# Design Specifications

Bees Lakes Habitat Restoration Project

Sacramento-San Joaquin Delta Conservancy

**90% Design Submittal**

*West Sacramento, CA*
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Submitted to:
City of West Sacramento

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# SECTION 01 11 00

# SUMMARY OF WORK
**01/08**

## PART 1 GENERAL

### 1.1 SUMMARY

This section provides for the following:

- Type of Contract (Lump Sum or other)
- Description of Work
- Project Location and Access
- Existing Facilities and Utilities
- Contractors Use of the Premises
- Work to be performed by the Contractor
- Schedule Constraints

### 1.2 WORK INCLUDED

This Specification section describes the Project location and access, existing facilities, the Contractor's use of the premises, Project occupancy, and the Work to be performed by the Contractor. The description of the Work that is provided herein is intended to be a general overview and does not include all the Work required under the Contract.

### 1.3 TYPE OF CONTRACT

This Contract consists of unit price Bid Schedule Items.

### 1.4 PROJECT DESCRIPTION

#### 1.4.1 Project Description

The Bees Lakes Habitat Restoration Project will remove invasive species, plant native grasses and plantings, and provide new pile supported elevated walkways and earthen recreational trails, pile supported viewing platforms and parking access.

#### 1.4.2 Location

The Project is located in the Southport basin of the City of West Sacramento and Yolo County, along the west bank of the Sacramento River as shown on the Plans. The Bees Lakes project area can be accessed via Village Parkway to Chicory Loop and is surrounded by levees. Direct site access is via the existing Southport levee crown patrol road on the west side of the site or from Chicory Loop. See the Plans for access locations.

### 1.5 EXISTING FACILITIES

Existing facilities are shown on the Plans to the extent known.

### 1.6 LOCATION OF UNDERGROUND FACILITIES

Prior to start of excavation, contact all local utility companies to verify line locations in the field. Verify the elevations of existing piping, utilities, and any type of underground obstruction.

### 1.6.1 Notification Prior to Excavation

Notify the Agency at least 15 days prior to starting excavation work. Contact Utility Companies 48 hours prior to excavating.

## 1.7 CONTRACTOR'S USE OF THE PREMISES

In addition to requirements presented elsewhere in the Contract documents, adhere to the following requirements:

a. The Contractor shall not create or permit the continued existence of any nuisance in or about the Work site.

b. The Contractor shall protect from its operations and not disturb existing properties and facilities, and access thereto, that are not in the Work area or are in the Work area unless otherwise shown on the Plans. The Contractor shall protect and minimize the disturbance of existing properties and facilities, and access thereto, within the Work area.

c. Materials and equipment shall be stored and protected, as recommended by the manufacturer and required by applicable codes and standards, to guarantee preservation of quality, appearance, and suitability for the Project. They shall be stored to facilitate inspection by the Agency. Materials shall not be stored on embankment slopes.

d. The Agency will provide the lands, easements, and rights-of-way, or other rights-to-enter as shown on the Plans. Nothing herein contained and nothing marked on the Plans, shall be interpreted as giving the Contractor exclusive occupancy of the lands, easements, or rights-of-way provided by the Agency.

e. The Work areas and the areas for the Contractor's use are shown on the Plans.

f. The Contractor shall be responsible for restoring, at its own expense, all disturbed Work areas to a condition similar to those existing prior to construction, except where other surfacing or treatment is required by the Contract documents.

## 1.8 WORK TO BE PERFORMED BY THE CONTRACTOR

Construction of the Project consists, in general, of the following activities:

a. Performing mobilization, demobilization, and Contract administration.

b. Clearing, Grubbing, tree removal and elderberry shrub relocations as required by the plans and Specifications.

c. Performing erosion and sediment control and storm water pollution prevention, and complying with all environmental controls and requirements related to the Contractor's operations as specified in Project licenses and permits obtained by the Agency, and as specified elsewhere in the Specifications.

d. Performing construction of the earthwork, structural and recreation items.

e. Performing construction surveying and construction quality control.

f. Providing all required submittals, equipment, personnel, and materials to construct the Project as required by the Plans and Specifications, and to complete the Project in accordance with the Contract Time.

g. Providing all required temporary facilities, utilities, and offices required to complete the Work.

h. Providing water for construction from available sources, including pumping, piping, hauling, and storage that may be required, and paying all fees and costs associated with developing the water supply, including, but not limited to, the cost of pumping if wells are used.

i. Providing as-built record documentation/redlines with field notes and changes to the design documents as a result of field direction or changes.

## 1.9 SCHEDULE CONSTRAINTS

The Contractor shall reference applicable Contract documents for information on Contract completion dates and liquidated damages.

Elderberry shrub trimming, relocations or removal shall only be done between 11/01 through 02/15 which is the dormancy period.

# PART 2 PRODUCTS

Not used.

# PART 3 EXECUTION

Not used.

-- End of Section --

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# SECTION 01 11 00.01

# MOBILIZATION AND DEMOBILIZATION
**06/06**

## PART 1 GENERAL

### 1.1 SCOPE

Mobilization shall consist of preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, for the establishment of all facilities necessary for work on the project, and for all other work and operations which must be performed, or costs incurred prior to beginning work on the various Contract items on the project site.

Demobilization shall consist of work and operations necessary to disband all mobilized items.

### 1.2 CONTRACTOR RESPONSIBILITY

The Contractor shall be responsible for furnishing all labor, equipment, supplies, and materials necessary to perform all operations required for Project completion and for establishing, maintaining, and providing security for the Project site for the duration of the Project.

### 1.3 TEMPORARY CONSTRUCTION FACILITIES

See Section 01 50 02.00 41 TEMPORARY CONSTRUCTION FACILITIES for requirements for temporary offices for the Contractor and the Agency.

### 1.4 STAGING AREAS

Staging areas shall be as shown on the Plans. Contractor shall coordinate with the Agency for locations of staging. By making the sites available to the Contractor, the Agency, the property owner, and any other person or agency connected with the properties shall in no way be responsible or liable for any activity of the Contractor, Subcontractors, or any individual or organization connected with the work of the Contractor.

#### 1.4.1 Alternative Staging Areas

The Contractor is required to use the proposed staging areas shown on the drawings for offices and staging. If alternative sites are determined to be necessary, they must be near the project and the Contractor must make all arrangements including but not limited to clearance of non-sensitive archeological and environmental sites for their use at the Contractor's expense and must be reviewed for conformance to contractual requirements by the Agency prior to use.

### 1.5 SPECIAL REQUIREMENTS

Contractor shall comply with all other applicable provisions of the GENERAL PROVISIONS and SPECIAL PROVISIONS including but not limited to restoration of landscape to original conditions. Unless specifically designated for

removal, no existing trees in staging areas shall be removed. If construction of ramps, berms or other features is necessary, the Contractor shall be responsible for the import and disposal of such material and the restoration of the site to its original condition.

## 1.6 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-09 Manufacturer's Field Reports

Mobilization/Demobilization Work Plan;

Before starting the work, the Contractor shall submit to the Agency a plan identifying his requirements for space for temporary structures, location and approximate size of mobile and stationary equipment, and storage of materials. The Contractor shall submit to the Agency a proposed plan and layout for all temporary offices, sanitary facilities, storage buildings, storage yards, temporary water service and distribution, and temporary power service and distribution.

Should the Contractor require space in addition to that available on-site, the Contractor shall make arrangements for storage of materials and equipment in locations off the construction site at the Contractor's own expense.

Stormwater Pollution Prevention Plan;

Refer to Special Provisions for Stormwater Pollution Prevention Plan requirements.

# PART 2 PRODUCTS

## 2.1 MATERIAL STORAGE BUILDINGS

Provide buildings or shelters at site as required for material storage for protection against the elements, theft or other damage. The buildings shall be of sufficient size and so arranged or partitioned to provide security for their contents and provide ready access for inspection and inventory. Buildings shall be located only where described in Section 01 50 02.00 41TEMPORARY CONSTRUCTION FACILITIES or where reviewed by the Agency.

### 2.1.1 Subcontractors' Storage Buildings

Subcontractors may provide temporary buildings or shelters for storage and protection of their materials. Buildings shall be located only where described in Section 01 50 02.00 41 TEMPORARY CONSTRUCTION FACILITIES or where reviewed by the Agency.

## 2.2 TEMPORARY TOILETS

Provide adequate chemical toilet facilities for all individuals connected with the work, in number as required by Federal and State Safety and Occupational Standards and at locations convenient for use. Keep in

sanitary condition. Remove at completion of construction and disinfect premises. Toilets shall be regularly maintained, cleaned and drained.

## PART 3 EXECUTION

### 3.1 REQUIREMENTS

The Contractor shall furnish, install, service and maintain for the duration of the project the personnel, material and equipment as described in paragraph 1.2 of this section.

#### 3.1.1 Codes

All facilities installed under this section shall meet the requirements of the applicable codes and regulations.

### 3.2 STORMWATER POLLUTION PREVENTION PLAN AND BEST MANAGEMENT PRACTICES

Contractor shall implement Standard Best Management Practices (BMPs), Implement the Storm Water Pollution Prevention Plan (SWPPP), and Comply with National Pollutant Discharge Elimination System (NPDES) Permit Conditions.

### 3.3 MOBILIZATION/DEMOBILIZATION WORK PLAN

Submit the mobilization/demobilization work plan and obtain approval from the agency.

### 3.4 TEMPORARY FACILITIES

Mobilize personnel and equipment required and provide/construct/install and maintain through the project duration temporary facilities including but not limited to staging areas, employee parking, office facilities, security and protective fencing, water and sanitary facilities, utility and Internet service.

### 3.5 EQUIPMENT AND PERSONNEL

Mobilize equipment and personnel required to perform the work as needed through the duration of the project.

### 3.6 DEMOBILIZE

Remove from the site all equipment and temporary facilities. Restore all areas disturbed pre-project condition by cleanup and removal of all materials including but not limited to materials delivered to the site and not used, trash and debris, temporary facilities including but not limited to staging areas, employee parking, office facilities, security and protective fencing, water and sanitary facilities and utility service. Re-vegetate all disturbed areas.

-- End of Section --

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# SECTION 01 22 00.00 10

# MEASUREMENT AND PAYMENT

## PART 1 GENERAL

### 1.1 SUMMARY

The measurement and payment section defines the unit of measurement and the method of payment for completed work as recorded on the bid schedule.

### 1.2 SUBMITTALS

Submit submittals in accordance with the appropriate technical provisions of the Project Specifications.

### 1.3 LUMP SUM PAYMENT ITEMS

Payment items for work which will be completed on a lump sum basis are listed as bid items in the bid schedule. All costs for work necessary to complete the Project, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the Work involved. The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all facilities, plants, labor, materials, tests, and equipment, and performing all associated Contractor quality control, environmental protection, and tests, providing all reports, meeting all safety requirements, and for performing all work required for which separate payment is not otherwise provided.

Contractor shall provide a schedule of prices for all lump sum items prior to start of construction. The schedule of values shall be a detailed list of items of work including quantities and unit prices. The schedule of values shall be part of the submittal for the lump sum payment items. Lump sum payment items shall not be accepted without the schedule of values. The schedule of values shall be used for progress payments and determining the completeness of the submittal.

### 1.4 UNIT PRICE PAYMENT ITEMS

Payment items for the Work that shall be performed on a unit price basis are listed in the bid schedule. The unit price and payment made for the work of each item listed shall constitute full compensation for furnishing all facilities, plants, labor, materials, tools, equipment, incidentals, performing all associated Contractor quality control, environmental protection and tests, providing all reports, meeting safety requirements, tests and reports, and for performing all Work required for each of the unit price items.

### 1.5 PAYMENT ITEMS

#### 1.5.1 Mobilization and Demobilization

1.5.1.1 Measurement and Payment

Measurement and payment for mobilization, demobilization, staging areas, temporary construction facilities, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item "MOBILIZATION AND DEMOBILIZATION"; which payment shall constitute full compensation for all the Work involved in mobilization and demobilization as shown or specified in the Contract documents and directed by the Agency.

1.5.2 Traffic Control

1.5.2.1 Measurement and Payment

Measurement and payment for providing traffic control, traffic control plan, obtaining local agency permits for traffic control, traffic control signage, related labor, equipment, and materials, and all costs associated therewith shall be made at the Contract lump-sum included in the bid item "TRAFFIC CONTROL"; which payment shall constitute full compensation for all the Work involved in traffic control for the duration of the project as shown or specified in the Contract documents, and directed by the Agency. Progress payments for Traffic Control will be monthly.

1.5.3 SWPPP Implementation

1.5.3.1 Measurement and Payment

Payment will be made for storm water pollution prevention plan implementation including installing and maintaining best management practices in accordance with the owner-provided storm water pollution prevention plan at the contract lump-sum price for item "SWPPP IMPLEMENTATION"; which payment shall constitute full compensation for all work involved in storm water pollution prevention plan implementation for the duration of the project including installation of best management practices for erosion control, spill control, monitoring, providing updates to the SWPPP, and record keeping as required by the law, as shown or specified in the Contract documents, and as directed by the Agency. Progress payments for SWPPP Implementation will be monthly.

1.5.4 Construction Fence/Orange Barrier Fence

1.5.4.1 Measurement

Construction fence/Orange Barrier Fence and related Work shall be measured by the linear foot installed as shown or specified in the Contract documents and as directed by the Agency.

1.5.4.2 Payment

Payment will be made for construction fence/Orange Barrier Fence as shown or specified in the Contract documents, and as directed by the Agency at the Contract bid price for "CONSTRUCTION FENCE". Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installing and maintaining construction fence for the duration of the project and for the removal and disposal of construction fencing.

### 1.5.5 Clearing and Grubbing

#### 1.5.5.1 Measurement and Payment

Clearing and grubbing and the disposal of the materials from this operation and for all other related Work shall be paid at the contract acre price for "CLEARING AND GRUBBING". This price shall constitute full compensation for furnishing all labor, materials, equipment and incidentals, and doing all work necessary to complete the clearing and grubbing including removal of rocks, debris, concrete rubble, existing AB aggregate surfacing not specified elsewhere or salvaged, demolition of structures not specified elsewhere, trees and stumps identified in the Plans or as directed by the Agency, fencing and all other deleterious items and as noted on or specified in the Contract documents and as directed by the Agency, including disposal or salvage of materials, and restoring all ground surfaces including filling of holes that result from tree removal. Clearing and grubbing of the project site shall be included in the contract bid price for "CLEARING AND GRUBBING".

### 1.5.6 Embankment and Trail Fill

#### 1.5.6.1 Measurement

Materials specified as Embankment and Trail Fill will be measured for payment by the cubic yard, in place, and quantities will be determined by the average end area method. The basis for measurement will be cross sections of the areas to be filled taken after clearing and grubbing operations. Cross sections shall be performed at significant breaks in grade except that the maximum distance between cross sections shall not exceed the distance specified in the General Specifications. Trail and Embankment Fill not constructed to design grade and section including allowable tolerance as indicated on the Contractor’s compliance survey will not be accepted. Trail and Embankment fill includes all fill associated with the construction of the parking area embankment along the south access embankment of Chicory Loop, trail access ramps and slope grading along western slope of Chicory Loop between the Sherwood Marina and Sacramento Yacht Club.

#### 1.5.6.2 Payment

Trail and Embankment Fill will be paid for at the Contract bid price for "TRAIL AND EMBANKMENT FILL". Payment shall constitute full compensation for the construction and completion of the trail and embankment fill including the import or reuse of suitable earthwork material, subgrade preparation and disking, and furnishing all labor and incidentals necessary to complete the Work required as shown or specified in the Contract documents, or as directed by the Agency.

### 1.5.7 Class 2 Aggregate Base

#### 1.5.7.1 Measurement

Class 2 aggregate base will be measured for payment by the ton, to the nearest ton. Quantities for payment will be certified by individual truck weight tickets delivered to the Agency at the time of delivery of each truckload of material. Moisture content not exceeding six percent by weight will be acceptable in determining payment quantities. Deductions will be

made from the certified weight for moisture in excess of this amount and for materials in excess of the allowable thickness.

1.5.7.2 Payment

Class 2 aggregate base will be paid for at the Contract bid price for "CLASS 2 AGGREGATE BASE". Payment shall constitute full compensation for the construction and completion of the class 2 aggregate base including material, subgrade preparation, and furnishing all labor and incidentals necessary to complete the Work required as shown or specified in the Contract documents, or as directed by the Agency.

1.5.8 Post and Cable Fencing

1.5.8.1 Measurement

Post and cable project fencing and related Work shall be measured by the linear foot installed as shown or specified in the Contract documents and as directed by the Agency.

1.5.8.2 Payment

Payment will be made for post and cable project fencing as shown or specified in the Contract documents, and as directed by the Agency at the Contract bid price for "POST AND CABLE PROJECT FENCING". Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for removal of the existing post and cable fence, installation of the new post and cable fence and maintaining the post and cable project fencing for the duration of the project.

1.5.9 Seeding

1.5.9.1 Measurement

Erosion control seeding as shown or specified in the Contract documents, and as directed by the Agency, shall be measured by the Acre using horizontal area surveys.

1.5.9.2 Payment

Erosion control seeding as shown or specified in the Contract documents, and as directed by the Agency, will be paid for at the Contract Bid Price per Acre for "EROSION CONTROL SEEDING". Payment shall constitute full compensation for erosion control seeding which shall include; installation, water, supplies, labor, equipment and material, and performing all operations to establish erosion control seeding. Erosion control measures that are required to be repeated due to the Contractor's negligence, carelessness, neglect, failure to install or maintain permanent erosion control seeding properly, shall be performed by the Contractor at no expense to the Agency.

1.5.10 Stabilized Decomposed Granite Surfacing

1.5.10.1 Measurement

Stabilized decomposed granite surfacing will be measured for payment by the ton, to the nearest ton. Quantities for payment will be certified by individual truck weight tickets delivered to the Agency at the time of delivery of each truckload of material. Moisture content not exceeding six percent by weight will be acceptable in determining payment quantities. Deductions will be made from the certified weight for moisture in excess of this amount and for materials in excess of the allowable thickness.

1.5.10.2 Payment

Stabilized decomposed granite will be paid for at the Contract bid price for "STABILIZED DECOMPOSED GRANITE". Payment shall constitute full compensation for the construction and completion of the stabilized decomposed granite including material, subgrade preparation, stabilizer, compacting and furnishing all labor and incidentals necessary to complete the Work required as shown or specified in the Contract documents, or as directed by the Agency.

1.5.11 Asphalt Concrete

1.5.11.1 Measurement

Asphalt concrete will be measured for payment by the ton, to the nearest ton. Quantities for payment will be certified by individual truck weight tickets delivered to the Agency at the time of delivery of each truckload of material. Moisture content not exceeding six percent by weight will be acceptable in determining payment quantities. Deductions will be made from the certified weight for moisture in excess of this amount and for materials in excess of the allowable thickness.

1.5.11.2 Payment

Quantities of asphalt concrete as measured above will be paid for at the Contract bid price for "ASPHALT CONCRETE ". Payment shall constitute full compensation for the construction and completion of the bituminous concrete, including material, compacting and furnishing all labor and incidentals necessary to complete the work required as shown or specified in the Contract documents, or as directed by the Agency.

1.5.12 Striping, Pavement Markings, Parking Signage and Parking Stops

1.5.12.1 Measurement and Payment

Measurement and payment for striping, pavement markings, parking signage and parking stops and related labor, equipment, materials, and all costs associated therewith shall be made at the contract lump sum price for item "STRIPING, PAVEMETN MARKINGS, PARKING SIGNAGE AND PARKING STOPS"; which payment shall constitute full compensation for all the work and material involved in striping, installing pavement markings, parking signage and parking stops for the parking area and incidental traveled way lane markings on Chicory Loop as specified in the Contract documents and as directed by the Agency.

1.5.13 Temporary Construction Facilities

Separate payment will not be made for providing temporary construction facilities, temporary signage, related labor, equipment, and materials.

All costs associated therewith shall be included in the bid schedule bid item "MOBILIZATION AND DEMOBILIZATION".

1.5.14 Quality Control System

Separate payment will not be made for providing and maintaining a Quality Control System. All costs associated therewith shall be included in the applicable unit prices or lump sum prices contained in the Bid Schedule.

1.5.15 General Signage and Safety

No separate payment shall be made for the work associated with general signage including project safety, hard hat, access and EIP signage as indicated in these specifications and all costs in connection therewith will be considered a subsidiary obligation of the Contract.

1.5.16 Surveying

No separate payment shall be made for providing surveying services, and all costs associated therewith shall be included in the applicable unit prices or lump sum prices contained in the Bid Schedule.

1.5.17 Extend Chimney Drain

1.5.17.1 Measurement and Payment

Measurement and payment for extending chimney drain and all costs associated therewith shall be made at the contract lump sum price for item "EXTEND CHIMNEY DRAIN"; which payment shall constitute full compensation for all the work and material, including drain rock, geotextile and drainage piping and other incidental material needed in extending the existing chimney drains as specified in the Contract documents and as directed by the Agency.

1.5.18 Viewing Platforms

1.5.18.1 Measurement and Payment

Measurement and payment for construction of the Viewing Platform and all costs associated therewith shall be made at the contract lump sum price for item "VIEWING PLATFORMS"; which payment shall constitute full compensation for all the work and material, including concrete, forms, reinforcement, expansion joints, metal decking, metal railing, fiberglass embedded solid polymer interpretive sign and mounting , wood beams, posts, benches, finishes, fasteners, connectors, drainage rock, geotextile, drain pipe, shop drawings, fabrication, excavation and other incidental material needed to construct the viewing platform as specified in the Contract documents and as directed by the Agency. Lump sum shall also include 20 hours of coordination with sign manufacturer and the City of West Sacramento for fiberglass embedded solid polymer interpretive sign and mounting.

1.5.19 Elevated Pile Supported Trails

1.5.19.1 Measurement

Elevated Pile Supported Trail and related Work shall be measured by the linear foot installed as shown or specified in the Contract documents and as directed by the Agency.

1.5.19.2 Payment

Quantities of elevated pile supported trails as measured above will be paid for at the Contract bid price for "ELEVATED PILE SUPPORTED TRAILS". Payment shall constitute full compensation for all the work and material, including metal decking, wood beams, posts, blockings, fasteners, connectors, finishes, flashing, shop drawings, fabrication, excavation and other incidental material needed to construct elevated pile supported trails as specified in the Contract documents and as directed by the Agency.

1.5.20 Abutments

1.5.20.1 Measurement and Payment

Measurement and payment for construction of the Abutments and all costs associated therewith shall be made at the contract lump sum price for item "Abutments"; which payment shall constitute full compensation for all the work and material, including concrete, forms, reinforcement, metal decking, railing, wood beams, finishes, fasteners, expansion joints, shop drawings, fabrication, excavation and other incidental material needed to construct the abutments and adjacent slabs-on-grade as specified in the Contract documents and as directed by the Agency.

1.5.21 Kiosk

1.5.21.1 Measurement and Payment

Measurement and payment for construction of the Kiosk and all costs associated therewith shall be made at the contract lump sum price for item "Kiosk"; which payment shall constitute full compensation for all the work and material, including concrete, forms, wood posts, beams, wood framing, plywood, fiberglass embedded solid polymer interpretive signs and mountings, standing seam metal roof, metal flashing, finishes, fasteners, connectors, shop drawings, fabrication, excavation and incidental materials needed to construct the kiosk as specified in the Contract documents and as directed by the Agency. Lump sum shall also include 20 hours of coordination with sign manufacturer and the City of West Sacramento for fiberglass embedded solid polymer interpretive sign and mounting.

1.5.22 Container Plantings

1.5.22.1 Measurement

Container plantings and related work shall be measured by each installed as shown or specified in the Contract documents and as directed by the Agency.

1.5.22.2 Payment

Payment will be made for container plantings as shown or specified in the Contract documents, and as directed by the Agency at the Contract bid price for “CONATAINER PLANTINGS”. Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installing and maintaining container plantings for the duration of the project.

### 1.5.23 Straw Wattle

#### 1.5.23.1 Measurement

Straw wattle and related work shall be measured by the linear foot installed as shown or specified in the Contract documents and as directed by the Agency.

#### 1.5.23.2 Payment

Payment will be made for straw wattle as shown or specified in the Contract documents, and as directed by the Agency at the Contract bid price for “SRAW WATTLE”. Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installing and maintaining Straw Wattle for the duration for the duration of the project and for the removal and disposal of Straw Wattle damaged during construction.

### 1.5.24 Drilled Piers

#### 1.5.24.1 Measurement

Drilled piers shall be measured by the linear foot from tip to cut-off elevation as shown or specified in the Contract documents and as directed by the Agency. Any drilled pier length extending above cut-off elevation indicated or below authorized tip elevation will not be measured for payment.

#### 1.5.24.2 Payment

Quantities of drilled piers as measured above will be paid for at the Contract bid price for "DRILLED PIERS". Contract bid price shall be based on the total number, length, and diameter of drilled piers, and reinforcing steel indicated on Contract documents.
Payment shall constitute full compensation for all the work and material, including drilled pier drilling, excavation for bells, removing excavated material, furnishing, placing, and removing casing where required, dewatering where necessary, furnishing and placing concrete, reinforcing steel, dowels, any other associated materials, and furnishing all labor, equipment, installation supervision and other incidental material needed to complete pile installation as specified in the Contract documents and as directed by the Agency.
Adjustment to bid price for drilled pier length may be made in accordance with unit prices in the Bid Proposal:

1. Indicate on Bid Proposal Form a single unit price per lineal foot, for each drilled pier of a given diameter as shown on the Contract documents.
2. These prices will be used to determine any additional amount due to Contractor if Engineer orders an increase in drilled pier length, or adjustments due to aborted piers, or credit due to Owner if decrease in drilled pier length is ordered.
3. No payments for changes in length will be made unless changes are directed by Engineer and such order is verified in writing.
4. No price adjustment will be made for individual drilled piers but will be made on the total lineal footage of drilled pier installed for each diameter.

Payment will be made for piles for which driving is discontinued due to encountering obstructions and for additional piles and foundation construction required at locations of discontinued piles.
No payment will be made for drilled piers placed outside of specified tolerances or drilled piers disapproved by Engineer for reasons stated elsewhere in this specification.
Contractor will be paid for all shafts drilled and terminated and new foundations placed due to underground obstructions at unit price indicated in bid documents.

1.5.25 Electrical Connection

1.5.25.1 Measurement and Payment

Measurement and payment for installing an electrical power connection to new aerator pumps, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item "ELECTRICAL CONNECTION"; which payment shall constitute full compensation for all the work and material, including providing and installing an electrical meter, electrical circuit breakers, wiring and all other electrical appurtenances and incidental material needed to supply power to aeration pumps as shown or specified in the Contract documents, and directed by the Agency.

1.5.26 Aeration Pump Shed Pad

1.5.26.1 Measurement and Payment

Measurement and payment for installing a reinforced concrete pad to support a new aerator pump shed, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item "AERATION PUMP SHED PAD"; which payment shall constitute full compensation for all the work and material, including concrete, forms, mounting bolts, reinforcement and other incidental material needed to construct the aeration pump shed pad, and foundation construction, including subgrade preparation, geotextile installation, and aggregate base foundation, as specified in the Contract documents and as directed by the Agency.

1.5.27 Aeration Pump Shed

1.5.27.1 Measurement and Payment

Measurement and payment for constructing a timber framed aerator pump shed, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item "AERATION PUMP SHED"; which payment shall constitute full compensation for all the work and material, including timber framed shed (walls, doors, roofing and siding), soundproofing, paint, blower bench, hardware and other incidental material needed to construct the aeration pump shed as specified in the Contract documents and as directed by the Agency.

1.5.28 Aeration Pump

1.5.28.1 Measurement and Payment

Measurement and payment for providing and installing aeration pumps, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item “AERATION PUMP”; which payment shall

constitute full compensation for all the work, material and other incidental material needed to install and test aeration pumps as specified in the Contract documents and as directed by the Agency.

1.5.29 Aeration Piping

1.5.29.1 Measurement

Aeration piping and related work shall be measured by the linear foot installed as shown or specified in the Contract documents and as directed by the Agency.

1.5.29.2 Payment

Payment will be made for aeration piping as shown or specified in the Contract documents, and as directed by the Agency at the Contract bid unit price as measured above for "AERATION PIPING"; which payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials and for performing all operations necessary for installing and testing aeration piping from the new aerator pumps to the aerators, including providing and installing aeration piping, wall penetrations, conduit, fittings, valve boxes, manifolds, and other incidental material needed to install aeration piping as shown or specified in the Contract documents and directed by the Agency.

1.5.30 Aerators

1.5.30.1 Measurement

Aerators and related work shall be measured by each installed as shown or specified in the Contract documents and as directed by the Agency.

1.5.30.2 Payment

Payment will be made for aerators as shown or specified in the Contract documents, and as directed by the Agency at the Contract bid price for "AERATORS". Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installing aerators.

1.5.31 Floating Island Delivery and Construction

1.5.31.1 Measurement and Payment

Measurement and payment for installing floating island delivery, construction, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item "FLOATING ISLAND DELIVERY AND CONSTRUCTION"; which payment shall constitute full compensation for all the work, material, and other incidental material needed to install floating island delivery and construction as specified in the Contract documents and as directed by the Agency.

1.5.32 Floating Island Planting

1.5.32.1 Measurement and Payment

Measurement and payment for floating island planting, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item “FLOATING ISLAND PLANTING”; which payment shall constitute full compensation for all the work, material, and other incidental material needed to install floating island planting as specified in the Contract documents and as directed by the Agency.

1.5.33 Floating Island Deployment and Anchoring

1.5.33.1 Measurement

Floating Island Deployment and Anchoring and related work shall be measured by each installed as shown or specified in the Contract documents and as directed by the Agency. Each deployed and anchored island shall include deployment of one island and installation of two anchors.

1.5.33.2 Payment

Measurement and payment for floating island deployment and anchoring, and for all other work covered by the Project Specifications shall be made at the Contract unit price as measured above for item "FLOATING ISLAND DEPLOYMENT AND ANCHORING"; which payment shall constitute full compensation for all the Work involved in deployment and anchoring, as well as material and other incidental material needed to deploy and anchor the floating islands as shown or specified in the Contract documents and directed by the Agency.

1.5.34 Pond Debris Clearing

1.5.34.1 Measurement and Payment

Measurement and payment for pond debris clearing, and for all other work covered by the Project Specifications shall be made at the Contract lump-sum price for item "POND DEBRIS CLEARING"; which payment shall constitute full compensation for all the Work involved in debris clearing, transport and disposal, as well as material and other incidental material needed to clear ponds of debris as shown or specified in the Contract documents and directed by the Agency.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

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SECTION 01 33 00.00 41

SUBMITTAL PROCEDURES
**03/04**

PART 1 GENERAL

1.1 SUMMARY

This section identifies the following regarding submittals:

- Submittal Descriptions
- Approving Authority
- Use of Submittal Register
- Number of Copies to be delivered to Agency
- Procedures for Submittal
- Agency Responsibilities
- Format of Submittal
- Quantity of Submittals
- Submittal Classification
- Submittal Register

1.2 SUBMITTALS

1.2.1 Submittal

Shop drawings, product data, samples, operation and maintenance data, and administrative submittals presented by the Contractor for review.

1.2.2 Submittal Descriptions (SD)

Submittals required are identified by SD numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required prior to a notice to proceed on a new contract. Submittals required prior to the start of the next major phase of the construction on a multi-phase contract. Schedules or tabular list of data or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work, submitted prior to contract notice to proceed or next major phase of construction.

Certificates of insurance.
Surety bonds.
List of proposed subcontractors.
List of proposed products.
Construction Progress Schedule.
Submittal register.
Schedule of prices.
Health and Safety Plan.
Mobilization/Demobilization Work plan.
Clearing and Grubbing, Work Plan
Contractor Quality Control (CQC) Plan.

Environmental Protection Plan (EPP).

SD-02 Shop Drawings

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

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

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary Work will be coordinated.

SD-03 Product Data

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

Samples of warranty language when the Contract requires extended product warranties.

SD-04 Samples

Not used

SD-05 Design Data

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

Design submittals, design substantiation submittals and extensions of design submittals.

SD-06 Test Reports

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

Reports that include findings of a test required to be performed by the Contractor on an actual portion of the Work or prototype prepared for the Project before shipment to the job site.

Reports that include findings of a test made at the job site or on samples taken from the job site, on portions of Work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedures.

SD-07 Certificates

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

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

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Not used.

SD-09 Contractor's Field Reports

Not used.

Factory test reports.

SD-10 Operation and Maintenance Data

Not used.

SD-11 Closeout Submittals

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

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

Interim "DD Form 1354" with cost breakout for all assets 30 days prior to facility turnover.

## 1.3 USE OF SUBMITTAL REGISTER

The Contractor shall prepare and maintain a submittal register. The Contractor shall not change data which is output in columns (a), (g), (h), and (i) once reviewed.

### 1.3.1 Submittal Register

The Contractor shall verify that all submittals required for the Project are listed and notify the Agency of missing submittals. The Contractor shall complete the following on the register:

Column (a) Activity Number: Activity number from the approved Project schedule.

Column (g) Contractor Submittal Date: Scheduled date for Agency to receive submittals.

Column (h) Review By Date: Latest date that Contractor needs review of the submittal by.

Column (i) Contractor Material: Latest date that Contractor needs material delivered for use/installation.

1.3.2 Contractor Use of Submittal Register

The Contractor shall update the following fields.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code and Column (k): Date of Action: used to record Contractor's review when forwarding submittals to QC.

1.3.3 Agency Use of Submittal Register

The Agency shall update the following fields.

Column (l) List date of submittal receipt.

Column (m) through (p) List date related to review actions.

Column (q) List date returned to Contractor.

1.3.4 Contractor Action Code and Action Code

Agency action codes shall be as follows (others may be prescribed by Transmittal Form):

R - Received

NN - No Exceptions Taken as Noted. May Proceed Based upon Satisfactory Performance

NE - No Exception Taken. May Proceed Based upon Satisfactory Performance

RR - Revise and Resubmit

1.3.5 Copies Delivered to the Agency

The Contractor shall update the submittal register and include one copy of the updated submittal register with each progress payment request submitted to the Agency.

1.4 PROCEDURES FOR SUBMITTALS

1.4.1 Procedures

The Agency will further discuss detailed submittal procedures with the Contractor at the Preconstruction Conference.

1.4.2 Reviewing and Certifying

The Contractor shall be responsible for reviewing and certifying that all required submittals are in compliance with Contract requirements. Agency review may include review by the USACE, DWR and other regulating agencies.

1.4.3 Constraints

a. Submittals listed or specified in this Contract shall conform to provisions of the Contract documents.

b. Submittals shall be complete for each definable feature of Work; submittals for components of definable features interrelated as a system shall be submitted at the same time.

c. When acceptability of a submittal is dependent upon conditions, items, or materials included in separate subsequent submittals, submittals will be returned by the Agency without review.

d. Review of separate materials, products, or components does not imply concurrence to proceed with construction.

1.4.4 Scheduling

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

b. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 15 calendar days for submittals for QC Manager approval and an additional 20 calendar days for submittals for Agency approval. Period of review for submittals with Agency approval begins when Agency receives submittal from QC organization. Period of review for each resubmittal is the same as for initial submittal. See 01 45 01.10 Quality Control System and 01 45 04.00 41 CONTRACTOR QUALITY CONTROL.

1.4.5 Variations

Variations from Contract requirements require Agency review and will be considered where advantageous to the Agency. Agency acceptance and approval of a submittal containing variations for Contract requirements that are not specifically noted as such by the Contractor shall not constitute a waiver of the Contract requirements. The Agency reserves the right to rescind inadvertent approval of submittals containing unnoted variations from Contract requirements. All costs associated with such rescission shall be borne by the Contractor.

1.4.5.1 Considering Variations

Discussion with the Agency prior to submission will help ensure that functional and quality requirements are met and will minimize rejections and resubmittals. When contemplating a variation from Contract requirements that results in lower cost, consider submission of the variation as a Value Engineering Change Proposal.

1.4.5.2 Proposing Variations

When proposing a variation from Contract requirements, deliver a written request to the Agency, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Agency. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for a variation from Contract requirements, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.4.5.3 Warranting that Variations are Compatible

When delivering a variation from Contract requirements for review, the Contractor warrants that it has reviewed the Contract to establish that the variation, if incorporated, will be compatible with other elements of the Work.

1.4.5.4 Review Schedule is Modified

In addition to the normal submittal review period, a period of ten (10) additional Working Days will be allowed for consideration by the Agency of submittals with variations from Contract requirements.

1.4.6 Contractor's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the Work and Contract documents.

b. Transmit submittals in a timely fashion to prevent delays in the Work, delays to the Agency, or delays to other contractors that might be working on other projects.

c. Correct and resubmit submittals that are rejected or returned without Agency review as specified in Section 1.3.8a.

d. Furnish additional copies of submittals when requested by the Agency, to a limit of twenty (20) copies per submittal.

e. Complete work that must be accomplished as basis of a submittal in time to allow the submittal to occur as scheduled.

f. Ensure no work has begun until submittals for that work have been returned by the Agency marked as "Approved," or "Approved as Noted", except to the extent that a portion of work must be accomplished as the basis of the submittal.

1.4.7 QC Organization Responsibilities

a. Note date on which submittal was received from the Contractor.

b. Review submittals within scheduling period specified and only for compliance with the Contract documents.

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

d. Act on submittals, determining appropriate action based on QC organization's review of submittal.

(1) When QC manager is approving authority, take appropriate action on submittal from the possible actions defined in paragraph entitled, "Actions Possible."

(2) When Agency is approving authority or when variation has been proposed, forward submittal to Agency with certifying statement or return submittal marked "Received" or "Revise and Resubmit" as appropriate. The QC organization's review of submittal determines appropriate action.

e. Ensure that material is clearly legible.

f. Stamp each sheet of each submittal with QC certifying statement or approving statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

(1) When approving authority is Agency, QC organization will certify submittals forwarded to Agency with the following certifying statement:

"I hereby certify that the (equipment) (material) (article) shown and marked in this submittal is that proposed to be incorporated with contract Number [_____], is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is submitted for Agency review.

Certified by Submittal Reviewer _____,
Date _____
(Signature when applicable)

Certified by QC Manager _____,
Date _____"
(Signature)

(2) When approving authority is QC Manager, QC Manager will use the following approval statement when returning submittals to Contractor as "No Exceptions Taken as Noted" or "No Exceptions Taken."

"I hereby certify that the (material) (equipment) (article) shown and marked in this submittal and proposed to be incorporated with contract Number [_____], is in compliance with the contract drawings and specification, can be installed in the allocated spaces, and is [_____] approved for use.

Certified by Submittal Reviewer _____, Date _____
(Signature when applicable)

Approved by QC Manager _____, Date _____"

(Signature)

g. Sign certifying statement or approval statement. The person signing certifying statements shall be QC organization member designated in the approved Quality Control Plan. The signatures shall be in original ink. Stamped signatures are not acceptable.

h. Update submittal register as submittal actions occur and maintain the submittal register at project site until final acceptance of all work by Agency .

i. Retain a copy of approved submittals at project site, including Contractor's copy of approved samples.

1.4.8 Agency's Responsibilities

The Agency will:

a. Note date on which submittal was received from the Contractor.

b. Review submittals for approval within scheduling period specified and only for compliance with the Contract documents.

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

1.4.9 Actions Possible

Submittals will be returned with one of the following notations:

a. Submittals marked "Received" will indicate the submittal has been previously reviewed, is not required, or is not complete. A submittal marked "Received" will be returned with an explanation of the reason it was not reviewed. The Contractor shall resubmit submittals with appropriate action, coordination, or change.

b. Submittals marked "No Exceptions Taken" authorize the Contractor to proceed with the work covered.

c. Submittals marked "No Exception Taken as Noted" authorize the Contractor to proceed with work as noted provided the Contractor takes no exception to the notations.

d. Submittals marked "Revise and Resubmit" indicate submittal is incomplete or does not comply with the Contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is reviewed by the Agency.

1.5 FORMAT OF SUBMITTALS

1.5.1 Transmittal Form

The Contractor shall transmit each submittal, except sample installations and sample panels, to the Agency. Transmit submittals with an accompanying transmittal form. The transmittal form shall identify the Contractor, indicate the date of the submittal, and include information prescribed by

the transmittal form and required in the Paragraph 1.5.2, "Identifying Submittals." Process the transmittal forms to record actions regarding sample panels and sample installations.

1.5.2 Identifying Submittals

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

a. Project title and location.

b. Construction Contract number.

c. Section number of the Specification section by which submittal is required.

d. Submittal description (SD) number of each component of submittal.

e. Bid item number(s) related to submittal.

f. When a resubmission, add alphabetic suffix on submittal description, for example, SD-10A, to indicate resubmission.

g. Name, address, and telephone number of Subcontractor, supplier, manufacturer, and any other second tier subcontractor associated with the submittal.

h. Product identification and location in the Project.

1.5.3 Format for SD-02 Shop Drawings

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

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

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

d. Dimension the drawings, except diagrams and schematic drawings. Prepare drawings to scale when demonstrating interface with other trades. Shop drawing dimensions shall be the same unit of measure as indicated on the Plans. Identify materials and products for work shown.

e. Shop drawings shall include the nameplate data, size, and capacity. Also include applicable federal, military, industry, and technical society publication references.

1.5.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instruction

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

b. Indicate, by prominent notation, each product that is being submitted. Indicate the Specification section number and paragraph number to which it pertains.

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

d. Product data shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number, if applicable. Submittals shall also include applicable federal, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for the initial submittal.

e. Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI) or ASTM, submit proof of compliance such as test results or a certificate from an independent testing organization, competent to perform testing, showing that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.5 Format of SD-04 Samples

Not used.

1.5.6 Format of SD-05 Design Data and SD-07 Certificates

a. Provide design data and calculations and certificates on 8-1/2 by 11 inch or 11 by 17 inch paper, as appropriate. Provide a bound volume for submittals containing numerous pages.

1.5.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

a. Provide reports on 8-1/2 by 11 inch paper in a complete bound volume.

b. Indicate by prominent notation, each report in the submittal. Indicate the Specification number and paragraph number to which it pertains.

1.5.8 Format of PSD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittals include a document that is to be used in the Project or to become part of the Project record, other than as a submittal, do not apply the Contractor's approval stamp to the document, but to a separate sheet accompanying document. The accompanying sheet shall identify and reference the submittal document it accompanies.

## 1.6 QUANTITY OF SUBMITTALS

### 1.6.1 Number of Copies of SD-02 Shop Drawings

Submit six (6) hard copies and one (1) PDF copy of submittals of shop drawings requiring review by the Agency.

### 1.6.2 Number of Copies of Product Data and Manufacturer's Instructions

Submit in compliance with the quantity requirements specified for shop drawings.

### 1.6.3 Number of Samples

Not used.

### 1.6.4 Number of Copies of SD-05 Design Data and SD-07 Certificates

Submit in compliance with the quantity requirements specified for shop drawings.

### 1.6.5 Number of Copies of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with the quantity and quality requirements specified for shop drawings.

### 1.6.6 Number of Copies of SD-10 Operation and Maintenance Data

Not used.

### 1.6.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit administrative submittals in compliance with quantity requirements specified for shop drawings.

## 1.7 FORWARDING SUBMITTALS

### 1.7.1 Submittals Required from the Contractor

As soon as practicable after Award of Contract, and before procurement of fabrication, forward to the Agency submittals required in the technical sections of this Specification, including shop drawings, product data, and samples.

The Agency will review the Contractor's submittals to verify the submittals comply with the Contract Documents.

#### 1.7.1.1 O&M Data

Not used.

## 1.8 REVIEWED SUBMITTALS

The Agency's review of submittals shall not be construed as a complete check, but will indicate only that the design, general method of construction, materials, detailing, and other information appear to meet the requirements of the Contract documents. Agency review will not relieve the Contractor of the responsibility for any error that may exist, as the Contractor is responsible for the satisfactory construction of the Work. After submittals have been reviewed by the Agency, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

## 1.9 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the Work will not be made if required reviews have not been obtained. No payment for materials incorporated in the Work will be made if all required Agency reviews have not been obtained. No payment will be made for any materials incorporated into the work covered by submittals found to contain errors or variations from the Contract requirements.

## 1.10 GENERAL

The Contractor shall make submittals as required by the Specifications. The Agency may request submittals in addition to those specified when deemed necessary to adequately describe the Work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the Contract Plans. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with Contract requirements. Proposed variations from the Contract requirements shall be clearly identified. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts, or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Submittals requiring Agency review shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. Samples remaining upon completion of the Work shall be picked up and disposed of in accordance with the manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

## 1.11 SUBMITTAL REGISTER

At the end of this Specification section is a Submittal Register showing items of equipment and materials for which submittals are required by the Specifications; this list may not be all inclusive and additional submittals may be required. The Contractor shall maintain a Submittal Register for the Project. The Agency will provide the initial Submittal Register. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Agency will be included in its export file to the Contractor. The Contractor shall track all submittals.

## 1.12 SCHEDULING

Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent Plans shall be so scheduled. A minimum of 15 working days exclusive of mailing time,

shall be allowed and shown on the register for review. No delay damages or time extensions will be allowed for time lost in late submittals.

1.13 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor's scheduled submittal date shown on the reviewed "Submittal Register."

1.14 AGENCY REVIEWED SUBMITTALS

Upon completion of review of submittals requiring Agency review, the submittals will be marked with "No Exceptions Taken" or "No Exceptions Taken as Noted." Four (4) copies of the submittal will be retained by the Agency and two (2) copies of the submittal will be returned to the Contractor.

1.15 INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Agency is not required on information only submittals. The Agency reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Agency from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Agency laboratory or for check testing by the Agency in those instances where the technical specifications so prescribe.

1.16 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets Contract requirements shall be similar to the following:

CONTRACTOR
(Firm Name)

_____ Reviewed

_____ Reviewed with corrections as noted on submittal data and/or attached sheet(s).

SIGNATURE: _____

TITLE: _____

DATE: _____

PART 2 PRODUCTS

Not Applicable

PART 3 EXECUTION

Not Applicable

-- End of Section --

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# SECTION 01 42 00

# SOURCES FOR REFERENCE PUBLICATIONS

## PART 1 GENERAL

### 1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g. ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

### 1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
444 North Capital Street, NW, Suite 249
Washington, DC 20001
Ph: 202-624-5800
Fax: 202-624-5806
E-Mail: info@aashto.org
Internet: https://www.transportation.org/

AMERICAN CONCRETE INSTITUTE (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
Internet: https://www.concrete.org/

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
8445 Freeport Parkway, Suite 350
Irving, TX 75063-2595
Ph: 972-506-7216
Fax: 972-506-7682
E-mail: info@concrete-pipe.org
Internet: https://www.concretepipe.org/

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
130 East Randolph, Suite 2000
Chicago, IL 60601
Ph: 312-670-5444
Fax: 312-670-5403
Steel Solutions Center: 866-275-2472

E-mail: solutions@aisc.org
Internet: https://www.aisc.org/

AMERICAN PETROLEUM INSTITUE (API)
1220 L Street, NW
Washington, DC 20005-4070
Ph: 202-682-8000
Internet: https://www.api.org/

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
P.O. Box 28518
1711 Arlingate Lane
Columbus, OH 43228-0518
Ph: 800-222-2768 or 614-274-6003
Fax: 614-274-6899
E-mail: tjones@asnt.org
Internet: https://www.asnt.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 800-548-2723 or 703-295-6300
Internet: https://www.asce.org/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Two Park Avenue
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
Internet: https://www.asme.org/

AMERICAN WELDING SOCIETY (AWS)
8669 NW 36 Street, #130
Miami, FL 33166-6672
Ph: 800-443-9353
Internet: https://www.aws.org/

THE ENGINEERED WOOD ASSOCIATION (APA)
7011 South 19th St.
Tacoma, WA 98466-5333
Ph: 253-565-6600
Fax: 253-565-7265
Internet: https://www.aapwood.org/

ASPHALT INSTITUTE (AI)
2696 Research Park Drive
Lexington, KY 40511-8480
Ph: 859-288-4960
Fax: 859-288-4999
E-mail: info@asphaltinstitute.org
Internet: https://www.asphaltinstitute.org/

AMERICANHORT (AH)
2130 Stella Court
Columbus, OH 43215
Ph: 614-487-1117 OH
Ph: 202-789-2900 DC

Internet: https://www.americanhort.org/

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959
Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: https://www.astm.org/

CALIFORNIA AIR RESOURCES BOARD (CARB)
1001 I Street
Sacramento, CA 95814
Ph: 800-242-4450
E-mail: helpline@arb.ca.gov
Internet: https://ww2.arb.ca.gov/

CALIFORNIA CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD (CVRWQCB)
11020 Sun Center Drive, @200
Rancho Cordova, CA 95670-6114
Ph: 916-464-3291
E-mail: info5@waterboards.ca.gov
Internet: https://www.waterboards.ca.gov/centralvalley/

CALIFORNIA CENTRAL VALLEY REGIONAL WATER QUALITY CONTROL BOARD (CVRWQCB)
11020 Sun Center Drive, @200
Rancho Cordova, CA 95670-6114
Ph: 916-464-3291
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Internet: https://www.waterboards.ca.gov/centralvalley/

FOREST STEWARDSHIP COUNCIL (FSC)
708 First Street North, Suite 235
Minneapolis, MN 55401
Ph: 612-353-4511
E-mail: info@us.fcs.org
Internet: https://us.fsc.org/

L.H. BAILEY HORTORIUM (LHBH)
Plant Biology Units
The L.H. Bailey Hortorium and Herbarium
440 Mann Library Building
Ithaca, NY 14853
Ph: 607-255-1052
Fax: 607-254-5407
Internet: https://plantbio.cals.cornell.edu/hortorium/

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Londonderry, NH 03053
Ph: 603-314-5380 or 800-733-2622
Fax: 603-314-5386
Internet: https://tcia.org/

U.S. ARMY CORPS OF ENGINEERS (USACE)
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Internet: http://www.publications.usace.army.mil/
or https://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-564-4700
Internet: https://www.epa.gov
--- Some EPA documents are available only from:
National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6060 or 1-800-363-2068
Fax: 703-605-6880
TDD: 703-487-4639
E-mail: info@ntis.gov
Internet: https://www.ntis.gov/

U. S. GREEN BUILDING COUNCIL (USGBC)
2101 L St NW, Suite 500
Washington, DC 20037
Ph: 202-828-7422
Internet: https://new.usgbc.org/

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
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Internet: https://www.archives.gov/
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Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
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Internet: https://www.gpo.gov/

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

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# SECTION 01 45 01.10

# QUALITY CONTROL SYSTEM (QCS)

## PART 1 GENERAL

### 1.1 SUMMARY

This Section provides the outline for Contractor's requirements for administration. The Contractor will institute a system that that will control all administrative aspects of the Work, including but not limited to:

- Correspondence
- Changes
- Storm Water Pollution Prevention Plan (SWPPP)
- Contractor Requests for Information (RFIs)
- Contractor Quality Control (CQC)
- Labor Compliance
- Subcontractors and Suppliers
- Equipment used for Construction
- Daily Reports of Construction
- Deficiencies encountered
- Safety
- Materials Testing
- Schedule of pay activities
- Payment Requests
- Notifications of Noncompliance

### 1.2 GENERAL

The Agency will have access to and monitor the Contractors system used in the administration of this Contract. The Contractor shall implement a system to record, maintain, and submit required information throughout the Contract period.

#### 1.2.1 Correspondence and Electronic Communications

For ease and speed of communications, both Agency and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format as discussed in the Preconstruction Conference. Correspondence, pay requests and other documents comprising the official Contract record shall also be provided in paper format, with signatures and dates where necessary. Formally submitted and received paper documents will govern, in the event of discrepancy with the electronic version.

#### 1.2.2 Other Factors

Particular attention is directed to 01 33 00.00 41, SUBMITTAL PROCEDURES, and Section 01 45 04.00 41, CONTRACTOR QUALITY CONTROL. Costs for the Quality Control System are included in other items of work, and there will be no separate payment for this work.

## 1.3 ADMINISTRATION

### 1.3.1 Correspondence

Contractor correspondence to the Agency shall be identified by use of unique, consecutive serial numbers. Correspondence initiated by the Contractor shall be prefixed with "C". The Agency's correspondence to the Contractor will be prefixed with "CA".

### 1.3.2 Equipment

The Contractor shall maintain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

### 1.3.3 Quality Control (QC)

The Contractor shall on a daily basis, track daily reports, identify and track deficiencies, document progress of the Work, and support other Contractor QC requirements. The Contractor shall maintain this data on a daily basis. The Contractor shall provide the Agency a Contractor Quality Control (CQC) Plan within the time required in Section 01 45 04.00 41, CONTRACTOR QUALITY CONTROL.

#### 1.3.3.1 Daily Contractor Quality Control (CQC) Reports.

Daily CQC Reports shall be submitted as required by Section 01 45 04.00 41, CONTRACTOR QUALITY CONTROL. Reports shall be submitted to the Agency within 24 hours after the date covered by the report. The Contractor shall also provide the Agency a signed, printed copy of the Daily CQC reports.

#### 1.3.3.2 Deficiency Tracking

The Contractor shall track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using a QC list of items. The Contractor shall maintain a current log of its QC list of items. The Contractor shall regularly update the correction status of the QC list of deficient items.

#### 1.3.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings.

#### 1.3.3.4 QC Requirements

The Contractor shall develop and maintain a complete list of QC activities including but not limited to testing, inspections, and observations. The Contractor shall update all data on these QC requirements as work progresses and shall promptly provide this information to the Agency.

### 1.3.4 Submittal Management

The Agency will provide the initial submittal register in electronic format in accordance with 01 33 00.00 41. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Agency

will be included in its export file to the Contractor. The submittal transmittal as outlined in Section 01 33 00.00 41 SUBMITTAL PROCEDURES, and the submittal register update shall be produced.

1.3.5 Import/Export of Data

At the Preconstruction Conference, the system to exchange Contractor data to and from the Agency and to maintain the submittal register and other Agency -provided data will be discussed.

1.4 DATA SUBMISSION

The Agency -preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by uploads to internet based data transfer/management site. E-mail with file attachment(s) may also be acceptable as coordinated with the Agency. For locations where these methods are not feasible, the Agency may permit use of other data transfer media (USB Flash Drive or CD) for data transfer. If used, it will be submitted in accordance with the following:

1.4.1 File Medium

The Contractor shall submit required data on transfer media capable of running under Microsoft Windows 10 or newer. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.5 NOTIFICATION OF NONCOMPLIANCE

The Agency will notify the Contractor in writing of any detected noncompliance with the requirements of the Contract documents. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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# SECTION 01 45 04.00 41

# CONTRACTOR QUALITY CONTROL

## PART 1 GENERAL

### 1.1 SUMMARY

This section lists the requirements for the Contractor to Monitor and ensure quality control. Specifically, the contractor shall prepare:

- A Contractor QC Plan
- A QC Organization
- Submittals and Deliverables
- Testing of materials
- Final Inspection.

### 1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C1077 | (2015) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation |
| ASTM D3740 | (2019) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction |
| ASTM E29 | (2013) Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications |
| ASTM E329 | (2021) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| ER 1110-1-261 | (1999) Quality Assurance of Laboratory Testing Procedures |

### 1.3 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control Program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

## 1.4 SUBMITTALS

Submittals shall be made as specified in Section 01 33 00.00 41 SUBMITTAL PROCEDURES. The Contractor Quality Control (CQC) organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

SD-01 Preconstruction Submittals

Contractor Quality Control (CQC) Plan;

G SD-06 Test Reports

Verification Statement

# PART 2 PRODUCTS

Not used.

# PART 3 EXECUTION

## 3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system. QC consist of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The QC system covers all construction operations, both onsite and offsite, and be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

## 3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN

The Contractor shall furnish for review by the Agency, not later than 15 Work Days after receipt of Notice To Proceed, the CQC Plan proposed to implement the requirements of the Contract documents. The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Agency will consider an interim plan for the first 30 Work Days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

### 3.2.1 Content of the CQC Plan

Include, as a minimum, the following to cover all construction-operations, both onsite and offsite, including work by subcontractors fabricators, suppliers and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement using a three phase control system for all aspects of the Work specified. The staff shall include a CQC System Manager who shall report to the project superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm that describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work that is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Agency.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of Subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, Specification paragraph requiring test, feature of Work to be tested, test frequency, and person responsible for each test. Laboratory facilities shall be approved by the Agency.

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of Work. A definable feature of Work is a task that is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be Work by the same trade in a different environment. Although each section of the Specifications may generally be considered as a definable feature of Work, there is frequently more than one definable feature under a particular section. This list shall be reviewed by the Agency during the coordination meeting.

j. Tracking procedures for data to include construction documentation report, i.e., frequency and distribution of soil testing (soil properties, compaction).

k. Procedures for tracking and resolving QA and non-compliances.

l. List of Field Quality Control Representative's tasks and staff.

### 3.2.2 Acceptance of Plan

Acceptance of the CQC plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Agency reserves the right to require the Contractor to make changes in the CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified. The Agency may accept interim CQC plan for particular portions of the Work.

### 3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Agency in writing of any proposed change. Proposed changes are subject to acceptance by the Agency.

## 3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Agency of the CQC Plan, the Contractor shall meet with the Agency and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 14 Calendar Days prior to the Coordination Meeting. During the meeting, the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's Management and control with the Agency's quality assurance. Minutes of the Coordination Meeting shall be prepared by the Agency and signed by both the Contractor and the Agency. The minutes shall become a part of the Contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by the Contractor.

## 3.4 QUALITY CONTROL ORGANIZATION

### 3.4.1 Personnel Requirements

The personnel requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC System Manager and shall serve as a member of the CQC staff. Personnel identified in the Technical Provisions as requiring specialized skills to assure the required Work is being performed properly shall also be included as part of the CQC organization. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the Work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff shall be subject to acceptance by the Agency. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an

effective and fully functional CQC organization. Complete records of all correspondence, material submittals, shop drawing submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Agency.

### 3.4.2 CQC System Manager and CQC Assistant System Manager

The Contractor shall identify as CQC System Manager an individual within its organization at the site of the Work who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer with a professional engineer registration with the State of California, with a minimum of 5 years construction experience on construction similar to the Work undertaken in this Contract. This CQC System Manager shall be on the site at all times during construction and shall be employed by the Contractor. The CQC System Manager shall be assigned no other duties or projects and shall work full-time during the construction of this Project. The CQC System Manager shall not be concurrently working on other projects or jobs. Near completion of the Project, the Agency may determine that the CQC System manager is not needed on a full-time basis. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

### 3.4.3 CQC Personnel

Provide as part of the CQC organization Government-approved CQC specialized personnel to assist the CQC System Manager. These individuals or specialize technical companies are employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on the specialized personnel's areas of responsibility; have the necessary education or experience in accordance with the experience matrix listed herein. At a minimum, Government-approved CQC Specialized Personnel must continuously represent the CQC System Manager at each site where construction operations are being performed.

These individuals have no other duties other than quality control.

| Experience Matrix | |
|---|---|
| Area | Qualifications |
| Civil | Graduate Civil Engineer or Construction Manager with 2 years', experience in the type of work being performed on this project or technician with 5 years related experience. |
| Mechanical | Graduate Mechanical Engineer with 2 years experience or person 5 years of experience supervising mechanical features of work in the field with a construction company. |
| Electrical | Graduate Electrical Engineer with 2 years related experience or person 5 years of experience supervising electrical features of work in the field with a construction company. |

| Experience Matrix | |
|---|---|
| Area | Qualifications |
| Structural | Graduate Civil Engineer (with Structural Track or Focus) or Construction Manager with 2 years experience or person 5 years of experience supervising structural features of work in the field with a construction company. |
| Geotechnical | Professional Engineer (PE) with 5 years experience supervising geotechnical features of work in the field with a construction company. |
| Environmental | Graduate Environmental Engineer with 3 years experience. |
| Concrete, Pavements and Soils | Materials Technician with 2 years experience for the appropriate area. |
| Submittals | Submittal Clerk with 1 year experience |

3.4.4 Organizational Changes

Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01 33 00.00 41 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

3.6 CONTROL

CQC is the means by which the Contractor ensures that the construction of the Project, complies with the requirements of the Contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of Work as follows:

3.6.1 Preparatory Phase

This phase shall be conducted prior to beginning work on each definable feature of Work, after all required plans/documents/materials are reviewed/accepted, and after copies of all Contract documents are at the Work site. This phase shall include:

a. A review of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the Work to be accomplished shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the construction

trailer and available for use by Agency personnel until final acceptance of the work.

b. A review of the Plans.

c. A check to assure that all materials and/or equipment have been tested, submitted, and reviewed.

d. A review of provisions that have been made to provide required control inspection and testing.

e. An examination of the Work area to assure that all required preliminary Work has been completed and is in compliance with the Contract.

f. An examination of required materials, equipment, and sample Work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate Activity Hazard Analysis to assure safety requirements are met.

h. A discussion of procedures for controlling quality of the work including repetitive deficiencies. Document allowable construction tolerances and workmanship standards for that feature of Work.

i. A check to ensure that the portion of the plan for the Work to be performed has been accepted by the Agency.

j. Discussion of the initial control phase.

k. The Agency shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the Daily CQC Report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet Contract Specifications.

### 3.6.2 Initial Phase

This phase shall be conducted at the beginning of a definable feature of Work. The following shall be accomplished:

a. A Check Work to ensure that it is in full compliance with Contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full Contract compliance. Verify required control inspection and testing are in compliance with the contract.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences resulting from a review of the Contract documents.

e. Check safety to include compliance with the safety plan and Activity Hazard Analysis. Review the Activity Hazard Analysis with each worker.

f. The Agency shall be notified at least 48 hours in advance of beginning the initial phase for a definable feature of work. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the Daily CQC Report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time specified quality standards are not being met.

### 3.6.3 Follow-up Phase

Perform Daily checks to assure control activities, including control testing, are providing continued compliance with Contract requirements, until completion of the particular feature of Work. Record the checks in the CQC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

### 3.6.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after greater than two weeks of inactivity; or if other problems develop.

## 3.7 TESTS

### 3.7.1 Inspection and Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product that conforms to contract requirements. Upon request, the Contractor shall furnish to the Agency duplicate samples of test specimens for possible testing by the Agency. Testing includes operation and/or acceptance tests when specified. Procure the services of an Agency-approved testing laboratory meeting the requirements of ER 1110-1-261 or establish an approved testing laboratory at the Project site. Perform the following activities and record and provide the following data:

a. Verify that inspection and testing procedures comply with Contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

a. e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

3.7.2 Testing Laboratories

3.7.2.1 Capability Check

The Agency reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D3740, ASTM E329, and ASTM C1077.

3.7.3 Onsite Laboratory

The Agency reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Agency. The laboratory shall be certified at the sole cost and expense of the Contractor.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials shall be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Agency shall be delivered to the Agency.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Conduct an inspection of the work by the CQC System Manager near the end of the work, or any increment of the work. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications, as required by paragraph DOCUMENTATION. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Agency that the facility is ready for the Agency Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Agency will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. An Agency Pre-Final Punch List may be developed as a result of this inspection. The CQC System Manager shall ensure that all items on this list have been corrected before notifying the Agency, so that a Final inspection with the Agency can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire Work or any particular increment of the Work if the Project is divided into increments by separate completion dates.

### 3.8.3 Final Acceptance Inspection

The CQC inspection personnel, plus the superintendent or other primary management person, and the Agency shall be in attendance at the final acceptance inspection. The final acceptance inspection will be formally scheduled by the Agency based upon results of the Pre-Final inspection. Notice shall be given to the Agency at least 14 Calendar Days prior to the date of final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all Contract Work acceptably complete for this inspection shall be cause for the Agency to bill the Contractor for the Agency's additional inspection cost.

## 3.9 DOCUMENTATION FOR DEFINABLE FEATURES OF WORK

Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. Include in these records the Work of Subcontractors and suppliers and on an acceptable form that includes, as a minimum, the following information:

a. Contractor/Subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom.

d. Test and/or control activities performed with results and references to Specifications/Plans requirements. The control phase shall be identified (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to Specifications/Plans requirements.

f. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in Plans and/or Specifications.

j. Contractor's verification statement.

Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the Work and workmanship comply with the contract. Furnish the original and one copy and electronic files of these records in report form to the Agency daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no Work is performed. As a minimum, one report shall be prepared and submitted for every 7 Calendar Days of no work and on the last day of a no work period. All Calendar Days need to be accounted for throughout the life of the Contract. The first report following a day of no work shall be for that day only. Reports need to be signed and dated by the CQC System Manager. Include copies of the test reports and copies of reports prepared by all subordinate quality control personnel within the CQC System Manger Report.

## 3.10 NOTIFICATION OF NONCOMPLIANCE

The Agency will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the Work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Agency may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

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# SECTION 01 50 02.00 41

# TEMPORARY CONSTRUCTION FACILITIES

## PART 1 GENERAL

### 1.1 SUMMARY

This Section, Temporary Construction Facilities, includes the following:

- Site Plan
- Identification of Employees
- Employee Parking
- Use of Utilities
- Signage
- Traffic Control
- Location of Field Office
- Security Provisions
- Layout of Temporary Fencing
- Cleanup Plan

### 1.2 GENERAL REQUIREMENTS

The contractor shall provide temporary access, staging, ramps, dewatering, parking and storage areas, administrative office facilities, temporary water supply and pumping, project signs and traffic control as required for the project.

#### 1.2.1 Site Plan

Before starting the Work, the Contractor shall submit a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used (if necessary), avenues of ingress/egress to the fenced area and details of the fence installation. Any areas that may have to be graveled to prevent the tracking of mud shall also be identified. The Contractor shall also indicate if the use of a supplemental or other staging area is needed.

Staging areas acquired for the project by WSAFCA are identified in the plans. Additional sites considered but not acquired for use are shown in the EIS.

If supplemental sites, including the additional site considered but not acquired, are determined to be necessary, they must be near the project and the Contractor must make all arrangements including but not limited to clearance of non-sensitive archeological and environmental sites for their use at the Contractor's expense and must be reviewed by the Agency prior to use.

#### 1.2.2 Employee Parking

Contractor employees shall park privately owned vehicles in an area approved by the Agency. Parking areas shall be included as part of the Site Plan submittal and approved by the Agency. This area will be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of

the levee. Parking on public roads outside the construction limit is not allowed.

1.2.3 Site Grading

If site grading is performed at the staging area, the site shall be restored to a natural vegetated condition at completion of Work.

1.3 AVAILABILITY AND USE OF UTILITY SERVICES

Provide for and maintain necessary temporary utility services required for field personnel.

1.3.1 Water

Temporary connections to existing fire hydrants and/or water mains may be utilized at the Contractor's option but be coordinated, by the Contractor, with the local approving Agency and be disconnected at Project completion.

1.3.2 Meters and Temporary Connections

In a manner satisfactory to the Agency and at the expense of the Contractor, provide and maintain necessary temporary connections, distribution lines, and meter bases (provided by the Contractor) required to measure the amount of each utility used.

1.3.3 Sanitation

Provide and maintain sanitary facilities for field personnel. Should lack of utilities in the proposed temporary construction area preclude the use of a plumbed trailer, minimum field-type sanitary facilities shall be provided with approval by the Agency. Agency toilet facilities will not be available to Contractor's personnel.

1.3.4 Telephone

The Contractor may arrange and procure telephone facilities as part of the temporary facilities at no additional cost to the Agency.

1.3.5 Electrical and Power

Provide temporary light and power service as required for the work and to inhibit vandalism. Provide safety switches and wiring into buildings and all required extension cords, lighting outlets, power outlets (grounded type), lamps and other equipment and accessories necessary for adequate temporary lighting and power for construction purposes. Remove temporary lighting and power and their connections at completion of the work.

1.4 WATER FOR CONSTRUCTION

1.4.1 Possible Sources

Location of the supply connection and meter are to be approved by the City of West Sacramento and the Agency. The Contractor is responsible for obtaining all required permits from the City of West Sacramento and/or DWR, for accessing and using water in accordance with permit requirements.

1.4.2 Other Sources

The Contractor is at liberty under the Contractor's own obligation to locate sources of construction water other than those described herein. The source shall be subject to the approval of the Agency and all costs associated with developing and using the source shall be the responsibility of the Contractor. The Contractor shall defend and hold harmless the Agency and its representatives and agents from any claims arising from the use of an alternative water source.

1.4.3 General Requirements

Regardless of the source of water chosen, the Contractor shall be responsible for all piping, pumping, valving, storage, hauling, and distribution of water needed for the construction operation al all work sites that comprise the Project.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Building-Type Office

The Contractor may, at its option, furnish and maintain a building-type mobile office or a permanent building acceptable to the Agency and providing, as a minimum, the facilities specified above.

1.5.2 Administrative Field Office

The Contractor shall provide and maintain administrative field office facilities for their use at the site. Agency office facilities will not be available to the Contractor's personnel.

1.5.3 Storage Area

The Contractor shall construct a temporary 6-foot-high chain link fence around their administrative Field Office and Storage Area.

1.5.4 Supplemental Storage Area

Fencing of materials or equipment will not be required at this site; however, the Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Agency.

Should the Contractor require space in addition to that available on-site, the Contractor shall make arrangements for storage of materials and equipment in locations off the construction site at the Contractor's expense.

1.5.5 Appearance of Trailers

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair.

1.5.6 Maintenance of Project Area

Fencing shall be kept in a state of good repair and proper alignment. Should the Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways; gravel gradation shall be at the Contractor's discretion. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers shall be edged or trimmed neatly.

Any buildings provided as a temporary field office shall be maintained by the Contractor during the life of the contract and upon completion and acceptance of the work shall become the property of the Contractor and shall be removed from the site.

### 1.5.7 Security Provisions

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office. Security lighting shall be removed upon completion of the Project.

## 1.6 TEMPORARY PROJECT SAFETY FENCING

### 1.6.1 Staging, Storage and Office Areas

Not later than 5 days after the date established for commencement of work and prior to the start of ground disturbing activities, the Contractor shall construct a temporary 6 foot high chain link fence around staging area, trailers, equipment and materials in conjunction with the current construction phase. The fence shall include plastic strip inserts, colored green, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. The fencing shall be maintained by the Contractor during the life of the contract. Upon completion and acceptance of the work, the fencing shall become the property of the Contractor and shall be removed from the work site.

### 1.6.2 Project Area Safety Fencing

As soon as practicable, but not later than 5 working days after the date established for commencement of work, the Contractor shall furnish and erect temporary project safety fencing at the work site. The safety fencing shall be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the locations identified by the Contract Documents and by the Agency. The safety fencing shall be maintained by the Contractor during the life of the contract and, upon completion and acceptance of the work, shall become the property of the Contractor and shall be removed from the work site. In areas of high visibility and access as determined by the Agency, the Contractor shall construct a temporary 6 foot high chain link fence. The fence shall include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Where soil conditions permit, fence posts may be driven, in lieu of concrete bases.

## 1.7 CLEANUP

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

## 1.8 RESTORATION OF AREAS USED BY CONTRACTOR

Upon completion of the Project and after removal of contractor facilities, materials, and equipment from within the fenced area, the fence shall be removed. All areas used by the Contractor, including staging, temporary construction easement areas, and haul roads, for the storage of equipment or material, or other use, shall be restored to pre-construction or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary. Erosion control seeding shall be completed in accordance with Section 32 92 19, EROSION CONTROL SEEDING.

## 1.9 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

### 1.9.1 Bulletin Board

Immediately upon beginning of Work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the Contract, Wage Rate Information poster, and other information reviewed by the Agency. The bulletin board shall be located at the Project site in a conspicuous place easily accessible to all employees. Legible copies of the aforementioned data shall be displayed until Work is completed. Upon completion of Work the bulletin board shall be removed by and remain the property of the Contractor. Bulletin boards shall be installed at each site.

### 1.9.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be as described in Section 01 35 26 GENERAL SIGNAGE AND SAFETY REQUIREMENTS. The signs shall be erected within 15 calendar days after receipt of the Notice to Proceed at each site.

## 1.10 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction the Contractor shall provide access and temporary relocated roads as necessary to maintain traffic. The Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Agency. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the Work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the State and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. The Contractor's traffic on roads selected for hauling material to and from the site shall interfere

as little as possible with public traffic. The Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. The Contractor shall be responsible for the repair of any damage to roads caused by construction operations. The Contractor shall perform a photo or video survey of all roads anticipated to be impacted by the Work.

Construction area traffic controls and devices shall conform to the requirements in the following requirements Attention is directed to the latest version of the "Manual on Uniform Traffic Control Devices for Streets and Highways" (hereafter referred to as the "Manual") published by the U.S. Department of Transportation, Federal Highway Administration. All traffic controls and devices shall be as specified in the Manual unless otherwise indicated herein or in the Contract. At no time shall the requirements in these Specifications be construed as to reduce the minimum standards of the Manual. Copies of the Manual may be purchased from the Caltrans, 1900 Royal Oaks Drive, Sacramento, California 95815.

All traffic control devices including, but not limited to, traffic cones or portable delineators, telescoping flag trees, arrow boards, barricades, and signs shall be placed before beginning construction work and shall be removed from the right-of-way at the end of each day or shift, or, for long-term closures, when no longer needed, and shall be placed so as to not obstruct bicycle lanes and pedestrian facilities. All traffic control devices left in the right-of-way by the Contractor are subject to removal by the Agency. The Contractor shall be required to pay any costs incurred by the Agency associated with the removal of these devices.

No equipment shall be parked within any traffic lanes, medians, or within the public right-of-way at any time of day or night, including holidays and weekends, without an approved lane or road closure. The Contractor shall notify the Agency a minimum of five (5) Working Days in advance of any lane closure and twenty (20) Working Days in advance of any road closure.

### 1.10.1 Barricades

The Contractor shall erect and maintain temporary barricades to limit public access to the Work area and to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night. Barricades shall remain the property of the Contractor and removed upon completion of the Work

#### 1.10.1.1 Materials

Materials for Type I, II, and Ill barricades shall conform to provisions of the Manual.

Type IV barricades shall be constructed of materials as follows:

Posts shall be four (4) inches by four (4) inches (4"x4"), nominal size, highway post grade redwood or No. 2 heart structural grade redwood (l000f). Rails shall be two (2) inches by six (6) inches (2"x6"), nominal size light framing construction grade Douglas fir, free of heart center.

Object markers for mounting on each post between the rails shall be red reflectorized sheeting, tape or plates, three inches by five inches (3"x5') minimum size. Where called for on the Plans, object markers shall be Type N markers (9-spot) conforming to the provisions of the Manual.

Paint for posts and rails shall consist of a minimum of one (1) coat of wood primer and two (2) coats of white exterior latex enamel, conforming to the provisions of the relevant technical provision of these Specifications.

Barricade warning lights shall conform to the provisions as specified in the Manual. Unless otherwise specified in the Contract, Type A Barricade Warning Lights (flashers) shall be used.

The Contractor shall establish the necessary quality control to assure compliance with these Specifications. No Certificate of Compliance, as such, will be required for Type IV barricades. A Certificate of Compliance may be required for Type I, II and III barricades for warning lights to assure compliance with these Specifications.

1.10.1.2 Installation and Maintenance

1.10.1.2.1 Construction Barricades

Construction barricades of the type specified in the Special Provisions shall be furnished and set at locations as directed by the Agency. The barricades shall be maintained for as long as necessary and shall be checked for their position location at the close of each day's activity and more often as necessary.

The batteries of warning lights shall be maintained at a high rate of charge at all times.

1.10.2 Flashing Arrow Sign (FAS)

The use of a Flashing Arrow Sign (FAS) is required on major streets for lane closures during hours of darkness and for all lane closures lasting more than two (2) hours, or as specified in the Contract or as directed by Agency. Major streets are those roadways with two (2) or more marked traffic lanes in each direction. An exception may be allowed in situations where it is determined by the Agency that the amount of traffic does not warrant the use of a FAS.

FAS face shall be finished with commercial quality flat black enamel and shall be equipped with yellow or amber lamps that form arrows. Each lamp shall be provided with a visor and the lamps shall be controlled by an electronic circuit. The control shall be capable of dimming the lamps by reducing the voltage to fifty percent plus or minus five (50% ± 5%) percent for nighttime use.

Each FAS shall be mounted on a truck or on a trailer and shall be capable of operating while the vehicle is moving and being placed and when the FAS is operating in place or being maintained. The trailer on which the FAS is mounted shall be equipped so that it can be leveled and plumbed.

Power to operate the sign shall be obtained from the vehicle on which the sign is mounted or from a generating plant mounted on the vehicle. The power supply shall be monitored by the Contractor and, if failure is

observed, a replacement FAS shall be put in use immediately either by the Contractor or the Agency. If the Agency provides and places the replacement FAS, the Contractor is responsible for reimbursement of the Agency's costs.

1.10.3 Construction Area Signs

1.10.3.1 General Requirements

The Contractor is responsible for informing the public of traffic conditions existing within the construction area at all times by placing warning and advisory signs. The term "Construction Area Signs" shall include all temporary signs required for the direction of public traffic through or around the Work during construction. These signs are shown in or referred to in the current Manual. All construction area signs shall be installed at the locations shown on the Plans and as directed by the Agency.

All construction area signs shall conform to the dimensions, color, and legend requirements of the Plans, the current Manual, and these Specifications. All sign panels shall be the product of a commercial sign manufacturer, and shall be as specified in these Specifications.

1.10.3.2 Covering Signs

The Contractor may be required to cover certain signs during the progress of the Work. Covers for construction area signs shall be of sufficient size and density to completely block out the message so that it is not visible either during the day or at night. Covers shall be fastened securely to prevent movement caused by wind.

1.10.3.3 Cleaning Signs

The Contractor shall clean all construction area sign panels at the time of installation and as often thereafter as the Agency determines to be necessary, but at least once every month.

1.10.3.4 Used Signs

Used signs will be considered satisfactory for use if approved by the Agency before placement.

1.10.3.5 Replacement and Backup Signs

To properly provide for changing traffic conditions and damage caused by public traffic or otherwise, the Contractor shall be prepared to furnish additional construction area sign panels, posts, and mounting hardware or portable sign mounts on short notice. The Contractor shall maintain an adequate inventory of the commonly required items at the job site or shall make arrangements with a supplier who is able, on a d Stopping or Parking Prohibition (Tow-Away Zone)

The Contractor may install "Tow-Away" or "No Parking, No Stopping" signs in critical areas to provide traffic lanes or work areas. Prohibition of stopping or parking, or the installation of tow-away signs, requires the approval of and issuance of a permit from the Agency and the City or County. The Contractor shall notify the Agency five (5) Working Days in advance of the placement of the signs. After approval of the stopping or parking restrictions or tow-away signs, the Contractor shall furnish and place

approved "NO STOPPING" or "NO PARKING" signs where directed. The messages on the signs must include the dates and times of the required prohibition. Article 22652 of the California State Vehicle Code requires a sign to be in place twenty-four (24) hours before it becomes legally enforceable.

1.10.3.6 Protection, Maintenance, Removal, Storage, and Resetting of Signs

The protection and maintenance of existing signs and the removal, protection, storage, and resetting of traffic signs that are affected by the Work is the responsibility of the Contractor, as directed by the Agency or as specified in the Special Provisions. The Contractor shall inventory all existing signs prior to the start of construction work. The Agency will confirm the inventory in writing prior to the start of construction work.

1.10.3.7 Movement of Traffic Signs and Traffic Control Facilities

Existing traffic signs and traffic control facilities within the limits of the Work shall not be moved except as necessary to prevent them from being damaged by construction operations or as directed in writing by the Agency. When a sign needs to be moved or removed because it interferes with the Contractor's work, it shall be done only with the written permission of the Agency and the City or County.

1.10.3.8 "Road Construction Ahead (C-18)" and "End of Construction (C-13)" Signs

All scheduled road construction within the right-of-way lasting longer than twenty-four (24) hours shall have permanent construction signs installed. C-18 "Road Construction Ahead" signs shall be installed at the approaches to the Work and C-13 "End of Construction" signs shall be installed at the egresses of the Work. Each sign shall be permanently placed on a four-inch by four-inch (4"x4") post and shall remain in place until the Work has been completed, or until directed by the Agency in writing. Exact placement of the signs will be determined in the field by the Agency and the City or County.

1.10.3.9 Obscuring Visibility and Conflicting With Meaning

Signs or other protective devices furnished and erected by the Contractor shall not obscure the visibility of, nor conflict in intent, meaning, and/or function with existing signs, lights, or traffic control devices, or any construction area signs, lights, and traffic control devices.

1.10.3.10 Permanent Construction Signs

Permanent construction signs shall be installed on galvanized steel posts in the same manner shown on the Plans for installation of roadside signs. Post sizes and numbers of posts shall be as shown on the Plans, except that when stationary mounted signs are installed and the type of sign installation is not shown on the Plans, post size and the number of posts will be determined by the Agency in conjunction with the City of West Sacramento Standard Specifications and Details. Posts shall be good, sound, galvanized steel posts, suitable for the purpose intended.

Sign panels for stationary signs shall consist of Type IIIA reflective sheeting applied to a sign substrate. Sign panels shall conform to the requirements specified for aluminum signs in the Caltrans "Specifications

for Aluminum Signs." Copies of the Caltrans "Specifications for Reflective Sheeting Aluminum Signs and Framing Details for Sheet Aluminum Signs" may be obtained from the Caltrans Office of Business Management, Material Operations Branch, 1900 Royal Oaks Drive, Sacramento, California 95815.

Sign panels shall also conform to the following:

Type IIIA reflective sheeting and aluminum substrates shall be as specified in the "Specifications for Reflective Sheeting Aluminum Signs." Sign substrates fabricated from materials other than aluminum shall be as specified in the Special Provisions.

Legend and border may be applied by a screening process or by use of pressure sensitive cut-out sheeting. Size and spacing of letters and symbols shall be as depicted on the sign specification sheets published by Caltrans. Copies of the sign specifications may be purchased from the Caltrans Publication Unit, 1900 Royal Oaks Drive, Sacramento, California 95815.

All rectangular sheet aluminum signs over 1375 mm (fifty-four [54] inches) measured along the horizontal axis, and all diamond-shaped sheet aluminum signs 1500 mm (sixty (60) inches) and larger shall be framed unless otherwise specified. Frames shall be constructed in accordance with "Framing Details for Sheet Aluminum Signs," Sheets 1 through 4 and Table I on Sheet 5, as published by Caltrans.

Sign panel fastening hardware shall be commercial quality.

1.10.3.11 Removal of Permanent Traffic Control Signs

For existing permanent traffic control signs that are to be removed and not relocated, the Contractor shall remove all sign faces, hardware, and posts. The Contractor shall deliver the removed items to the Agency. The Contractor shall replace any sign faces, hardware, or posts damaged during removal and transport.

1.10.3.12 Regulatory Sign Placement and Removal

The temporary relocation of each "STOP" or other regulatory traffic sign shall be done immediately upon its removal, to a location as close as possible to the original position of sign or as directed by the Agency and City or County.

Stop signs and other traffic control signs and facilities necessary for the control of traffic during the Project shall be maintained in their original positions, as noted in the Agency's inventory, except for temporary repositioning necessitated by the Work. No signs may be moved from their original positions without prior written approval of the Agency. Temporary sign positions must be equivalent to the original positions. The standard sign position is seven (7) to ten (10) feet from the edge of pavement. Stop signs should not be located more than thirty (30) feet from the painted roadway centerline, unless they are supplemental signs, more than forty (40) feet in advance of the limit line, or more than twenty (20) feet beyond the limit line. When the intersection approach width for one direction of traffic is thirty (30) feet or more, the Agency may require that stop signs be erected on both the left and right sides of that approach.

Temporary traffic control signs may be mounted on portable supports only during working hours when the Contractor's workers are available to maintain the signs in proper position at all times. The position and mounting devices for temporary signs shall be subject to the approval of the Agency. Outside of working hours, and at all other times when the Contractor is not available to maintain signs on portable temporary supports, all temporary stop signs and other traffic control signs must be mounted on their original or equivalent posts. The posts must be set in the ground with compacted backfill to a depth of at least thirty-two (32) inches in the same way that permanent signs are installed. The bottom of the sign face must be at least five (5) feet but not more than seven (7) feet above the edge of traveled way, and must be seven (7) feet above the edge of traveled way if subject to pedestrian traffic adjacent to the post. When temporary sign post holes must be dug in completed pavement surfaces, the Agency shall review the temporary position with respect to the proper final position.

1.10.3.13 Sign Posts

When the Work will change traffic patterns, require relocation, removal, or installation of permanent regulatory traffic control and other signs, the Contractor shall relocate, remove, or install sign posts as shown on the Plans, or as directed by the Agency.

1.10.4 Flagging

1.10.4.1 Flaggers

Flaggers shall perform their duties and shall be provided with the necessary equipment in accordance with the current "Instructions to Flaggers" published by Caltrans. The equipment shall be furnished and kept clean and in good repair by the Contractor at the Contractor's expense. All flaggers shall be trained as required by Cal-OSHA Regulations, and proof of such training shall be made available by the Contractor upon request by the Agency.

Flaggers shall be used where necessary to control the flow of traffic through the construction site and shall be used in all cases where traffic is being routed through the construction zone under one-way control, or when ordered by the Agency.

1.10.5 Traffic Control

The Contractor shall submit a Traffic Control Plan for Agency review. The Traffic Control Plan shall describe methods used to safely control traffic in and around the Work areas. Plan shall detail signage, traffic control personnel, anticipated traffic flow patterns, hours of operation and safety measures.

1.10.6 Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the Work under this Contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, shall be adequate to ensure safe operation at all times and shall comply

with 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS. Location, grade, width, and alignment of construction and haul roads shall be subject to review by the Agency. Lighting shall be adequate to assure full and clear visibility for full width of haul road and Work areas during any night work operations. Upon completion of the work, haul roads shall be removed unless designated by the Agency to remain.

1.11 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Traffic Control Plan

Site Plan

Before starting the work, the Contractor shall submit to the Agency a site plan identifying his requirements for space for temporary structures, location and approximate size of mobile and stationary equipment, and storage of materials. The Contractor shall submit to the Agency a proposed plan and layout for all temporary offices, sanitary facilities, storage buildings, storage yards, temporary water service and distribution, and temporary power service and distribution.

Pre-Construction Survey of Roads

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

-- End of Section --

# SECTION 01 74 19

# CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

## PART 1 GENERAL

### 1.1 SCOPE

Construction and demolition waste management shall consist of the transportation of, sale, removal, recycling, reuse, and disposal of material from Constructions activities.

### 1.2 AGENCY POLICY

Agency policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

### 1.3 MANAGEMENT

The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all Subcontractors, vendors, and suppliers to participate. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the Work. In the management of waste, consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal Project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

### 1.4 PLAN

A waste management plan shall be submitted within 15 calendar days after Contract award and prior to initiating any site preparation Work. The plan shall include the following:

a. Names of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation.

c. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas

and equipment to be used for processing, sorting, and temporary storage of wastes.

d. Characterization, including estimated types and quantities, of the waste to be generated.

e. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the Project.

f. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.

g. Identification of materials that cannot be recycled/reused with an explanation or justification.

## 1.5 RECORDS

The Contractor shall maintain records documenting the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Engineer during construction, and a copy of the records shall be delivered to the Engineer upon completion of the construction.

## 1.6 COLLECTION

The Contractor shall provide the necessary containers, bins, and storage areas to facilitate effective waste management and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials and separated by one of the following methods:

### 1.6.1 Source Separated Method

The Contractor shall separate waste products and materials that are recyclable from trash and sort into appropriately marked separate containers and then transport to the respective recycling facility for further processing.

### 1.6.2 Co-Mingled Method

The Contractor shall place waste products and recyclable materials into a single container and then transport to a recycling facility where the recyclable materials are sorted and processed.

### 1.6.3 Other Methods

Other methods proposed by the Contractor may be used when reviewed by the Engineer.

## 1.7 DISPOSAL

Except as otherwise specified in other sections of the Specifications, disposal shall be in accordance with the following:

### 1.7.1 Reuse

First consideration shall be given to salvage for reuse. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in the Project.

### 1.7.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

### 1.7.3 Waste

The Contractor shall dispose materials with no practical use or economic benefit at a landfill or incinerator.

## 1.8 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan

# PART 2 PRODUCTS

Not used.

# PART 3 EXECUTION

Not used.
-- End of Section --

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# SECTION 01 78 00

# CLOSEOUT SUBMITTALS

## PART 1 GENERAL

### 1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-02 Record Drawings

Record Drawings

The final Record Drawings for this Project shall consist of two sets of the approved Record Drawings prepared by the Contractor.

SD-03 Product Data

As-Built Record of Equipment and Materials

Two copies of the record listing the as-built materials and equipment incorporated into the construction of the Project.

SD-09 Reports

Final CQC Summary;

Final CQC records and quality control data

### 1.2 PROJECT RECORD DOCUMENTS

#### 1.2.1 Record Drawings

This paragraph covers Record Drawings completed as a requirement of the Contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to Plans which are revised to be used for final Record Drawings.

##### 1.2.1.1 Agency Furnished Materials

One set of electronic CADD files in the specified software and format revised to reflect all bid amendments will be provided by the Agency at the preconstruction conference for projects requiring CADD file Record Drawings. Electronic drawings will be in AutoCAD Civil 3D.

##### 1.2.1.2 Working Record and Final Record Drawings

The Contractor shall revise two (2) sets of paper drawings by red-line process to show the record conditions during the prosecution of the Project. These working record marked drawings shall be kept current on a weekly basis and at least one set shall be made available on the jobsite at all times. Changes from the Plans which are made in the Work or additional information

that might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. Final Record Drawings shall be prepared after the completion of each definable feature of Work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the Project). The working record marked prints and final Record Drawings will be jointly reviewed for accuracy and completeness by the Agency and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final Record Drawings as specified herein, the Agency will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the Agency and the Contractor regarding the accuracy and completeness of updated drawings. The working and final record drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the Record Drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Valves, splice boxes and similar appurtenances shall be located by dimensioning along the utility run from a reference point. The average depth below the surface of each run shall be recorded.

b. Correct grade, elevations, cross section, and alignment of roads, earthwork, structures and utilities if any changes were made from the Plans.

c. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

d. The topography, invert elevations and grades of drainage installed or affected as part of the Project construction.

e. Changes or modifications that result from the final inspection.

f. Where Plans or Specifications present options, show only the option selected for construction on the final record prints.

g. If borrow material for this Project is from sources on Agency property, or if Agency property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

h. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

i. Modifications (the Contractor shall include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

(1) Follow directions in the modification for posting descriptive changes.

(2) Place a modification circle at the location of each deletion.

(3) For new details or sections that are added to a drawing, place a Modification Circle by the detail or section title.

(4) For minor changes, place a Modification Circle by the area changed on the drawing (each location).

(5) For major changes to a drawing, place a Modification Circle by the title of the affected plan, section, or detail at each location.

(6) For changes to schedules or drawings, place a Modification Circle either by the schedule heading or by the change in the schedule.

(7) The Modification Circle size shall be 1/2 inch diameter unless the area where the circle is to be placed is crowded. Smaller size circle shall be used for crowded areas.

1.2.1.3 Drawing Preparation

The Record Drawings as may be necessary to correctly show the features of the Project as it has been constructed by bringing the Contract set into agreement with reviewed working record prints, and adding such additional drawings as may be necessary. These working record marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this Project and must be returned to the Agency. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Agency.

a. Colors shall be the "base" of red, green, and blue. Color code for changes as follows:

(1) Deletions (Red) - Over-strike deleted graphic items (lines), lettering in notes and leaders.

(2) Additions (Green) - Added items, lettering in notes and leaders.

(3) Special (Blue) - Items requiring special information, coordination, or special detailing or detailing notes.

b. Within ten (10) calendar days after Agency review of all of the working Record Drawings for a phase of Work, the Contractor shall prepare the final record drawings for that phase of Work and submit two sets of prints of these drawings for Agency review. The Agency will promptly return one set of prints annotated with any necessary corrections. Within 7 calendar days the Contractor shall revise the drawings accordingly at no additional cost and submit one set of final prints for the completed phase of Work to the Agency. Within ten (10) calendar days of substantial completion of all phases of Work, the Contractor shall submit the final Record Drawing package for the entire project. The drawings shall be complete in all details and identical in form and function to the contract drawing files supplied by the Agency. Any transactions or adjustments necessary to accomplish this

are the responsibility of the Contractor. Failure to submit final record drawing files and marked prints as specified shall be cause for withholding any payment due the Contractor under this Contract. Approval and acceptance of final Record Drawings shall be accomplished before final payment is made to the Contractor.

1.2.1.4 Payment

No separate payment will be made for Record Drawings required under this Contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.2.2 Record of Equipment and Materials

The Contractor shall furnish one copy of preliminary record of equipment and materials used on the Project at least 15 calendar days prior to final inspection. This preliminary submittal will be reviewed and returned 7 calendar days after final inspection. Two sets of final record of equipment and materials shall be submitted within 10 calendar days after final inspection. The designations shall be keyed to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA

| Description | Specification Section | Manufacturer and Catalog, Model, and Serial Number | Composition and Size | Where Used |
|---|---|---|---|---|

1.2.3 Final Approved Shop Drawings

Furnish final approved Project shop drawings within 30 calendar days after transfer of the completed facility to the Agency.

1.2.4 Construction Contract Specifications

The Contractor shall furnish final Record Specifications, including modifications thereto, within 30 calendar days after transfer of the completed facility.

1.2.5 Real Property Equipment

The Contractor shall furnish a list of installed equipment furnished under this Contract. This list shall include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location, model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. A draft list shall be furnished at time of transfer. The final list shall be furnished within 30 calendar days after transfer of the completed facility.

1.2.5.1 Schedule

The Contractor shall submit a final schedule showing the proposed schedule versus the final schedule for all work.

1.2.6 Test Results

The Contractor shall submit copies of all QC and QC laboratory test reports with Engineer's stamp and signature.

1.2.7 Photo Documentation

The Contractor shall submit all pre-construction and post-construction photo documentation in electronic format.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

-- End of Section --

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# SECTION 03 00 05
# CONCRETE

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete and grout.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 117, Specification for Tolerances for Concrete Construction and Materials.
      b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
      c. 212.3R, Chemical Admixtures for Concrete.
      d. 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
      e. 304.2R, Placing Concrete by Pumping Methods.
      f. 305.1, Hot Weather Concreting.
      g. 306.1, Cold Weather Concreting.
      h. 318, Building Code Requirements for Structural Concrete.
      i. 347, Guide to Formwork for Concrete.
      j. CT-13, Concrete Terminology.
   2. ASTM International (ASTM):
      a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
      b. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
      c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. A1064, Standard Specification for Steel Wire and Welded Wire Replacement, Plain and Deformed, for Concrete.
      e. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
      f. C33, Standard Specification for Concrete Aggregates.
      g. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      h. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      i. C138, Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
      j. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.
      k. C150, Standard Specification for Portland Cement.
      l. C172, