct adjust of the design before work begins to account for potential changed conditions.

b. Dredging and Dredged Material Placement Plan: Prior to commencement of dredging, submit a plan for sequence of dredging, dredging methods and plant utilized, the proposed pipeline route and material placement requirements, protection of structures, equipment, and land features. The plan shall include the equipment and methods to be employed by the Contractor for screening of material, 24-hour monitoring of pipeline during operations per permit conditions, and disposal site management and discharge. Contractor shall coordinate with Owner to schedule US Army Corps of Engineers site visit no more than 14 working days of commencing work.

c. Notice to Mariners: Submit a copy of Notice to Mariners at same time sent to Fifth Coast Guard District.

d. Certificates of Equipment and Machinery Operator Authorization: Submit a list of designated personnel qualified and authorized to operate machinery and equipment. The list shall be maintained at the job site in a current status at all times.

e. Operational Plan to Minimize Endangered Species Takes; Hydraulic/Pipeline Dredge Special Recording Requirements Plan; and Hydraulic/Pipeline Dredge Endangered Species Special Equipment Plan: Develop and submit the plans as required by permits in this section.

2. Post-construction Submittals;

a. <u>After-Dredging Survey:</u> At project completion, perform and submit to Owner an After-Dredging Survey meeting requirements of paragraphs 3.5 and 3.5.1 of this Section.

b. <u>Upland Fill Placement Survey</u>: A post-construction fill survey shall be taken by the Contractor following completion of fill placement and prior to demobilization payment. The survey shall be taken on parallel profile lines (ranges) spaced at a maximum of 50 feet intervals. The minimum stationing interval shall be 25 feet or at breaks in slope. The Contractor shall furnish the Owner the survey data certified by an independent registered/certified surveyor in electronic format and hard copy. The data shall be submitted to the CE in the following files:

- ASCII data with all survey points: Easting (x), Northing (y), and Elevation (z).
- The Owner will communicate additional data requirements for survey data formats at the Preconstruction Conference.

1.6 OBSTRUCTION IDENTIFICATION

A. The Contractor may encounter obstructions or other debris that is not identified and may pose a hazard to navigation. The Contractor shall advise the Owner immediately of any obstructions or other debris of this nature that is encountered.

1.7 ORDER OF WORK

A. Dredging of the Base Bid Work shall proceed in a uniform and contiguous manner from one end of the marina basin to the travel lift area

1.8 ENVIRONMENTAL WINDOWS

A. See Environmental permits for any restrictions on dredging.

1.9 NOTICES

A. The Contractor must give the Owner or his/her designated representative five (5) days advance written notice before commencing work.

1.10 NAVIGATION AIDS

A. There may be aids to navigation within the project boundaries. In the event that such aids to navigation need to be removed for the accomplishment of the contract work, it is the responsibility of the Contractor to provide the U.S. Coast Guard (USCG) and any other responsible parties notification 5 weeks prior to needing a navigation aid moved. Any impacts to the work due to the inability of the Contractor to accomplish any needed movement of aids to navigation will not be the responsibility of the United States Government or of the Contracting Officer or his/her designated representative.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REMOVAL AND PLACEMENT OF EXCAVATED MATERIAL

A. General Information: The Contractor shall perform the work shown with one or more dredges and transport the material by hydraulic pipeline and deposited within the designated placement area. The Contractor shall be responsible for providing all discharge pipelines for deposit within the designated areas. The Contractor shall comply with all terms and conditions of any Environmental Permits. The condition of the dredging and placement areas, at the time of the latest survey, is depicted on the contract drawings; however, due to natural changes in topography, the actual elevations at the time of the work may vary from the elevations indicated.

B. Dredge Positioning System: Each dredge must be equipped with an electronic positioning system, capable of positioning the dredge in the channel with accuracies as shown in Table 3.1 Minimum Performance Standards for Corps of Engineers Hydrographic Surveys (Mandatory) in USACE EM 1110-2-1003. This positioning system must be established, operated, and maintained by the Contractor during the entire period of the contract. The positioning system must be used to precisely locate the dredge and must be capable of displaying and recording the dredge's location in an acceptable coordinate system, which can be related to, or is directly based on, the South Carolina Lambert State Plane Coordinate System. Navigation channel control, and shore station control, if required, will be provided to the Contractor in the same South Carolina coordinate system prior to commencement of work. It is the responsibility of the Contractor to have the positioning/navigation system reviewed, inspected and approved by the Owner prior to commencement of work.

C. Temporary Malfunctions: Should the vessel displacement load measurement, or position plotting equipment become inoperable, the Contractor shall stop all work until repairs are made.

D. Warning Signs: The Contractor shall erect and maintain at his own expense suitable navigation warning signs at each end of a submerged pipeline and at any other points necessary to prevent hazards to navigation.

E. Misplaced Material: The requirements and methods of dredged material placement for this contract shall be in accordance with contact documents and Environmental Permits obtained for the scheduled work. Any material that is deposited elsewhere than in places designated or in a manner than approved by the Engineer is in violation of the Environmental Permit and will not be paid for. Additionally, the Contractor may be required to remove such misplaced material and deposit it where directed by the Engineer at the Contractor's expense and be subject to an unsatisfactory performance rating by the Owner.

3.2 PLACEMENT OF DREDGED MATERIAL

A. Material placement shall generally occur from south to north within the Dredged Material Containment Area (DMCA); however, the Contractor may alter the placement at his/her discretion. In addition, the Contractor shall refrain from preventing the material fines from leaving the placement area.

B. The temporary dikes may be constructed within the DMCA from the dredge material to assist in settling as needed. The Contractor shall not disturb the existing grade within the placement area to construct the temporary dike without the Owners approval. At the completion of fill placement activities, the Contractor shall deconstruct the temporary dikes and berms by distributing and grading the material to the lines and elevations as indicated and specified. The Contractor shall smooth grade the entire placement site to form one (1) contiguous and uniform emergent placement area. The maximum (steepest) slope allowed for the placement area is 1 V: 20 H. The Contractor shall also smooth grade

3.3 QUALITY CONTROL

The contractor shall establish and maintain a quality control system for all dredging operations to assure compliance with contract requirements and record his inspections and tests under this system.

A. Inspections and Testing Requirements: Inspections and testing shall be the responsibility of the Contractor, subject to the approval of the Owner.

B. Equipment and Machinery Requirements: All measuring equipment, global positioning systems (GPS) and other electronic positioning systems, data plotting and recording equipment, and the procedures associated with each respective item of equipment, shall be subject to the approval of the Owner. Verification of current calibration for each respective item of equipment, as approved by the Owner, shall be provided by the Contractor prior to use of the equipment on the work. All records produced by the equipment shall be inspected and certified as complete by the CQC Representative and included as a part of the Daily Quality Control Report.

C. Miscellaneous Inspections and Test Records: A copy of the records of all inspections and tests, as well as record of corrective action taken, shall be included in the Control Plan and furnished to the Owner as a part of the Daily Quality Control Report. The Contractor shall establish and maintain quality control for operations in connection with the work in the field to assure compliance with contract requirements. The Contractor shall inspect for compliance with contract requirements and record the inspection of all operations.

All results of inspections shall be documented with narrative explanations and photographs as necessary to document the conditions of field quality. The results and supporting data shall be recorded and provided by the Contractor in the Daily Report of Operations.

D. Reporting and Certificates: All measuring, plotting, and recording equipment and procedures shall be subject to the approval of the Owner. Verification of their calibration, certified by the

CQC representative, shall be furnished prior to use on the work. All records produced by the equipment shall be authenticated by the authorized representative of the contractor and then provided to the Owner with the Daily Report of Operations.

3.4 DAILY REPORTING REQUIREMENT

A. The Contractor shall prepare and maintain a Daily Report of Operations and furnish copies daily to the Owner. A copy of the form prescribed for recording the required information and any further instructions on the preparation of the report will be furnished at the preconstruction conference. The Contractor shall also furnish the following item daily to the Owner during dredging operations:

1. Copy of dredge leverman's log
2. Records of dredge pump vacuum and pressure gauge readings
3. Estimate of material volume removed (cumulative and within the previous 24-hour period.)
4. Explanation of any mechanical or weather delays experienced within the previous 24-hour period. (A delay shall be defined as any time period where the production rate falls below the average rate anticipated for the project.)

3.5 REQUIRED DREDGING PRISM, OVERDEPTH, AND SIDE SLOPES

A. The dredging limits and required cross-sections are shown on the plans. The Contractor must complete the work as required to achieve the proposed dimensions.

1. Overdepth: This contract allows 1 ft of overdredge throughout the entire project length. No payment will be made for any material that is removed from below the allowable overdepth or outside of the indicated side slopes.

2. Side Slopes: Material actually removed, within limits approved by the Owner, leaving final side slopes no flatter than the side slopes indicated by the typical dredging sections shown on the drawings may be paid for, whether accomplished by dredging the original position or the space below the pay slope plane and allowing upslope materials to fall into the cut.
3. Excessive Dredging: Material taken from beyond the limits will be deducted from the total amount dredged as excessive dredging and will not be credited. The Contractor is advised that dredging conducted outside the authorized dredge footprint could be considered a violation of state and federal laws, requiring restoration, mitigation, or fines. Any additional costs incurred by the Contractor, or requirements for restoration or mitigation resulting from dredging outside the limits identified in the plans shall not be charged to the Owner.

3.6 SURVEY REQUIREMENTS

A. All surveying shall be performed, signed and sealed by a surveyor registered/certified in the State of South Carolina.

1. Bathymetric Surveys: The Contractor will provide the Owner with pre and post-dredging bathymetric surveys. The pre-dredging bathymetric surveys shall be completed and provided to the Owner at least one (1) week prior to work commencement to allow the Owner to adjust the design for changed conditions if required. The post-dredging survey will be conducted within 3 days after the completion of dredging.

