City and County of San Francisco
PORT OF SAN FRANCISCO

PIER 80 MOORING AND BERTHING IMPROVEMENTS

CONTRACT NO. 2871

PROJECT MANUAL

VOLUME 3 OF 3

(Division 00)

03/2025

Each Bid shall be enclosed in an envelope bearing the description:
''BID FOR PIER 80 MOORING AND BERTHING IMPROVEMENTS (Port of San Francisco Contract No. 2871)''.

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SECTION 02 40 00

MARINE DEMOLITION

PART 1GENERAL

1.1 SCOPE

A. The work of this section consists of the marine demolition and disposal detailed in this specification and Demolition Plans S-201 through S-209. Marine demolition includes removal and disposal of the following:

1. Existing fender system at Pier 80 along the North and East Berths comprised of approximately 14 to 16-inch diameter timber piles, waler, chock, and bull rail system.

2. Existing piles and pile stumps, decking, loose concrete, wood debris and other debris on the seafloor present in area Pier 80 footprint shown on S-201. All piles and pile stumps to be broken off to mudline.

3. Removal of asphalt topping at new bollard locations.

1.2 RELATED SECTIONS

A. Section 00 31 00 Available Project Information

B. Section 01 33 00 Submittals

C. Section 01 35 45 Health and Safety Criteria

D. Section 01 41 00 Regulatory Requirements

E. Section 01 57 19 Environmental Mitigation Measures

F. Section 01 57 20 Environmental Requirements Construction Over Water-In SF Bay

1.3 SUBMITTALS

A. Submittals shall follow the requirements of Section 01 33 00 – Submittal procedures.

1. Within fifteen (15) days of NTP contractor to submit Construction, Demolition and Debris Management Plan to the Port for approval. Plan shall provide a detailed description of methods and equipment to be used for marine demolition, sequence of operations, and details including but not limited to containment, disposal method and location. The demolition and removal procedures shall also provide for a review of a phased construction fencing plan. Plan shall include procedures for safe conduct of the work, including procedures and methods to provide necessary supports, anchoring, or mooring if required, care in removal and disposition of materials, protection of personnel, adjacent property, and existing facilities.

1.4 REQUIREMENTS

A. Project permits limit the in-water demolition to only occur during in-water work windows, June 15 through November 30.

B. Do not begin marine demolition work until authorization is received from the Port's Representative.

C. The work includes demolition and/or removal of all materials indicated or specified in this section and in Project Plans S-201 through S-209.

D. All materials resulting from demolition work shall become the property of the Contractor and shall be removed from the limits of the work site as soon as practicable. Material generated by the demolition shall be removed daily from the site. Store materials which cannot be removed daily in areas approved by the Port shall not be allowed to remain at the site more than 15 days. Do not allow accumulations outside the project boundaries.

E. Provide suitable off-site location for offloading, handling, sorting, and disposal of debris generated by the demolition. Contractor shall be responsible for locating and identifying the marine debris disposal sites.

F. Remove debris accumulated on structures as necessary to avoid loss of material during high tide or due to wave or wind action.

G. Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Construct a containment system to prevent contamination of San Francisco Bay when conducting demolition or other similar work.

H. During demolition activities, completely surround the work area with debris boom or similar to contain all floating debris. Floating debris shall be removed as necessary, but at least once per shift.

I. Take all precautions regarding the entry of foreign debris into the Bay water

J. Creosote-treated timber piles: Contractor shall extract, handle, and dispose of all piles in accordance with all project specifications and project permits. Treated Wood Waste (TWW) resulting from the demolition of piles and/or decking will be managed in accordance with Alternative Management Standards developed by the Department of Toxic Substances Control (DTSC). TWW will be handled by the Contractor under the presumption that the material is a non-hazardous waste which will be disposed of at a solid waste facility specifically licensed to accept TWW under the Alternative Management Standards as a non-hazardous waste per Section 01 57 20. Contractor is responsible for maintaining, handling and storing the TWW in accordance with DTSC requirements. These requirements include separating and preventing contact with other waste or materials. The Contractor will prevent ground contact of the TWW materials and prevent exposure to the public and managing proper documentation throughout the disposal process.

1.5 REFERENCES

A. ANSI - American National Standards Institute: A10.6 - Demolition Operations - Safety Requirements.

B. California Code of Regulations: Title 8 - Industrial Safety Orders, Construction Safety Orders.

1.6 PROTECTION

A. The Contractor shall conduct Work in such a manner to assure minimal interference and complete communication with Port and Pier 80 operations. Channels must not be blocked without prior authorization and per schedule, and vessel traffic must be allowed to continue with no interruptions.

B. During the marine demolition work, the Contractor shall continuously evaluate the condition of the site being demolished and take immediate action to protect all personnel working in and around the demolition site.

C. Contractor shall review any City utility maps and any Port utility drawings available at Port Engineering offices to assure that no utilities are in the area affected by the demolition operations prior to commencing demolition. It is the Contractor's responsibility to investigate and confirm if utilities are in the areas to be demolished and to protect all utilities from damage. If utilities are located in an area that could be affected by the Work, Contractor shall verify location of such utilities and exercise caution when working around these utilities. If required, Contractor shall arrange for utility disconnection as required by public or private utility companies.

D. Existing utilities in adjacent locations to remain in service. Contractor shall notify Port's Representative at least 48 hours in advance of, and obtain written approval for, a temporary utility service interruption. The interruption shall be the minimum duration approved by Port's Representative to accomplish the required work.

1.7 HAZARDOUS MATERIALS

A. Contractor shall perform hazardous materials testing of the marine debris removed to identify debris recycling and/or disposal requirements and shall submit demolition documentation to the Port. Contractor shall remove, handle, store, and dispose of marine debris in accordance with all City of San Francisco, State and Federal regulations and requirements.

1.8 ACCEPTANCE CRITERIA

A. Acceptance for Demolition will be based on Contractor field documentation, including daily field logs and photographs documenting demolition and progress of work within areas defined in Contract Sheet S-201, debris barge photographs documenting removal of piles, concrete, steel, and other loose debris removed from seafloor.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED AND DISPOSED

A. Existing piles and pile stumps, decking, loose concrete, wood debris and other debris on the seafloor present in area of Pier 80 footprint shown on S-201. All piles and pile stumps to be broken off to mudline.

B. Concrete and Asphalt Paving: Where concrete or asphalt is to be removed, saw paving along straight lines along limits of work to be removed to a depth of not less than 3/4-in., or to a depth that will not damage features required to remain.

C. Items not identified in the Contract documents which are encountered during the Contractor's work, shall be brought to the attention of the Port's Representative, who will determine what disposition is to be made of the item(s).

D. The Contractor shall provide and place bracing and shoring as necessary to prevent movement or damage to structures and improvements which are to remain. The

Contractor shall cease operations and notify the Port's Representative immediately if safety or any facility appears to be compromised or endangered. The Contractor shall not resume operations until safe conditions have been restored.

3.2 DISPOSITION OF MATERIAL

A. Title to Materials: Title to all materials and equipment to be removed, except as specified otherwise, is vested in the Contractor upon receipt of Notice to Proceed. The Port will not be responsible for the condition or loss of, or damage to, such property after Notice to Proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site but shall first be removed and transported by the Contractor to an offsite location.

B. Care in Removal: The Contractor shall take care to keep debris and other materials from falling into the water. No extra compensation shall be made for the retrieval and removal of floating or sunken demolition debris.

3.3 CLEANUP

A. Debris and Rubbish: Remove and transport debris and rubbish in a manner that will prevent spillage on sidewalks, parking areas or adjacent areas. Clean up spillage from sidewalks, parking areas and adjacent areas.

B. Regulations: Comply with Federal, State, and local hauling and disposal regulations.

END OF SECTION

SECTION 03 10 00

CONCRETE FORMS AND ACCESSORIES

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. The work under this Section consists of furnishing all materials, formwork, equipment, and labor to erect formwork for construction of cast-in-place concrete elements, including shoring, bracing, and anchorage, opening for other work, form accessories, and form stripping.

1.02 RELATED SECTIONS

A. Section 03 20 00 - CONCRETE REINFORCEMENT

B. Section 03 30 00 - CAST-IN-PLACE CONCRETE

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. 117.1 - Guide for Tolerance Compatibility in Concrete Construction; 2014.

2. 301 - Specifications for Concrete Construction; 2020.

3. 318 - Building Code Requirements for Structural Concrete and Commentary; 2014.

4. 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).

1.04 DESIGN REQUIREMENTS

A. Design, engineer, and construct formwork, shoring, and bracing to conform to design and code requirements. Resultant concrete shall conform to required shape, line, and dimension.

B. Where the Contractor elects to use self-consolidating concrete or concrete containing superplasticizers, forms shall be designed to accommodate the higher lateral pressures resulting from the more fluid plastic concrete.

1.05 SUBMITTALS

A. See Section 1.02 – Related Sections.

B. Shop Drawings: Indicate pertinent dimensions, materials, bracing, and arrangement of ties.

C. Submit drawings and calculations of shoring, sealed by a Civil Engineer, registered in the State of California to the Port for review prior to any concrete operations.

1.06 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 347R, ACI 301, and ACI 318.

1.07 REGULATORY REQUIREMENTS

A. Conform to applicable code for design, fabrication, erection, and removal of formwork.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver void forms and installation instructions in manufacturer's packaging.

B. Store void forms off ground in ventilated and protected manner to prevent deterioration from moisture.

PART 2 – PRODUCTS

2.01 FORMWORK - GENERAL

A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish concrete work.

B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.

C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

D. Comply with relevant portions of ACI 347R, ACI 301, and ACI 318.

2.02 FORM MATERIALS

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form facing for unexposed finish concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance. Lumber shall be dressed on at least two edges and one side for tight fit.

2. Form facing for exposed finish concrete: Metal, or other acceptable panel-type materials of known structural properties, of sufficient strength and stiffness to provide continuous, straight, smooth, exposed surfaces and prevent leakage. Furnish in largest practicable sizes to minimize number of joints.

2.03 FORMWORK ACCESSORIES

A. Form Release Agent: Commercial formulation form release agent with a maximum of 350 mg/l volatile organic compounds (VOCs) that will not bond with, stain, or

adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Composition: Colorless reactive, mineral oil-based, soy-based, or vegetable-oil based compound.

2. Do not use materials containing diesel oil or petroleum-based compounds.

B. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 3 inches to the plane of the exposed concrete surface.

C. Chamfer Strips: Chamfered, wood strip type; 1 x 1 inch size; maximum possible lengths.

D. Taper Tie Hole Plug: Mechanical device for plugging tie holes; anchors optional flush or recessed grout.

1. Products: Dayton Superior Corporation; A58 Sure Plug.

E. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and centers before proceeding with formwork. Ensure that dimensions agree with the Contract Drawings.

3.02 SHORES AND SUPPORTS

A. Comply with ACI 347R for shoring and reshoring. Unless otherwise noted, the Contractor shall shore or brace all existing construction during concrete operations. It shall be the sole responsibility of the Contractor to design and provide adequate shoring, bracing, formwork, etc. to protect life and property. Submit drawings and calculations of shoring, sealed by a Civil Engineer, registered in the State of California to the Port for review prior to any concrete operations.

3.03 ERECTION - FORMWORK

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

1. General: Design, erect, support, brace, and maintain formwork and existing structure used as supports or forms to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork

construction tolerances and surface irregularities complying with the following ACI 347R limits:

a. Provide Class A tolerances for concrete surfaces exposed to view.

b. Provide Class C tolerances for other concrete surfaces.

2. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

3. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, recesses, and the like for easy removal.

4. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

5. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

6. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.

7. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

8. Align joints and make watertight. Keep form joints to a minimum.

9. Obtain approval before framing openings in structural members that are not indicated on the Contract Drawings.

10. Provide chamfer strips on external corners of beams, joists, columns, and walls.

11. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.

12. Coordinate this section with other sections of work that require attachment of components to formwork.

13. If formwork is placed after reinforcement, resulting in insufficient concrete cover over reinforcement, request instructions from the Port before proceeding.

3.04 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

1. Verify that forms are clean and free of rust and other deleterious substances before applying release agent.

2. Do not allow excess form-release agent to accumulate in forms or come into contact with in-place concrete surfaces or reinforcing steel against which fresh concrete will be placed. Apply according to manufacturer's instructions.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.05 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.06 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

3.07 FORMWORK TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 117.1.

B. Camber slabs and beams in accordance with ACI 301.

3.08 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of pile caps, decks, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours for Precast concrete, or 7 days for Cast-in-place concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at least 75 percent of the specified 28-day minimum compressive strength. Determine potential compressive strength of in-place concrete by testing field-cured specimen's representative of concrete location or members. Contractor shall obtain cylinders for such testing independent of cylinders obtained by the Port's testing laboratory for quality assurance testing. Contractor shall use independent testing lab suitable to the Port for such testing and bear all related costs.

C. Form-facing material may be removed only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.09 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to the Port.

3.10 FIELD QUALITY CONTROL

A. An independent testing agency will conduct inspections and testing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

END OF SECTION 03 10 00

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 – GENERAL

1.01 SCOPE OF WORK

A. The work under this Section consists of furnishing all materials, formwork, equipment, and labor to install concrete reinforcement in precast and cast-in-place concrete elements. This section also includes fabrication, certification, and inspection of the reinforcement and accessories for steel reinforcement.

1.02 RELATED SECTIONS

A. Section 03 10 00 - CONCRETE FORMS AND ACCESSORIES

B. Section 03 30 00 - CAST-IN-PLACE CONCRETE

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. 301 - Specifications for Concrete Construction; 2020.

2. SP-66 - ACI Detailing Manual; 2004.

B. American Society for Testing and Materials (ASTM)

1. A416/A416M - Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete; 2015.

2. A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 15ae1.

3. A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2015.

4. A970 - Headed Steel Bars for Concrete Reinforcement; 2018.

5. A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2017.

C. American Welding Society (AWS)

1. D1.1/D1.1M - Structural Welding Code – Steel; 2015.

2. D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2017.

D. Concrete Reinforcing Steel Institute (CRSI)

1. (DA4) - Manual of Standard Practice, 29th Edition; 2017 w/Errata.

2. (P1) - Placing Reinforcing Bars, 10th Edition; 2019.

1.04 SUBMITTALS

A. Contractor shall submit the following documents for review by the Port. The review by the Port shall not relieve the Contractor of responsibility from compliance with the Contract Drawings and Specifications. Submittals shall be made sufficiently ahead of installation to allow the Port to review and for any re-submittals that may be required. Normally, submittals will be processed and returned to the Contractor within (10) working days of receipt.

1. Manufacturer's Certificate: Certify that prestressing strands, spiral wire, reinforcing bars, and accessories supplied for this project meet or exceed specified requirements.

2. Reports: Submit certified copies of mill test reports for each heat of reinforcing provided to the project, documenting compliance with the applicable ASTM specification, including chemical analysis, tensile tests, and bend tests.

3. Product data: Provide manufacturer’s information and ICC ES reports for the following: mechanical couplers, deformed bar anchors, and headed reinforcement.

4. Shop drawings shall be prepared and submitted in accordance with ACI SP-66 and CRSI Manual of Standard Practice.

5. Where welding of reinforcement is permitted and approved by the Port, provide welding procedure specifications (WPSs) for each unique type of weld of reinforcing steel.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301.

B. Identification of Reinforcement: The Contractor shall provide documentation with each load of reinforcement shipped to the project to indicate the manufacturer(s) and heat number(s) of all reinforcing bars included in the shipment, including mill certificates pertinent to each heat of reinforcing bars.

1. Reinforcing bars that are not so identified shall be tested to document compliance with the physical and chemical properties of the applicable ASTM specification.

C. Testing Service: the Port will engage an approved testing lab to perform all production work tests and inspections. The Contractor shall engage a testing laboratory to provide required submittals data, including strength tests on alternate materials.

1. Materials and installed work may require testing and retesting at any time during progress of work.

D. Special Inspection: Special Inspection is required for the following elements of the work:

1. Reinforcing steel placement: The special inspector shall verify the following.

a. The reinforcing grade, size, number, location, and bend detailing are as shown on the Contract Drawings and are in acceptable condition.

b. All required devices have been properly installed to secure the reinforcement in place during the placement of concrete.

E. Welding of Reinforcing Steel (where approved by the Port). Verify the following:

1. An appropriate approved welding procedure specification (WPS) is available at the site and that the welder has properly considered the process to be performed and the joint configuration.

2. The welder follows the essential variables of the WPS.

3. The materials and process comply with the applicable provisions of AWS D1.1/D1.1M and AWS D1.4/D1.4M, and these specifications.

4. Each welder has satisfactorily passed appropriate AWS qualification tests for the procedure to be performed, and if pertinent, has undergone recertification.

PART 2 – PRODUCTS

2.01 REINFORCEMENT

A. Reinforcing Steel:

1. Deformed carbon-steel bars - ASTM A615/A615M Grade 60, or

2. Deformed low-alloy steel bars - ASTM A706/A706M Grade 60

B. Headed Reinforcing Bars: ASTM A970; HRC 555 T-heads (ICC ESR-2935) or approved equal.

C. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gage.

2. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Provide supports with legs that are solid plastic (CRSI Class 1).

2.02 FABRICATION

A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.

B. Welding of reinforcement is permitted only with the specific approval of the Port's Representative. Perform welding in accordance with AWS D1.4/D1.4M.

PART 3 – EXECUTION

3.01 PLACEMENT

A. Place, support, and secure reinforcement against displacement. Do not deviate from required position.

B. Welding of reinforcing steel shall only be permitted for bars conforming to ASTM A706/A706M.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcing as indicated on the Contract Drawings.

3.02 FIELD QUALITY CONTROL

A. An independent testing agency will inspect installed reinforcement for conformance to contract documents before concrete placement.

B. Special Inspection of reinforcing steel shall include the following:

1. Confirm bar size, bends, condition, and placement, and adequacy of ties and support.

2. Full-time inspection of welds, including verification of bar material, availability of welding procedure specification (WPS) and conformance with WPS.

3. Perform site bend test on 10% of all deformed bar anchors and headed studs, in accordance with AWS D1.4/D1.4M.

END OF SECTION 03 20 00

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Concrete slabs and beams.

B. Concrete pedestals.

C. Joint devices associated with concrete work.

D. Miscellaneous concrete elements, including equipment pads.

E. Concrete curing.

F. Non-shrink grout.

1.02 RELATED SECTIONS

A. Section 03 10 00 - CONCRETE FORMS AND ACCESSORIES

B. Section 03 20 00 - CONCRETE REINFORCEMENT

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1. 211.1 - Selecting Proportions for Normal-Density and High Density Concrete - Guide; 2022.

2. 212.3R - Report on Chemical Admixtures for Concrete; 2016.

3. 301 - Specifications for Concrete Construction; 2020.

4. 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

5. 304.2R - Guide to Placing Concrete by Pumping Methods; 2017.

6. 305R - Guide to Hot Weather Concreting; 2020.

7. 306R - Guide to Cold Weather Concreting; 2016.

8. 308R - Guide to External Curing Concrete; 2016.

9. 309R - Guide for Consolidation of Concrete; 2005.

10. 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2019.

B. American Society for Testing Materials (ASTM)

1. C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2019.

2. C33/C33M - Standard Specification for Concrete Aggregates; 2013.

3. C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.

4. C42/C42M - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete; 2020.

5. C94/C94M - Standard Specification for Ready-Mixed Concrete; 2017.

6. C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2021.

7. C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

8. C150/C150M - Standard Specification for Portland Cement; 2015.

9. C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete; 2020.

10. C157/C157M - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete; 2017.

11. C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.

12. C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2014a.

13. C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.

14. C227 - Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method); 2010.

15. C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016)

16. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.

17. C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.

18. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2017.

19. C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.

20. C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2017.

21. C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete; 2017.

22. C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.

23. C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2020.

24. C1260 - Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method); 2021.

25. C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction; 2020a.

C. California Department of Transportation (Caltrans)

1. CTM 217 - Method of Test for Sand Equivalent; 2011.

2. CTM 227 - Method of Test for Evaluating Cleanness of Coarse Aggregate; 2012.

D. U.S. Army Corps of Engineers (USACE)

1. CRD-C621 - Specification for Non-Shrink Grout; 1988.

1.04 SUBMITTALS

A. Submit the following to the Engineer for review, prior to performing work.

1. Mix designs and test data for concrete mixes, 15 days minimum prior to intended placement. Mix design submittals shall include, as a minimum, the following:

a. List of materials proposed weights and volumes of each material per cubic yard.

b. Specification of source for each material.

c. Gradation listing of aggregates and certification that coarse and fine aggregates meet the requirements listed in the Concrete Materials Article of this Section.

d. List of admixtures, with manufacturer's data sheets.

e. Certification that all aggregates are compatible with the proposed cement.

2. Drawings indicating proposed locations of construction joints and control joints.

3. Description of curing methods proposed and products to be employed.

4. Laboratory test reports to justify the compressive strength of each proposed mix design.

B. Submit the following to the Engineer for record:

1. Product data and Material Safety Data Sheets (MSDS) for proprietary materials and items, including curing compounds, epoxy resins, surface treatments and proprietary anchoring systems.

2. Tickets for each batch of concrete delivered to the jobsite containing the following information:

a. The mix identification number.

b. The specified compressive strength.

c. The volume of concrete in the delivery truck.

d. The time the concrete was batched (i.e., the time that water was discharged into the delivery truck to mix with the cement and aggregates).

e. List of admixtures.

f. Slump of concrete as placed.

g. Volume of water added to the delivery truck after initial batching.

h. Location where the concrete is being placed, including plan location and story.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

1. Maintain one copy of each document on site.

B. For each class of concrete, acquire cement from one source and aggregate from one source for the entire project.

C. Follow recommendations of ACI 305R when concreting during hot weather.

D. Follow recommendations of ACI 306R when concreting during cold weather.

E. The Contractor shall engage a testing laboratory to provide required submittals data including concrete mix design tests and strength tests on alternate materials.

1. Materials and installed work may require testing and retesting at any time during progress of Work.

F. Testing Service: A representative of the Port will engage an approved testing lab to perform all production work tests, and inspections. The Ports's Testing Service shall also be known as the Special Inspector.

1. The Ports's Testing Service shall review all mix designs and confirm their appropriateness for the intended purpose.

G. Special Inspection: Special Inspection is required for the following elements of the work.

1. Placement of concrete: The special inspector shall verify the following.

a. The concrete delivered to the job has been prepared with the approved mix design appropriate for the application and is transported and placed within the time and under the conditions permitted by ASTM C94/C94M and this specification.

b. The concrete is placed, consolidated, and finished as indicated on the drawings.

c. Test specimens are taken and cured as indicated in this specification.

PART 2 – PRODUCTS

2.01 FORMWORK

A. Comply with requirements of Section 03 10 00 - CONCRETE FORMS AND ACCESSORIES.

2.02 REINFORCEMENT

A. Comply with requirements of Section 03 20 00 - CONCRETE REINFORCEMENT.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.

B. Fine and Coarse Aggregates: ASTM C33/C33M. Aggregates shall be hard durable material from established sources with proven records of successful use in providing concrete with minimum shrinkage.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that may cause spalling.

2. Coarse Aggregate: Cleanness value not less than 75 when tested per Caltrans CTM 227.

3. Fine Aggregate: Sand equivalent not less than 75 when tested per Caltrans CTM 217.

4. The restriction on alkali-aggregate reactivity noted in Sections 7.3 and 11.2 of ASTM C33/C33M shall apply. Aggregates shall be tested according to ASTM C227, C1260, or C1293 and shall be considered innocuous if the limits provided in Appendix X1 of ASTM C33/C33M are met.

C. Fly Ash: ASTM C618, Class F.

D. Ground Granulated Blast Furnace Slag: ASTM C989, Grade 100 or 120.

E. Silica Fume: ACI 211.1.

F. Water: Clean and not detrimental to concrete.

2.04 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.

1. 1. Products:

a. Hycrete, Inc; W1000: www.hycrete.com.

b. W.R. Meadows, Inc.; ADI-CON CW Plus: www.wrmeadows.com.

c. Xypex Chemical Corporation; XYPEX Admix C-500: www.xypex.com.

C. General: As approved by Engineer. Conform to ACI 212.3R Concrete admixtures shall not contain calcium chloride.

D. Air Entrainment Admixture: ASTM C260/C260M, certified by manufacturer to be compatible with other required admixtures.

E. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing, Type B - Retarding, Type C - Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating, Type F - Water Reducing, High Range, and Type G - Water Reducing, High Range and Retarding.

1. The Contractor may propose the use of admixtures not conforming to ASTM C494/C494M. Such admixtures may be used with prior review and approval of Engineer. Approval of such admixtures is at the sole discretion of Engineer.

2.05 ACCESSORY MATERIALS

A. Bonding Agent: Two-component, 100% solids, moisture-tolerant, structural epoxy adhesive product compliant with ASTM C881/C881M.

1. Sikadur 32 Hi-Mod LPL, manufactured by Sika Corp.

2. MasterEmaco P 124, manufactured by BASF Master Builders Solutions.

3. Euco #452 Series or Duralcrete Series, manufactured by Euclid Chemical Company.

4. FX-752 Epoxy Bonding Agent, manufactured by Denso.

5. Approved equivalent.

B. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, shrinkage compensating agents, Portland cement, water reducing and plasticizing agents. Product shall be non-corrosive and non-staining, complying with COE CRD-C621 and ASTM C1107.

1. Minimum Compressive Strength at 48 Hours: 2,000 psi.

2. Minimum Compressive Strength at 28 Days: 4,000 psi.

3. Flowable Products:

a. Sikagrout 212, manufactured by Sika Corp.

b. MasterFlow 713, manufactured by BASF Master Builders Solutions.

c. NS Grout, manufactured by Euclid Chemical Company.

d. FX-229, manufactured by Denso.

e. Approved equivalent.

C. Moisture-Retaining Cover: ASTM C171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.

D. Liquid Curing Compound: ASTM C309, Type 1-D, clear or translucent with fugitive dye. Moisture loss not more than 0.5 kg per square meter of surface in 72 hours when tested per ASTM C156.

1. Liquid curing compound shall form a uniform, continuous adherent film that will not check, crack, or peel, and shall be free of holidays, pinholes, or imperfections.

2. Liquid curing compound shall not affect the proper bonding of waterproof membranes, floor coverings, surface coverings or paint.

2.06 BONDING AND JOINTING PRODUCTS

A. Construction Joint Devices: Integral galvanized steel; 0.027 inch thick, formed to tongue and groove profile, knockout holes spaced at 6 inches, ribbed steel spikes with tongue to fit top screed edge.

2.07 CONCRETE MIX DESIGN

A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.

B. Concrete Strength: Establish required average strength for each class of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.

1. For trial mixtures method, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.

a. Do not use the same testing lab for field quality control testing.

2. Mix designs shall be accompanied by compressive tests and slump test reports; and by standard deviation analysis if field experience method is used.

C. Aggregate Size and Gradation.

1. Maximum aggregate size for each class of concrete is indicated on the drawings.

2. Select the aggregate size range for each class of concrete to produce a well-graded mixture of aggregate sizes.

a. For 1-1/2-inch maximum aggregate size, no more than 50 percent by weight of the total coarse aggregate shall pass through a 3/4-inch square sieve.

b. For 1-inch maximum aggregate size, no more than 50 percent by weight of the total coarse aggregate shall pass through a 1/2-inch square sieve.

c. For 3/4-inch maximum aggregate size, no more than 50 percent by weight of the total coarse aggregate shall pass through a 3/8-inch square sieve.

d. For 1/2-inch maximum aggregate size, no more than 50 percent by weight of the total coarse aggregate shall pass through a No. 4 square sieve.

e. For 3/8-inch maximum aggregate size, no more than 50 percent by weight of the total coarse aggregate shall pass through a No. 8 square sieve.

D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

1. Admixtures may be used only with prior approval of Engineer.

2. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

   a. Modify the dosage of air-entraining admixtures when also employing mid-range water reducers, which may entrain additional air.

3. Use admixtures for water reduction and set accelerating or retarding in strict compliance with manufacturer's directions.

E. Mix Design requirements for each class of concrete shall be as indicated on the drawings.

F. Control of Drying Shrinkage.

1. Concrete mix designs for all elements other than foundations shall be designed to produce concrete with a 35-day (total) drying shrinkage of less than 0.045 percent.

2. Drying shrinkage shall be determined from tests performed in accordance with ASTM C157/C157M.

3. Test specimens for shrinkage tests shall be 4-inch by 4-inch by 11.25-inch prisms.

4. Documentation of successful drying shrinkage tests shall be provided for each mix design as part of the Contractor's mix design submittals.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Not less than 2 inches and not more than 4 inches for concrete without high-range water-reducing admixtures (superplasticizers).

2. Concrete containing high-range water-reducing admixture (superplasticizer): Not more than 8-inches.

H. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in Work.

I. Mix Design Limitations:

1. Portland Cement content: Maximum of 80 percent by weight of total cementitious materials.

2. Fly Ash content.

a. Elevated slabs: Maximum 25 percent by weight of total cementitious materials.

b. Other applications: Maximum 35 percent by weight of total cementitious materials.

3. Ground Granulated Blast Furnace Slag content: Maximum 40 percent by weight of total cementitious materials.

4. Silica Fume Content: Maximum 7 percent by weight of total cementitious materials.

5. Water-Cementitious Material ratio: Maximum 40 percent by weight.

6. Total air content, determined in accordance with ASTM C173/C173M:

a. Interior applications and exterior applications not subject to freeze/thaw conditions: 2% maximum.

2.08 MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C94/C94M, and as specified.

1. Mixing and delivery time shall be limited to 90 minutes.

a. When air temperature is between 85 and 90 degrees Fahrenheit, reduce mixing and delivery time to 75 minutes.

b. When air temperature is above 90 degrees Fahrenheit, reduce mixing and delivery time to 60 minutes.

c. Longer mixing and delivery times may be approved by Engineer for mix designs containing appropriate admixtures to improve flowability and increase set time.

2.09 TEMPERATURE CONTROL

A. Concrete elements that are subject to temperature control requirements include the following:

1. Concrete elements with minimum cross-sectional dimensions of 4 feet or greater.

B. Temperature control requirements are as follows:

1. Maximum element core temperature: 160 degrees Fahrenheit.

2. Maximum temperature differential between core and element surface: 35 degrees Fahrenheit.

3. Maximum temperature differential between element surface and ambient air: 35 degrees Fahrenheit.

C. The Contractor shall submit for approval an analysis of the heat expected to be generated by curing of all concrete elements subject to temperature control requirements. If the analysis indicates that the specified relative or absolute temperature increase will be exceeded, the Contractor shall propose the means to control the heat. The analysis and temperature-control proposal shall be prepared by a professional engineer licensed in the State of California.

D. Means to control the temperature of concrete during curing may include:

1. Cooling of mix water or concrete aggregates.

2. Partial replacement of mix water with finely chipped ice.

3. Addition of pozzolans as partial replacement for portland cement.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

B. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3.03 JOINTS

A. Construction Joints: Locate and install construction joints as indicated on the drawings. Additional construction joints may be provided with prior approval of Engineer.

1. Prior to placing concrete against hardened concrete, thoroughly roughen existing concrete surface to 1/4-inch amplitude. Apply bonding agent, in accordance with manufacturer’s instructions, on all hardened concrete surfaces that will be joined with fresh concrete.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Notify Engineer not less than 24 hours prior to commencement of placement operations.

C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

D. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.

E. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. Deposit concrete to avoid segregation at its final location.

F. Do not allow fresh concrete to fall more than 8 feet without using pipes, tubes, or other means to prevent segregation.

G. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints. At construction joints or placements against existing concrete, thoroughly roughen surface to 1/4-inch amplitude, clean off all dust and debris and place bonding agent immediately prior to concrete placements.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309R.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305R and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 degrees Fahrenheit. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide uniformity of color and texture through one of the following methods:

1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

2. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.

3. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.

D. Curbs, slabs, and pads: Round exposed edges and corners with 1/2-inch radius, except where chamfered as indicated in Section 03 10 00 - CONCRETE FORMS AND ACCESSORIES.

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Normal concrete: Not less than 7 days.

2. High early strength concrete: Not less than 4 days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified for surfaces not in contact with forms.

D. Surfaces Not in Contact with Forms:

1. Begin curing as soon as free water has disappeared and before surface is dry.

2. Initial Curing: When concrete bleed rate, concrete temperature, ambient temperature, relative humidity, wind speed, and solar heating create a risk of premature drying, keep concrete surface continuously moist by water

ponding, water-fog spray, or saturated burlap. Start as soon as free water has disappeared and before surface is dry.

a. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 3 days.

b. Spraying: Spray water over floor slab areas and maintain wet.

c. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.

3. Intermediate Curing: When concrete finishing is completed before final set of the concrete and when final curing methods might damage the concrete either mechanically or by raising the water/cement ratio of the near-surface region, conduct intermediate curing using evaporation retarder or fogging.

4. Final Curing: Begin final curing immediately after finishing is complete, after the concrete has reached final set and will not be damaged by final curing operations. Employ one or a combination of the following methods:

a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.

b. Moisture-retaining cover: Place in widest practicable width with sides and ends lapped at least 3 inches. Seal in place with waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

c. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

(1) Reapply curing compound to surfaces that are subject to rainfall within three hours of initial application.

(2) Reapply compound to surfaces subject to traffic or construction operations that wear down or damage the membrane.

3.07 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Engineer.

B. Mix dry-pack mortar, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be

patched with bonding agent. Place patching mortar before bonding agent has dried.

2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability or strength. If defects cannot be repaired, remove, and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability or strength. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.

4. Repair defective areas, except single holes not exceeding 1-inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated single holes 1-inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs with prior acceptance of Engineer as to method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.08 FIELD QUALITY CONTROL

A. An independent Testing Agency will perform field inspection and quality control testing.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

D. Sampling and testing for quality control during concrete placement shall include the following.

1. Sampling Fresh Concrete: ASTM C172/C172M, except modified for slump to comply with ASTM C94/C94M.

    a. Slump: ASTM C143/C143M; one test at point of discharge for each set of compression test specimens; additional tests when concrete consistency seems to have changed.

    b. Concrete Temperature: ASTM C1064/C1064M; One test hourly when air temperature is 40-degrees Fahrenheit and below or 80-degrees Fahrenheit and above, and one test for each set of compressive-strength specimens.

2. Compression Test Specimens: ASTM C31/C31M; One set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

    a. Take one additional test cylinder per set during cold-weather concreting (as defined in "Cold-Weather Placement" paragraph of "Placing Concrete" Article of this Section) cured on job site under same conditions as the concrete it represents.

3. Compressive-Strength Tests: ASTM C39/C39M; One specimen shall be tested at 7 days, two specimens tested at 28 days, and one specimen retained for later testing if required.

   a. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 300 psi.

   b. Frequency of tests: A minimum of one set of cylinders shall be tested for any individual structural element or each day's placement of a class of concrete exceeding 25 cu. yd. An additional set of cylinders shall be tested for each 100 cu. yd. of each class of concrete.

      (1) When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

4. Continuous inspection is required during concrete placement.

5. Verify that specified curing temperatures and techniques are maintained.

6. Test and inspection results shall be reported in writing to the Port, Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, specified compressive strength (f'c), concrete mix proportions and materials, compressive breaking strength, and age of concrete at break.

7. Additional Tests: The testing lab will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing lab may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M, or by other methods as directed.

3.09 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

C. Repair or replacement of defective concrete will be determined by Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.10 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

3.11 CLEAN-UP

A. Remove from site and properly dispose of all debris from work of this section.

END OF SECTION

SECTION 03 82 16

POST-INSTALLED ANCHORS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Adhesive anchors (threaded rods or deformed bar dowels) set in holes drilled in concrete.

B. Bollard anchors

1.02 RELATED SECTIONS

A. Section 03 30 00 - CAST-IN-PLACE CONCRETE

1.03 REFERENCE STANDARDS

A. American Society for Testing Materials (ASTM)

1. E488 - Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements; 2022.

2. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

B. International Code Council (ICC)

1. ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; ICC Evaluation Service, Inc.; 2017 (Revised 2020).

2. ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; ICC Evaluation Service, Inc.; 2022.

1.04 SUBMITTALS

A. ICC-ES reports for products proposed as alternatives to those specified.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.

2. Installation methods.

3. Storage and handling requirements and recommendations.

4. Data sheets.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm having a minimum of five years of experience producing products of the type specified, with a complete line of installation tools and accessories.

B. The Port will engage a qualified independent Testing Agency to perform testing and inspection related to the work specified in this Section.

1. The Testing Agency shall verify the following.

a. The specific manufacturer and model of anchors have been approved for the application by the Engineer.

b. The holes are drilled at the angle required and of the diameter and depth required.

c. The holes are clean prior to installation of the anchors.

d. The adhesive packaging indicates an expiration date, and that the expiration date has not passed.

e. The adhesive is mixed properly and that the initial portion of adhesive coming out of the nozzle is wasted, as required by the manufacturer.

f. Expansion anchors are installed with the manufacturer's specified torque.

g. The anchors are installed according to the manufacturer’s recommendations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of leftover materials in accordance with requirements of local authorities having jurisdiction.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 – PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Adhesive Anchors in Concrete.

1. SET-3G, manufactured by Simpson Strong-Tie (ICC ESR-4057).

2.02 MATERIALS

A. Anchors: Steel reinforcing bars.

1. Diameter: As indicated on drawings.

2. Length: As indicated on drawings.

3. Chain anchorage reinforcing bar dowels to be threaded on one end to allow for bolted connection to padeyes.

B. Anchors: Threaded steel rods with hex nuts.

1. Material: As indicated on drawings.

2. Diameter: As indicated on drawings.

3. Length: As indicated on drawings.

C. Anchor Bonding Adhesive.

1. Complying with requirements of ICC ES AC308; independent agency certified; in addition to basic testing, show ability to withstand creep and ability to withstand seismic forces.

D. Accessories and Tools: As recommended by adhesive manufacturer, including:

1. Screens for use in hollow and unreinforced masonry, to hold adhesive in place until cured.

2. Retaining plugs to hold adhesive and anchor in place in overhead applications.

3. Brushes for cleaning anchor holes.

4. Dispensing tools.

E. Shrink-Resistant Grout

1. As specified in Section 03 30 00 - CAST-IN-PLACE CONCRETE.

PART 3 – EXECUTION

3.01 PREPARATION

A. Locate existing reinforcing in the area where holes are to be drilled through nondestructive means. Mark the locations of existing reinforcing on the surface of the existing concrete or masonry.

B. Do not begin installation until conditions are such that anchors will not be disturbed before complete adhesive curing is complete.

C. Plan installation so that adhesive can be installed in optimum manner to achieve good bonding.

D. Ensure that anchors are free of grease, oil, dirt, and other foreign material.

3.02 INSTALLATION

A. Do not drill holes for anchors where existing reinforcing will interfere with proper drilling.

B. Drill holes of proper diameter and depth, in accordance with adhesive manufacturer's published structural design information.

1. If holes cannot be drilled to the proper depth due to obstructions within the existing material, abandon shallow holes and fill with non-shrink grout. Drill the replacement hole for each abandoned hole at the location indicated by the Engineer.

C. Blow out and brush holes, removing dust and debris.

D. Install in strict accordance with manufacturer's instructions and recommendations.

E. Installation limitations for adhesive anchors installed in concrete:

1. Install adhesive anchors in holes drilled with a rotary impact drill or rock drill. Do not install adhesive anchors in core-drilled holes.

2. Do not install adhesive anchors in concrete having strength less than 2,500 psi, age less than 21 days, or temperature less than 50 degrees Fahrenheit.

3.03 FIELD QUALITY CONTROL

A. Contractor shall notify the Port 48 hours in advance of installing anchors to ensure proper structural observation and Special Inspection.

B. An independent Testing Agency will perform field quality control tests.

C. The Testing Agency shall perform tests of anchors according to ASTM E488 and as follows:

1. Test ten percent of each application of anchors to the tensile or torque proof load as indicated on the drawings.

a. One application of anchors or dowels shall be defined as those anchors or dowels of the same type, diameter and depth installed by a single crew in a single day.

b. Test locations are random at the discretion of the testing lab, unless otherwise directed by the Engineer.

c. Test at least one anchor in each unique installation condition.

2. Tension test loads shall be maintained for a minimum of two minutes.

3. Tension test criteria:

   a. Anchor displacement at the end of the loading period shall be limited to one-fifth of the nominal anchor diameter.

   b. Displacement following release of the test load shall return to zero.

4. Torque test criteria:

   a. Anchors 1/2" diameter and larger: Test torque must be reached within 1/2 turn of the nut.

   b. Anchors 3/8" diameter and smaller: Test torque must be reached within 1/4 turn of the nut.

5. Anchors that fail tests shall be replaced and retested.

   a. All anchors in the same application as the failed anchor shall be tested, until 10 consecutive anchors pass.

3.04 PROTECTION

A. After cleaning, protect holes from contamination prior to anchor installation.

B. Do not disturb anchors until minimum cure time to loading has passed.

C. Protect installed products until completion of project.

D. Replace damaged and improperly installed anchors at the direction of the Engineer.

3.05 CLEANUP

A. Remove from site and properly dispose of all debris from work of this section.

END OF SECTION 03 82 16

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SECTION 35 59 13.16

RESILIENT FOAM-FILLED FENDERS

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

A. The work under this Section consists of the design, fabrication, testing, and delivery of resilient foam-filled fender units and associated hardware to the project site.

B. The Fender Supplier shall furnish the foam-filled fender units, the support chains, and all hardware required for attaching the fender to the chains and chains to the bracket connections located on the berths.

C. All items furnished by the Fender Supplier must follow the Plans, the Specifications, and the standards referenced herein.

1.02 REFERENCE STANDARDS

A. American Bureau of Shipping (ABS)

1. 2 – Rules for Building and Classing Steel Vessels; 2019.

B. American Welding Society (AWS)

1. D1.1/D1.1M – Structural Welding Code – Steel; 2015.

C. American Society for Testing and Materials (ASTM)

1. A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2022.

2. A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

3. A413/A413M – Standard Specification for Carbon Steel Chain; 2021

4. D395 – Standard Test Methods for Rubber Property – Compression Set; 2018.

5. D412 – Standard Test Methods for Vulcanized Rubber Property and Thermoplastic Elastomers – Tension; 2016 (Reapproved 2021).

6. D470 – Standard Test Methods for Crosslinked Insulations and Jackets for Wire and Cable; 2021.

7. D624 – Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer; 2000 (Reapproved 2020).

8. D1052 – Standard Test Method for Measuring Rubber Deterioration – Cut Growth Using Ross Flexing Apparatus; 2009 (Reapproved 2019).

9. D1149 – Standard Test Method for Rubber Deterioration – Cracking in an Ozone Controlled Environment; 2018.

10. D1630 – Standard Test for Rubber Property – Abrasion Resistance (Footwear Abrader); 2021.

11. D1667 – Standard Specification for Flexible Cellular Materials – Poly (Vinyl Chloride) Foam (Closed-Cell); 2022.

12. D2240 – Test Method for Rubber Property-Durometer Hardness; 2015 (Reapproved 2021).

13. D3575 – Standard Test Methods for Flexible Cellular Materials Made from Olefin Polymers; 2020.

14. F1145 – Standard Specification for Turnbuckles, Swaged, Welded, Forged; 2005 (Reapproved 2022).

15. F2192 – Standard Test Method for Determining and Reporting the Berthing Energy and Reaction of Marine Fenders; 2005 (Reapproved 2022).

D. U.S. General Services Administration (GSA)

1. FS RR-C-271 (Rev F) – Chains and Attachments, Welded and Weldless; 2011.

1.03 SUBMITTALS

A. The Manufacturer shall submit the following documents for review and approval by the Port. The review by the Port shall not relieve the Manufacturer of responsibility from compliance with the Plans and Specifications. Submittals shall be made sufficiently ahead of fabrication, shipment, and installation to allow the Port to review and approve.

B. Design Data – Prior to fabrication, submit literature for the proposed fender product, including the following:

1. Fender Unit Dimensions.

2. Fender Unit Rated Performance Data (RPD) – Submit copies of the following performance curves for each fender type. RPD shall be submitted per ASTM F2192.

    a. Reaction and percent compression curve.

    b. Energy and percent compression curve.

3. Chain Assembly Performance Data – Specify the following for both the internal and supporting chain assemblies for each fender type:

    a. Safe working load (Service.)

    b. Proof load.

    c. Breaking load.

4. Material specifications for all components for each fender type.

5. Method of manufacture for each fender type.

6. Product Warranty for each fender type.

C. Test Reports – Submit copies of reports for the following tests for each fender type. The tests shall have been performed within three years of submittal of the reports for review.

1. Fender cyclic-compression test.

2. Fender sustained-load test.

3. Fender pull-through test.

4. Skin thickness core test.

D. Certificates – Submit certificates of compliance certifying that materials meet the requirements of these Specifications.

E. Galvanized Steel Hardware – Provide certificates of conformance or compliance certifying that surface preparation, coverage, and thickness meet the requirements of these Specifications.

F. Coatings – For any proposed coating system, submit manufacturer and product information for review.

G. Samples – Provide a sample of the colored elastomer skin.

H. Installation Instructions – Provide installation instructions for each fender type, including dimensions, method of assembly, and hardware details.

I. Operation and Maintenance Instructions – Provide fender manual for each fender type.

1.04 DELIVERY, HANDLING, & STORAGE

A. Rejection – Fender units that are delivered to the site in a damaged condition or that are not in conformance with this specification are subject to rejection. Any rejected materials shall be replaced with suitable materials at no additional cost to the Port.

B. Fender Marking – Unless otherwise specified, all fender units shall be identified in readable characters at least 1 in. high, either directly or on corrosion and sunlight resistant permanently attached tags. The markings shall include the following:

1. Full or abbreviated manufacturer name.

2. Fender size model or part number designation.

3. Fender serial number.

4. ASTM designation (including type, grade, and class) or ISO number and year, as applicable.

5. Rated performance (energy and reaction).

C. Installation Instructions – The Fender Supplier shall provide installation instructions for the Construction Contractor to follow for each fender type provided. Instructions shall include methodology for lifting and recommendations for the use of slings or other protective devices.

D. Maintenance & Operational Instructions (Fender Manual) – The Fender Supplier shall provide a Fender Manual describing operational and maintenance requirements for each fender type provided.

E. Handling Coated Material

1. Store, handle, and place coated material in a manner that will minimize damage to the coating and will not reduce its effective protective value.

2. Repair damaged surfaces as directed by the Port and per the Manufacturer's recommendations.

3. Handle coated work which is flexible in a manner that will prevent flexing sufficient to crack coating, especially when temperature is below 40 degrees F.

4. Do not place coated surfaces on strips or skids until coating has hardened thoroughly.

5. In transporting, fasten and protect coated materials in a manner that will prevent movement and preclude chafing and rubbing, and when unloading, do not dump or drop. Place coated material in position carefully on suitably prepared beds and with minimal handling. Wide fabric slings used for lifting, and strips, slings, blocks, skids, cradles, and other supports shall provide ample bearing areas.

1.05 QUALITY ASSURANCE

A. Elastomer Skin – The elastomer skin of the fender units shall have a smooth surface, free from cracks, burrs, warpage, checks, chipped, or blistered surfaces.

B. Foam Core – The foam core shall be homogeneous and of one-piece fabricated construction and shall not be in chip or granular form. The foam core shall not contain scraps, strips, or sheets of foam either rolled or stuffed into the required shape unless pieces are bonded together in layers of uniform patterns to form a homogeneous, one-piece core.

C. Steel Fabrication – The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be detrimental to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. Make bends by controlled means to ensure uniformity of size and shape.

D. Welding – All structural welding shall be done in accordance with the provisions of AWS D1.1/D1.1M. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

1.06 WARRANTY

A. The Fender Supplier shall furnish the Manufacturer’s warranty. The warranty shall be issued directly to the Port and shall not be limited in dollar value. The warranty period shall be not less than 24 months from the date of substantial completion.

PART 2 – PRODUCTS

2.01 RESILIENT FOAM-FILLED FENDERS

A. Quantity – A total of twenty-nine (29) resilient foam-filled fender units are to be provided as shown on the Plans, including two (2) spare.

B. Performance Requirements – Each foam-filled fender unit shall have the following performance characteristics:

1. Size:

a. 8 ft diameter by 10 ft long

2. Minimum Energy Absorption at 60% deflection (inclusive of manufacturer tolerances):

a. 8x10 Fender: 894 ft-kips

3. Maximum Reaction Force (inclusive of manufacturer tolerances):

a. 8x10 Fender: 416 kips

4. Support Chain Force: 113 kips (Service); 224 kips (Ultimate)

5. The fender units shall be designed so that when compressed across its diameter by two parallel flat plates extending the full length and width of the fender, the unit shall absorb at least the energy noted above with a corresponding load of no more than the reaction noted above.

6. The fender shall also be designed to withstand the reaction load noted above sustained for a duration of not less than 24 hours each occurrence for at least 200 occurrences per year during a 10-year predicted life.

C. Fender Unit Configuration

1. Fender units shall have cylindrical mid-bodies with conical or hemispherical shaped ends terminating in an end fitting on the cylinder's centerline at each end. If conical ends are provided, they shall have an angle of 60 to 75 degrees when measured from the central axis of the fender.

2. The fittings at either end shall be connected through the center of the fender by a chain, shall terminate in a clevis fitting sized for the indicated shackle and shall swivel to allow the end fitting to rotate freely on the axis of the fender.

3. Design end fitting as small as possible to transmit the ultimate load of the shackle to the fender. End fitting shall be sized so as not to contact loading surfaces when the fender is compressed to 30 percent of its original diameter (70 percent compression).

4. Fill interior of the fender with energy absorbing closed-cell foam as specified. The use of chipped or particulate foam is not acceptable.

D. Foam Core – The energy absorbing foam core shall be a closed-cell cross-linked polyethylene foam with the following properties:

1. Density, ASTM D3575, 3.3 to 6.5 pcf.

2. Tensile strength, ASTM D3575 or ASTM D412, 42 psi minimum

3. Elongation (ultimate), ASTM D3575 or ASTM D412, 95 percent minimum

4. Water absorption percent volume after 24-hour exposure, ASTM D3575, 5.0 percent maximum

5. Continuous service air temperature, 0 to 120 degrees F

6. 25 percent compressive set, ASTM D3575, 8 percent maximum

7. 50 percent compressive set, ASTM D3575, 12 percent maximum

E. Fender Skin

1. The outer fender skin shall be minimum 1.25 in. thick and constructed of elastomer as specified.

2. Filament reinforcing is required. Twelve separate filament reinforcing wraps shall be applied as specified under Filament Wrap. The filament wraps shall be evenly distributed in the inner 80 percent to 90 percent of the elastomer thickness. The outer 10 percent to 20 percent of elastomer shall have no filament reinforcing. The elastomer and filaments shall be applied in a continuous manner to ensure adhesion between the various layers.

3. The connection of the skin to the end fittings shall be designed and sized to transmit twice the safe tensile capacity of the chain into the fender skin.

F. Elastomer – The elastomer used in the fender skin shall be 100 percent PTMEG (polytetramethyleneether glycol) polyether urethane elastomer, ultraviolet stabilized with 2.5 percent carbon black or equivalent, with the following unreinforced properties:

1. Shore A. hardness, ASTM D2240, 75 to 95

2. Tensile strength, ASTM D412, 2000 psi minimum

3. Elongation (ultimate), ASTM D412, 300 percent minimum

4. Tear strength, ASTM D624, 185 lbs/inch minimum

5. Flex life (Ross), ASTM D1052, 100,000 cycles minimum

6. Abrasion resistance (NBS), ASTM D1630, 100 minimum

G. Filament Wrap

1. Construct each filament reinforcing wrap of continuous filaments applied in a helical pattern, at a helix angle of 0.79 to 1.05 rad 45 to 60 degrees to the longitudinal axis of the buoy. A wrap shall consist of two such filament helixes of equal but opposing helix angles.

2. The spacing between the filaments in the same helix shall be no more than 1/8 in., measured in a direction parallel to the longitudinal axis of the fender.

3. Each wrap shall extend along the entire longitudinal axis of the fender and shall also encase the fender end fittings and secure them to the fender body.

4. The reinforcing filaments shall be nylon tire cord of 2540 denier weight with the following properties:

a. Breaking strength, 50 pounds

b. Elongation (ultimate), 16 percent

H. Color

1. A colored sample of the elastomer skin measuring 12 in. by 12 in. shall be provided to the Port for approval prior to fabrication.

I. Reparability

1. The fender casing shall be repairable in the event of tears or punctures in the elastomer skin.

2. The repaired area shall have not less than 90 percent of the properties as specified in paragraph entitled “Elastomer.”

3. Required repair materials shall be readily available from the Manufacturer.

J. Source Quality Control

1. Fender Cyclic-Compression Test

a. Procedure – Compress the fender along its diameter between two parallel flat plate surfaces to a compressed dimension of 40 percent of its original diameter. Repeat the compression and release cyclic loadings for a minimum of 10 full cycles of compression.

b. Failure Criteria – Permanent deformation, cracking, or tearing of the fender skin, fender core, or end fittings shall constitute failure of this test.

2. Fender Sustained-Load Test

a. Procedure – Apply the compressive reaction load noted in these Specifications and hold this load for 24 hours, recording the load and deflection each hour. Immediately after release of the load, measure rebound of the fender. Continue to record fender rebound for 24 hours. The maximum rate of compression per minute shall be 20 percent of the total reaction force at 60 percent compression. The full compression cycle, not including rebound, shall take a minimum of 5 minutes.

b. Failure Criteria – Failure of the fender or foam core to rebound to 90 percent of its original diameter after 24 hours shall constitute failure of this test. If the foam core is not bonded to the skin of the fender, devise and execute a means for measuring rebound of the foam core and for measuring the void between the foam core and the skin.

3. Fender Pull-Through Test

a. Procedure – Devise and perform a test which will measure the resistance of the end fittings and internal chain to pull through the longitudinal axis of the fender.

b. Failure Criteria – Failure of the chain, end fittings, or skin to resist at least 40 kips of pull-through tension shall constitute failure of this test. After loading, evidence of permanent deformation, cracking, or tearing of the fender or end fittings shall also constitute failure of this test.

4. Skin Thickness Core Test

a. Procedure – After delivery of all the fenders to the construction site and before fender installation, perform a minimum of three (3) skin thickness tests per fender for at least three (3) fenders to be selected at random by the Port. Test locations on the fenders will be selected by the Port. Each test shall consist of taking a 1/4 in. diameter (minimum) to 1/2 in. diameter (maximum) core from the fender skin, which can be removed from the skin and examined for thickness of elastomer and placement of reinforcing. Take skin thickness measurements from the core sample and record measurements, noting placement of reinforcing. Skin thickness tests will be witnessed by the Port. The Port shall be notified 10 working days prior to conducting skin thickness tests. After skin thickness testing, patch core holes with elastomer of the same composition and thickness as the specified elastomer skin. Nylon reinforcing is not required in core hole patches.

b. Failure Criteria – Where the skin thickness measurement is less than the specified minimum by more than 10 percent, reject the fender. In addition, if the average of skin thickness tests for one fender is not equal to or greater than the specified minimum, reject the fender. If tested fender is rejected, at the option of the Port, then all the fenders are to be tested. Replace rejected fenders with units meeting the provisions of this specification. Test replacement fenders for skin thickness as specified herein.

K. Internal & Connecting Hardware

1. The Fender Supplier shall furnish all internal and connecting hardware required for attaching the chain assemblies to the fender and to the padeye anchorage point.

2. The chain assemblies shall consist of shackles, swivels, turnbuckles, end clevises, and chains.

3. Size of chain and associated hardware shall be recommended by the Fender Supplier and subject to the approval of the Port.

4. All connecting hardware shall have a capacity greater than the chains.

5. The internal and connecting chains and associated hardware, at a minimum, shall conform to the following:

a. Chain Bracket: Trelleborg CB1 440 mm

b. Chain: ABS 2, Grade 2, Stud Link or Open Link

c. Shackle: FS RR-C-271, Type IVA, Class 3, Grade A

d. Swivel: FS RR-C-271, Type VII, Class 2

e. Turnbuckle: ASTM F1145, Type 1, Class B, Grade 1

6. The internal chains, end clevises, connecting chains, turnbuckles, swivels, shackles, and chain brackets shall be galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M, as appropriate.

7. All connecting bolts and pins shall be of mild steel, matching the properties of the shackle bow. For Class 3 shackles, the bolt or pins shall be secured in place with stainless steel (Type 316) cotter pins or locking pins.

8. Shackles shall be at least 2 in. in diameter and shall have a minimum ultimate tensile capacity larger than the attached chain.

9. All structural steel not specifically detailed on the Drawings, shall have a minimum thickness of 3/8-inch (10-mm) for box sections and 1/2-inch (12-mm) for open sections or plates exposed to corrosion on more than one side.

PART 3 – EXECUTION

3.01 CONSTRUCTION CONTRACTORS SERVICES

A. Installation shall be performed by the Construction Contractor in accordance with the instructions provided by the Fender Manufacturer.

B. Antiseize Compound – Coat threads of bolts prior to applying washers and nuts. Recoat bolt thread projection beyond nut after tightening.

3.02 FENDER SUPPLIER'S SERVICES

A. Fenders shall be delivered to the project site by the Fender Supplier. The cost of delivery shall be included in the Fender Supplier's fee.

B. A representative from the Fender Supplier shall perform the following works at the jobsite:

1. A minimum of 2 days to provide technical direction to work on proper installation techniques and procedures, during or just prior to installation of the first fender units.

2. A minimum of 1 day to provide visual inspection of completed installations for conformance with installation procedures.

3. Within 5 working days, submit written documentation to confirm that all fender units and components have been installed in accordance with all contract documents and to the satisfaction of the supplier.

C. The cost of transportation, meals, lodging, and other associated costs of the representative shall be included in the Fender Supplier's fee.

END OF SECTION 35 59 13.16

SECTION 35 59 33.14

CAST-STEEL MARINE BOLLARDS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Cast-steel marine bollards.

1.02 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC)

1. AISC Steel Construction Manual; 2017.

B. American National Standards Institute (ANSI)

1. B18.2.2 - Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts; 2022.

C. American Society for Testing and Materials (ASTM)

1. A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application; 2020.

2. A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

3. A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

4. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.

D. Reference Specifications (RS)

1. Section 03 30 00 - CAST-IN-PLACE CONCRETE.

E. Steel Structures Painting Council (SSPC)

1. Good Painting Practice (Volumes 1 and 2); 2016.

2. PS 13.01 - Epoxy Polyamide Painting System; 2004.

3. SP 6 - Commercial Blast Cleaning; 2006.

1.03 SUBMITTALS

A. Contractor shall submit the following manufacturers' information for approval prior to manufacturing of bollards and hardware.

1. Qualifications:

    a. Five reference letters from US clients with contact information.

    b. List of ten completed projects with same type of bollard installed for more than 5 years.

2. Product Data: Provide product data sheets and installation instructions for the following:

    a. Coating System

    b. Grout

B. Installation Procedures

C. Shop Drawings: Provide for bollards and hardware, including through bolts.

    a. Indicate thickness, type, grade, class of metal, and dimensions.

    b. Show construction details, including bolt pattern, reinforcement, anchorage, and installation with relation to other construction.

2. Certificates: Certify that the following products meet or exceed specified requirements:

    a. Carbon Steel

    b. Through bolts and Fasteners

    c. Paint

D. Submit the following information after the manufacturing of bollards and hardware:

1. Mill test certificates for each heat number. Record showing heat numbers and serial numbers.

2. Record showing heat numbers and serial numbers.

3. Galvanizing certificate.

4. Certificate of conformance for line pull rating.

    a. One bollard from each heat shall be made with two coupons. One coupon shall be tested at the factory, and the results are to be sent to the Engineer prior to shipment of the bollards. The second coupon will remain attached to the bollard until final delivery for testing by the Port.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver bollards to the site primed.

B. Attach weight tags indicating the weight of the bollard to each bollard prior to shipment.

PART 2 – PRODUCTS

2.01 DESIGN CRITERIA

A. Design and calculations shall be stamped and signed by a State of California registered civil engineer who specializes in the design of marine structures.

B. Bollards shall have a load rating of 225 metric tons. Bollards shall have a minimum factor of safety of 2.0 against yield and 3.0 against breaking. Minimum load direction is from 0 degrees to 45 degrees in the vertical plane and 0 degrees to 180 degrees in the horizontal plane.

C. Bollards shall have a hole through the top through which grout shall be deposited after placement and bolting of the bollards. Bollards shall be filled per manufacturer's installation guidelines.

D. Bollard anchor hardware shall be supplied by the bollard manufacturer to ensure proper fit.

2.02 MATERIALS

A. Bollard material shall be stress-relieved cast steel conforming to manufacturer's recommendations based on the safe working load (SWL) shown on Drawings.

B. Anchorage Hardware

1. Through bolts:

    a. Type and Grade: As indicated on Drawings.

    b. Diameter: As indicated on Drawings.

    c. Length: As indicated on Drawings..

2. Anchorage nuts:

    a. Type and Grade: As indicated on Drawings.

    b. Diameter: As indicated on Drawings.

3. Washers:

    a. Type and Grade: As indicated on Drawings.

    b. Diameter: As indicated on Drawings.

    c. Thickness: As indicated on Drawings.

4. All anchorage hardware shall be hot-dipped galvanized as indicated on Drawings.

C. Anchor Bolt Caps

1. SAP-SEAL Snap-on Caps manufactured by SAP-SEAL Products, Inc. shall be used at bollard anchors.

D. Non-shrink Grout

1. Grout used for bollard anchors and leveling pad shall be ASTM C1107, premixed, non-staining, and non-shrink.

E. Pitch Pocket Sealant

1. Sika Sarnafiller manufactured Sika Corporation shall be used to fill bollard anchor pockets as shown on Drawings.

F. Paint

1. Coatings shall conform to SSPC PAINT 22, Primer, Intermediate, and Top Coats.

2. Top coat color shall be Safety Yellow.

3. Paint “SWL = 225 MT” over top coat of bollard. Contractor may submit alternative method for marking SWL for approval by owner.

2.03 FABRICATION

A. Metal surfaces shall be clean and free from mill scale, flake rust and rust pitting, well-formed and finished to shape and size, with sharp lines, angles, and smooth surfaces. The external surfaces of all castings upon which ropes may lie or slip shall be cast or ground smooth to prevent damage to ropes in service.

1. Machining and coring shall leave clean true lines and surfaces.

B. Bolt Holes and Seats

1. The location of holes for fastenings shall conform so accurately with the dimensions shown as to ensure interchangeability of castings without structural alterations.

2. The seats for anchorage nuts shall be true facings and the castings shall be machined if necessary to contain them.

C. Construction: Thickness of metal and details of assembly and supports shall give ample strength and stiffness for the minimum loads specified or indicated. Tolerances shall be in accordance with ASTM A27/A27M.

D. Fabrication and fit-up assembly for a bolt template shall be done in the shop with notice to the Engineer if the Engineer wants to witness.

E. All bollards must have their serial numbers stenciled onto the surface of the bollard.

2.04 MIXING

A. Mix grout in accordance with manufacturer's instructions.

2.05 SHOP FINISHING

A. Blast to SSPC-SP6, or greater, and clean grease or other foreign matter with suitable degreaser before applying any coatings. Bollard shall be finished with a 3-coat paint system as specified herein.

B. Work shall be performed during ambient conditions and temperatures within limits of coating manufacturers' recommendations and at least 2 degrees F above dew point temperature.

C. Provide catalyst components for the coating system specific for resin components. Use thinners that are compatible with the coating.

D. Apply the epoxy-polyamide system in accordance with SSPC PS 13.01.

E. The epoxy-polyamide system coatings shall consist of a two-component system that includes a pigmented polyamide resin, Component A, and an epoxy resin, Component B. Mix both components in a ratio of 1 to 1 by volume. Do not thin coatings when doing so will result in total volatile organic compounds exceeding limits enacted by local air pollution control district. When thinning is allowed and is necessary, such as during cold temperature application or to improve application characteristics, add up to two cups of ethylene glycol monoethyl (EGM) ether for each gallon of the coating.

F. Mix the epoxy-polyamide coating system components of coating by power stirring until a smooth, uniform consistency results. Stir coating periodically during its induction period.

G. Apply the primer coating to dry surfaces not more than 4 hours after near-white blast cleaning. Apply coats of each system so that the finished surfaces are free from runs, sags, brush marks and variations in color.

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

I. Provide total system minimum dry film thickness of 9-mils. Measure using a magnetic gauge.

PART 3 – EXECUTION

3.01 INSTALLATION

A. For bollard grout fill, follow application procedures required by manufacturer.

B. Install bollard on wharf deck, using grout pad to level.

C. Anchor through bolts shall be accurately set with template supplied by manufacturer to ensure direction of the horn face is away from the edge of deck, toward shore.

D. Through bolt annulus through the deck shall be fully grouted.

E. After grouting has cured for 7 days, anchorage nuts shall be tightened to snug condition.

F. Anchorage nuts in bollard base shall be covered with SAP-SEAL Snap-on caps. Anchorage nuts below the deck shall also be covered with caps.

G. Areas around anchorage nuts in bollard anchor pockets shall be filled with pitch pocket sealant.

END OF SECTION 35 59 33.14