2. Singlebeam Surveying Method: The singlebeam survey system will be used. Horizontal location of survey lines and depth sounding points will be determined by the use of an

automated positioning system utilizing DGPS (differential global positioning system). Depth soundings will be taken using a dual frequency (200/28 KHz) depth sounder. The fathometer will be calibrated using velocity casts to account for variations in the speed of sound in the water at the survey site and compared to periodic bar checks for consistency. The echo sounder system will be calibrated at the job site and verified for accuracy twice daily.

3. Survey Lines: Depth soundings will be secured by running survey lines parallel to the longitudinal axis of the marina axis Lines shall be run on 25 ft intervals (stations) to assure good coverage of the bottom. Cross check lines will be run along the l toes and centerline. The after dredging survey will be performed in the same manner and location (stations) as the pre-dredging survey.

4. Copies of post-dredging hydrographic data will be submitted to the Owner within two (2) days after each survey is completed. The delivery format for data submission is an ASCII file containing x, y, and z data. The horizontal data will be provided in the North American Datum of 1983 (NAD '83) South Carolina State Plane, U.S. survey feet. Vertical data will be provided in feet referenced to Mean Lower Low Water (MLLW), unless otherwise specified. An 8.5x11" plan view plot of the survey track points, as well as contour lines at appropriate elevation intervals. These plots will be provided in PDF format. Survey metadata will also be provided.

B. Control: Survey control will be established from the existing survey control description data and construction baseline information as shown on the drawings.

C. Data References: All survey points shall be recorded in three dimensions (x,y,z) using the existing control, corrected for tidal changes.

D. Tolerances: The Survey shall meet Class 1 Hydrographic Survey Accuracies, as outlined in EM 1110-2-1003, and augmented by EC 1130-2-210. All surveying procedures, methods and equipment shall be reviewed and approved prior to construction.

E. Data Submittal: All post survey data shall be submitted directly to the Owner. The x,y,z data shall be submitted electronically in excel compatible format. Cross-sections plotted on 8-1//2 x 11-inch paper shall accompany the survey data and shall provide an estimate of the material removed from each station. The cross-sections may be submitted in PDF format. The After-Dredging channel surveys will be used to verify the design template was dredged and by permit agencies to verify limits of the dredge template.

3.7 DREDGING IN PROGRESS

A. It is the responsibility of the Contractor to furnish and install a minimum of two (2) temporary "DREDGING IN PROGRESS" signs in the vicinity of the dredging operation. The signs will be reviewed and approved by the Owner or his/her designated representative prior to deployment.

3.8 SUBMERGED PIPELINE

A. The Contractor must mark the pipeline route with buoys with yellow lights at intervals not to exceed 50 feet unless otherwise approved by the Owner or his/her designated representative and at abrupt changes in direction. The Contractor must also erect signs along routes of submerged pipelines. The signs shall be 4' by 8' and read: "CAUTION: SUBMERGED PIPELINE." (d) All lights must be visible for at least 1 mile on a clear dark night, visible all around the horizon, not less than three (3) and not more than 10 feet above the water and equally spaced.

In the event the Contractor elects to submerge his/her pipeline, the location of the submerged pipeline must be marked with signs, buoys,flags, and lights conforming to U.S. Coast Guard regulations and to the complete satisfaction of the Owner.

3.9 EXISTING STRUCTURES

A. The Contractor must exercise appropriate care when dredging adjacent to or in the vicinity of existing structures. The Contractor must not work closer to existing structures than the distance shown on the drawings. Any damage to existing structures caused by impact from the dredge or other plant or by dredging in excess of specified limits, must be repaired to the satisfaction of the Owner or to the owners of the structure.

3.10 PIPELINE ROUTES

A. The Contractor shall monitor the pipeline location and restrict the equipment from inadvertently moving into area that were not authorized in the Environmental Permit.or impact the historic barge. The Contractor shall cease work immediately and remove any equipment that travels into the referenced areas and shall immediately notify the Owner in writing of any occurrence where the equipment moves into the designated areas. The Contractor shall be liable for any damage, required restoration, fines, mitigation or any other required actions resulting from the equipment / materials inadvertently moving into the restricted areas.

3.11 PIPELINE LEAKAGE

A. A tight dredge discharge pipeline must be maintained along all sections of the pipeline to prevent spilling of dredged effluent outside of the placement areas. To minimize damage caused by leaks in the pipeline, the Contractor must provide a periodic patrol of the pipeline. A minimum of 4 daily inspections must be made by the Contractor during disposal operations. The Contractor must burlap and strap weld all joints of shore sections of pipeline. When significant leaks occur in the pipeline, which can cause erosion or appears to be a safety hazard to the public, the Contractor must immediately cease pumping operations until the pipeline is repaired. Should any material leak into waters or wetlands, the Contractor must promptly restore the waters or wetlands to the satisfaction of the Owner and responsible Federal and State resource agencies.

END OF SECTION 35 20 23

SECTION 35 51 14

ALUMINUM FLOATING DOCK SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section consists of the design, fabrication, and installation of an aluminum framed floating dock systems with aluminum decking, complete and ready to use, including polyethylene encapsulated floatation float systems; composite timber wales (if applicable); aluminum framing and connection hardware; pile guide frames; piles; dock restraint components; and dock accessories. Dock accessories shall include everything on or within the docks that is not considered a structural component of the system, including but not limited to cleats, fenders, bumpers, corner guards, wear plates, hinge plates, armoring, and all other ancillary components, devices, and features to provide for a complete system.

B. The layout and functional dimensions of the floating dock system are indicated on the project drawings. The floating dock systems shall be designed by the manufacturer to meet all requirements of the project drawings and these specifications. All materials shall be compatible and suited for sustained use in a marine environment.

1.2 RELATED WORK

A. Submittals - Section 01 33 00

B. Prestressed Concrete Piles - Section 31 62 13

C. Gangway Systems - Section 05 60 00

D. Marina Piping and Equipment Systems - Section 33 05 10

E. Marina Electrical Work - Section 26 27 29

1.3 REFERENCES

A. References shall be the latest edition available as of the date of the invitation to bid unless otherwise specified. The following standards are hereby incorporated in this Specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. Design Standards:

Marina Guidelines –American Society of Civil Engineers (ASCE) Manual 50 “Planning and Design Guidelines for Small Craft Harbors”

Aluminum - The Aluminum Association, Inc. (AA) "Aluminum Design Manual”

Steel - American Institute of Steel Construction (AISC) "Steel Construction Manual”.

Structural Loads – American Society of Civil Engineers (ASCE) 7-16 “Minimum Design Loads for Buildings and Other Structure”.

C. Timber - National Forest Products Association (NFP) "National Design Specifications for Wood Construction (NDS)".

D. Concrete - American Concrete Institute. (ACI) "Building Code Requirements for Reinforced Concrete" ACI Standard 318.

E. Accessibility – U.S Department of Justice (DOJ) “Building Code Standards for Accessible Design”

F. American National Standards Institute (ANSI)

1. ANSI B18.22.1 Plain Washers

G. American Society for Testing and Materials (ASTM)

1. ASTM A36 Carbon Structural Steel
2. ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes
5. ASTM A307 Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
6. ASTM A 449 Standard Specification for Hex Cap Screws, Bots and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength
7. ASTM B 209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
8. ASTM B308 Aluminum-Alloy 6061-T6 Standard Structural Profiles
9. ASTM B 211 Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
10. ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
11. ASTM B 308/B 308M Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
12. ASTM B 429/B 429M Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
13. ASTM B 574 Standard Specification for Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod

14. ASTM C578 Rigid, Cellular Polystyrene Thermal Insulation

15. ASTM D792 Density and Specific Gravity (Relative Density) of Plastics by Displacement

16. ASTM D 1037 Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

17. ASTM D 1187 Asphalt-Base Emulsions for Use as Protective Coatings for Metal

18. ASTM D 2241 Standard Specification for Poly Vinyl Chloride (PVC) Pressure-rated Pipe

19. ASTM D 4020 Standard Specification for Ultra High Molecular Weight Polyethylene Molding and Extrusion Material

20. ASTM F593 Stainless Steel Bolts, Hex Cap Screws, and Studs

21. ASTM F594 Stainless Steel Nuts

H. American National Standards Institute (ANSI)

1. AWS D1.2/D1.2M Structural Welding Code – Aluminum

1.4 DESIGN CRITERIA FOR FLOATING DOCKS

A. Information presented herein is based upon the Designer's best estimate of those factors that reasonably can be expected to affect the design, performance, and durability of the floating dock system. The proposed floating dock system shall be subject to thorough engineering analysis using all relevant criteria that could affect the stability, structural integrity and durability of the dock system based on the performance criteria as indicated on project drawings and specified herein.

B. Submitted calculations shall demonstrate that the floating dock systems are designed to withstand the required loading without damage, including floating structures, anchor systems, and all ancillary components and connections, using the criteria specified in this Section as a minimum requirement. The design loads, load combinations and allowable stresses are described herein.

C. The dock system shall be installed along the west bank of the Waccamaw River in Bucksport, South Carolina - River Mile 25.72 or Atlantic Intracoastal Waterway (AIWW) Mile Marker 377. This section of the Waccamaw River is characterized as a tidally influenced water body. The floating aluminum dock system shall consider passing boats on the AIWW.

D. The layout and principal dimensions of the floating dock systems are indicated on the project drawings. The Contractor shall provide a system that conforms to the layout and dimensions indicated in the project drawings, and the provisions of these specifications. Minor variances in dock dimensions to accommodate manufacturer's standard products are acceptable with approval.

E. The dock system shall consist of aluminum channel or truss with polyethylene float modules fully encasing polystyrene foam core. Decking shall consist of power coated slip resistant aluminum deck panels. Modules shall be connected to form continuous sections of floating

dock by bolted connections capable of transmitting all loads imposed upon individual dock modules, or combinations of dock modules, to the floating dock restraint system. Module depth shall be determined by the manufacturer to conform with the specified float freeboard and marina basin bathymetry.

F. Manufacturers deemed capable of furnishing a dock system conforming to these requirements are

- Bellingham Marine Industries
- Meeco Sullivan Floats
- Marinetek
- GatorDock
- AccuDock
- Structurmarine

G. Deck freeboard under deadload only at the time of dock system acceptance shall be 19 in. unless otherwise shown on the drawings, with a tolerance of +/- 1 inch. Freeboard under combined dead load plus uniform live load, shall not be less than 10 inches for the transient docks and shall not be less than 6 inches for the row dock.

H. The floating dock systems shall be designed to float level under dead load. The deck of the float modules shall be level and flush upon completion within the following tolerances.

1. Dead Load Deck Surface Slope

   a. Transverse Direction: Not more than 1/8 inch per foot.

   b. Longitudinal Direction: Not more than 1 inch per 10 feet of length and cumulatively maintain deck within specified freeboard limits.

2. Assembly Gap between Adjoining Floats: Minimum ¼ inch, maximum ½ inch on ADA accessible routes or ¾ inch all others.

3. Vertical Height Difference between Adjoining Floats and Deck Panels: Maximum ¼ inch on ADA accessible routes or $^{3}/_{8}$ inch all others.

I. Special floats shall be designed to support the superimposed dead loads imposed by gangways, ramps, or other dock accessories. Float modules with superimposed loads shall have the same freeboard as floats with no such loading, so that there will be no residual stresses when the floats are interconnected and to ensure that the dock system deck is level within the specified tolerance. Individual float module depth shall be designed to provide support for concentrated loads to ensure that the floating dock system maintains the specified freeboard within the required tolerance.

J. The floating dock system shall be designed so that electrical conduit sleeves integrated in the aluminum framing and utility main lines located beneath the dock edge frame remain a minimum of 4-inches above the water surface under dead load conditions to facilitate installation and servicing of the utilities. If HDPE pipe is used for firewater or potable water piping and are not integrated with framing underneath deck, then the piping shall be placed a minimum of 2-inches below the water surface. Access openings shall be provided at convenient locations as required for access to service utilities.

K. The floating dock system shall be designed to be restrained by guide piles. Preliminary guide pile section, length, tip elevations and location have been determined by the Engineer from the environmental conditions and estimated design loads. Float system manufacturer shall re-analyze the pile restraint and determine the final section, length, tip elevation and location of the guide piles based on their specific system requirements.

1.5 DESIGN LOADS

A. Dead load shall consist of the weight of float modules, framing, wale system, attachment aluminum, miscellaneous connection devices, and all other permanently attached accessories such as utilities, fire protection equipment, cleats, bumpers, etc. Contractor shall exercise care to be sure that all dead loads are accurately determined and accounted for, including superimposed gangway system loads, consideration of weight gain due to water absorption, and manufacturing tolerances that affect the final freeboard.

B. Minimum live loads shall consist of:

1. Uniform Live Load (ULL) of 40 pounds per square foot of deck, including the area of landings and ramps supported by the dock**.**

2. Concentrated Live Load (CLL) of 400 pounds, applied at any location on the floating dock greater than 12 inches from the edge.

3. Wind Load (WL) on the projected side and end areas of the vessels and dock:

a. Wind Pressure of 20 per square foot of profile area (vessels in place). Wind pressure for dock without vessel in place shall be a 145mph 3 second gust.

b. Vessel Profile Beam (ft.) = design slip width (ft.) – 1, or if slip width is not defined, = 8 ln L – 14 (L is vessel length in ft.)

c. Vessel Profile Height (ft.) = 0.15 L

d. Wind Load Application:

i. Assume 100 percent berth occupancy.

ii. 100 percent applied to vessels in the unshielded berths or row.

iii. 20 percent applied to all vessels in the remaining (shielded) berths, provided 100 percent loading is applied for design of each dock finger and finger connection. To be considered “shielded”, a vessel must be downwind of an equal (or larger) vessel and berthed on the same main walkway.

iv. Transverse load on vessel applied at the 1/3 and 2/3 points to the dock finger.

v. On docks where the berth length is not defined (‘side-ties’), wind loads shall be based on the maximum vessel length (L) to be accommodated, spaced at 1.25 x L over the length of the dock.

e. Mooring load from line pull acting in any direction from any cleat location, applied at a 45-degree angle from the horizontal.

4. Vertical Wave Load (VWL) due to hogging/sagging:

    a. Wave height (H_s) of 1.0 feet

    b. Wave length equal to 50 feet or the length of a finger for fingers less than 50 ft.

    c. Wave direction (propagation) parallel to longitudinal axis of dock.

5. Current Load (CL) shall be based on a current speed of 0.2 knots with vessels in place and 0.5 knots without vessels.

6. Impact Load (IL) due to impact of a vessel shall be applied as follows:

    a. Vessel docking weight (lbs) = 25 L^2 (L is vessel length in ft)

    b. Vessel approach at a speed of 3 feet per second and an angle of 10 degrees from the dock or finger face.

    c. Impact loads applied normal to cantilever fingers at outboard end and to pile supported fingers at the midpoint between the pile support and the main walkway

    d. On side tie docks, impact loads shall be based on the maximum vessel length to be accommodated and applied midway between pile supports.

C. The minimum gangway load shall consist of:

1. Superimposed dead load of the Gangway system tributary to the dock

2. Transferred Uniform Live Load of 50 pound per square foot on Gangway area tributary to the dock

D. Loading cases for design:

1. Case 1 – Dead Load only, including superimposed Gangway Dead Load.

2. Case 2 – Dead Load + Uniform Live Load, including transferred Gangway Dead and Live Load.

3. Case 3 – Dead Load + Concentrated Live Load

4. Consider wind load cases parallel and perpendicular to axis of dock:

    a. Case 4a – Dead Load + Parallel Wind Load + Vertical Wave Load + Current Load

    b. Case 4b – Dead Load + Perpendicular Wind Load + Horizontal Wave Load + Current Load

5. Case 5 – Dead Load + Impact Load

6. Case 6 – Lifting and Handling Loads

E. Design Calculations

1. Calculations for loads imposed by the handling and lifting methods to be employed shall be provided.

2. The material strength properties, load or safety factors and capacity reduction factors shall be as defined by the applicable code or justified by rational analysis.

3. The design calculations shall include, but not be limited to the following:

a. Determination of extreme fiber stresses in structural members for all load cases

b. Stresses in the dock system connections for all load cases

c. Transfer of moored vessel forces to the dock system

d. Transfer of dock system loads to guide piles that consider the difference in the structural stiffness of the dock system and the guide piles of various length to depth of fixity and section.

e. Transfer of forces at guide pile frames and connections

f. Transfer of forces at dock modules and dock module connections

g. Freeboard calculations for all float modules

h. Transfer of guide pile loads to soil, including analysis of pile-soil interaction

1.6 REQUIREMENTS FOR GUIDE PILE SYSTEM

A. Guide piles shall be fabricated and installed in conformance with the provisions of Section 31 62 13 – “Prestressed Concrete Piles” of these specifications.

B. The Contractor shall determine the section, length, tip elevation and location of the guide piles required for the proposed dock system in order to optimize the overall dock design, revising the tentative guide pile design indicated on the Drawings as necessary.

C. Pile design criteria indicated on Drawings include the pile cut-off elevation, the design water levels that determine the elevation of the applied dock load, and the local water depth.

D. A geotechnical report that contains relevant soils information for design is available for review.

1.7 SUBMITTALS

A. Prior to ordering dock system materials, submit final design calculations signed and sealed by a Professional Engineer holding a valid Certificate of Registration in the State of South Carolina. The calculations shall demonstrate that the floating dock system, using the criteria specified as minimum requirements, is designed to withstand the load conditions without damage.

B. Prior to fabrication of the dock system components, submit shop drawings signed and sealed by a Professional Engineer holding a valid Certificate of Registration in the State of South

Carolina. The shop drawings shall indicate the proposed berth layout and slip size, float module dimensions, float module construction details, connection details, and location and methods for attaching utilities and accessories. Submit shop drawings for all specially fabricated items including weldments and hardware, railing, curbing, cleat installation and catalog sheets for all manufactured items that are to be incorporated into the floating dock system.

C. Prior to installation of the dock system components, submit certified test reports:

1. Float Module Materials
2. Fasteners
3. Aluminum Alloy
4. Foam
5. Plastic Lumber and Polymer Board
6. Aluminum Plates and Shapes
7. Stainless Steel
8. Welder Qualifications

D. Prior to ordering the dock system accessories, submit catalog cut sheets:

1. Bumper Strips and Corner Bumpers
2. Signage
3. Pile Guide Rub Blocks
4. Fire Extinguishers and Cabinets
5. Coatings

E. Prior to ordering the dock system, submit experience data verifying the dock system supplier's required years of experience in the manufacture and installation of aluminum floating docks including the project location, date of installation, and Owner (including the name, address, phone number of a person who can be contacted for verification). An example of a previous installation of the proposed system for this project shall be included.

F. Prior to ordering the dock system, submit the quality control procedures to be used during the design, manufacture and installation of the floating dock system.

G. Prior to completion of the dock system, submit an operation and maintenance procedures manual for the floating dock system. The manual shall include Part 1 - Recommendations for Sizing and Tying-up Vessels in the Marina consistent with the designer's assumptions and highlighting the limitations on berth occupancy to present overloading the dock system; and, Part 2 – Recommendations for Maintenance and Maintenance Procedures and Materials by brand name and specification. All data shall be on 8 1/2 by 11 inches (and 11 by 17 inches, folded to fit) sheets of paper bound in a book with a protective cover. The binder external cover shall be identified as "Floating Dock System Operation and Maintenance Manual".

H. Prior to completion of the dock system, submit a complete and accurate record of all float modules manufactured. The record shall include assigned float identification number, date cast, related concrete cylinder strength tests and all quality assurance tests and inspection items performed on the float module.

1.8 CONTRACTOR'S QUALIFICATIONS

A. The dock system shall be furnished by a firm having a minimum of ten (10) years' experience in the manufacture and installation of concrete floating dock systems. The dock system design being proposed for this project shall have been successfully installed for a minimum of five (5) years at another location.

1.9 DELIVERY, HANDLING AND STORAGE

A. Use all means necessary to protect materials before, during, and after delivery to the work site, and to protect the installed work and materials of all other trades. Use extreme care in the off-loading of materials to prevent damage.

B. Deliver the materials to the Work site and store, all in a safe area, out of the way of traffic, and shored up off the ground surface.

C. Place identification numbers on all float modules (such they are not covered up after assembly) that conforms to the shop drawing numbering system. Also identify hardware and store. Protect all metal products with adequate weatherproof outer wrappings.

D. In the event of damage caused by the Contractor, make repairs and/or replacements as necessary to the satisfaction of the Engineer at no additional contract cost.

1.10 QUALITY CONTROL PROCEDURES

A. Tests and inspections shall be performed by the Contractor using qualified individuals, engineering companies, and testing laboratories that shall perform those special inspections specified herein and such other tests and inspections as may be required to establish the acceptability of the work.

B. Float manufacturing plant shall have an established quality control system for the manufacture of aluminum framing and polyethylene float modules. The manufacturer shall provide documentation of his ongoing quality control program covering floating dock manufacturing. Weld quality control shall be an AWS certified program; qualify welders using procedures, materials, and equipment of the type required for the work. The Engineer, prior to start of floating dock fabrication, shall review and approve the proposed quality assurance program and welder's AWS certifications.

C. If a non-conformance is encountered, the Contractor shall notify the Engineer as soon as possible and recommend a change in materials or procedure to resolve the non-conformance for approval by the Engineer.

1.11 WARRANTY

A. The individual floating dock modules shall carry a warranty against defects in materials and workmanship for a period of five (5) years from the date of project acceptance. All other dock system components including structural members and accessory items shall carry a manufacturer's warranty against defects in materials and workmanship for a minimum of one (1) year from the date of project acceptance. If within the respective warranty periods any materials or their installation are found to be defective, the Contractor shall repair or replace the defective item to the satisfaction of the Owner and at no cost to the Owner. This warranty excludes coverage for damage caused by abuse, misuse or neglect, and improper maintenance unless warranty period maintenance by the Contractor is included under the terms of the Contract.

B. The Contractor shall provide warranty period maintenance for the dock system and include the cost therefore in the bid price.

PART 2 - PRODUCTS

2.1 FLOATING DOCK MODULES

A. Aluminum: Aluminum Alloy Series 5000 or Series 6000 and shall be in accordance with AA Specification for Aluminum Structures, ASTM B 209, ASTM B 211, ASTM B 221, ASTM B 308/B 308M, ASTM B 429/B 429M, and ASTM B 574 for various metals used. All welds shall be in accordance with AWS D1.2/D1.2M.

B. Metal Accessories: Provide Aluminum or Stainless Steel. Stainless Steel shall conform to ASTM A 276, Type 316 or 316L as applicable. Dissimilar metals shall be isolated with a FS TT-P-664 protective coating to prevent galvanic or corrosive action.

1. Fasteners: ASTM F 593 and ASTM F 594. All bolts, screws, and nuts shall be Type 304 or 316 Stainless Steel. Washers shall comply with the requirements of ANSI B18.22.1 and shall be Type 304 or 316 Stainless Steel.

C. Polystyrene Foam: Foam core for floats shall be a rigid block of closed cell expanded polystyrene. The polystyrene foam shall have a unit weight between 0.95 pounds per cubic foot and 1.25 pounds per cubic foot. Properties of the foam shall conform to ASTM C 578, with maximum water absorption less than 4.0 percent by volume as determined by ASTM C 272, Method C. The foam core shall not have more than 10 percent reground material, and reground foam pieces shall not exceed 3/8 inch diameter.

D. Flotation Units: All units shall be rotationally molded for seamless one-piece construction. Flotation encapsulation material shall be manufactured from linear virgin polyethylene resin containing UV ray inhibitors and carbon black pigment. Normal wall thickness shall be a minimum of 0.150 in. Flotation units shall be designed to maintain the desired buoyancy and freeboard even if punctured or cracked. Flotation unit and frame to act as one integral unit.

E. PVC pipe shall be ASTM D 2241 thin wall class 200, SDR 21, embedded as required for all through rods and electrical raceways.

F. Pull boxes for electrical raceways shall conform to National or local electrical codes for wiring method, and shall be set flush with the walking surface, and self-draining. All bolts for lids on pull boxes shall be ASTM F 593, Group 2, (316) stainless steel. Boxes shall have a 1-inch nominal concrete bottom and bottom shall not be lower than the inverts of the PVC sleeves.

2.2 PLASTIC LUMBER AND POLYMER BOARD

A. Plastic lumber for use as rub boards shall be UV stabilized UHMW or structural grade HDPE unless otherwise noted.

B. Attach polymer board and plastic lumber with stainless steel fasteners.

2.3 GUIDE PILE RUB BLOCKS

A. Rub blocks shall be black UHMW polyethylene sheet conforming to ASTM D 4020 2-inch-thick minimum. Blocks shall be secured with Type 316 stainless steel fasteners. Fasteners shall be counter bored to prevent fastener contact with the pile surface. Allow for a minimum block wear of 1 inch without damage to pile surface. Top and bottom edges of the block facing the guide pile shall be rounded to ¾ inch radius.

B. Rub Blocks shall be adjustable to accommodate Guide Pile installation tolerances; clearance between each Rub Block and the pile shall be adjusted to 1 inch maximum and 1/2 inch minimum under “no load” condition. Fixed blocks that bind within the guide are prohibited.

2.4 DOCK CLEATS

A. Dock cleats shall be ductile iron, hot dipped galvanized open base cleats Type 504H as supplied by Henderson Marine Supply or approved equal. Cleat locations and sizes shall be as indicated on the Drawings; attach cleats to the docks in accordance with the dock manufacturers’ recommendation.

2.5 SAFETY LADDERS

A. Ladders shall be Aluminum 600 Series.

B. Provide ladders in location specified on the Contract Drawings.

2.6 DOCK FENDER

A. Dock fenders shall be continuous minimum 3-inch D-type fenders black or white in color, non-marking as provided by Flexmaster, Fend-All or approved equal. The dock fender shall be applied to the exposed edges and corners of all docks.

B. Install all fenders per manufacturer’s recommendation on either a aluminum channel on the dock system or to a composite timber fascia, using large headed non-staining aluminum or stainless steel nails

2.7 WELDMENTS AND HARDWARE

C. Stainless steel hardware shall be Type 316 unless otherwise noted. Bolts shall be ASTM F 593 Group 2. Nuts shall be ASTM F 594 Group 2.

D. Fasteners for dock accessories shall be stainless steel unless otherwise noted.

2.8 PILE CAPS

A. Guide piles shall have a properly sized and fitted white, fiberglass minimum 1/8 inch thick pile cap as supplied by Henderson Marine Supply or approved equal. Mount in accordance with cap manufacturer's recommendations.

2.9 FIRE EXTINGUISHER CABINETS AND EXTINGUISHERS

A. Provide 10-pound 4A60BC UL Rated Fire Extinguishers in Henderson Fire Extinguisher cabinets, item 11-020 R or approved equal. Mount in accordance with the dock manufacturer's recommendations

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with approved shop drawings with connections tightened as required after complete installation of each unit of the work in the water and before final inspection.

B. All welding shall be performed under the supervision of properly certified welders and shall conform to the current specifications of the American Welding Society.

C. Fasteners shall not protrude beyond the fascia into the berthing area. Fasteners protruding above the surface of the deck shall have a low, rounded profile.

D. Bolts shall be of the size required, with adequate thread length. Holes for all lag bolts and screws shall be pre-drilled and turned into place. Driving is not allowed.

E. Composite timber shall be fabricated accurately to provide uniform gaps and butt joint connections. Lumber splices shall not exceed 1/2 inch between adjoining ends.

F. All wales, fascia, spacers, panels, or any other members, which are subject to foot traffic, shall be flush with aluminum walking surface.

3.2 DOCK ACCESSORIES

A. All dock accessories shall be installed in accordance with the drawings, specifications and the manufacturer's recommended method of installation.

B. Schedule installation of dock accessories to avoid damage from other work.

3.3 DOCK UTILITIES

A. Coordinate the location of piping and electrical conduit so as to avoid interferences with each other and dock system structure. Cutting or coring of structural members on account of utility interference shall not be permitted.

B. Support pipe and conduit by stainless steel mounting straps, brackets or hangers. Fasten using stainless steel screws to aluminum and composite wood. Pipe support shall allow sufficient pipe/conduit motion at dock system joints to prevent line failure due to flexing. For lines

suspended underneath the fascia board or aluminum framing, mounting straps shall allow a clearance of 1/2" between top of pipe/conduit and bottom of framing/fascial board to permit motion.

3.4 DOCK SYSTEM TOLERANCES

A. Install floating dock system to the planned dimensions within the tolerances shown on the project drawings or specified herein. Any float exceeding the allowable tolerances shall be removed and replaced.

B. Float Fabrication Tolerances:(allowable variation of construction dimension from nominal dimension shown on the project drawings)

1. Float Width: +/- 3 inches from nominal float width.

2. Float Depth: As required to satisfy freeboard requirements.

3. Note: The above tolerances are intended to permit flexibility adapting available framework for use on this project. Once the construction dimension is fixed by the Contractor, more stringent assembly tolerances shall govern.

C. Dock freeboard that is less than specified may be corrected by replacing polyethylene shells with units with more flotation or by placing supplemental flotation under the dock only with the approval of the Owner's Representative. Supplemental floats shall consist of polyethylene shells, 0.15inch minimum thickness, encapsulating expanded polystyrene foam cores designed for complete submersion in water with no vents or air valves. The floats shall interlock with the dock to prevent lateral displacement on accordance with the dock manufacturer's recommendation.

3.5 FIELD TESTING OF DOCK RESTRAINT SYSTEMS

A. Testing of the dock restraint systems shall be used to determine the actual dock restraint system capacity, number and embedment of the dock restraint systems for this dock system.

B. Contractor shall perform one (1) lateral load test in accordance with ASTM D 3966 to confirm guide pile capacity and geotechnical parameters used for design of guide piles. Guide pile selected for lateral load testing shall be ten (10) feet longer than the production pile length.

END OF SECTION 35 51 14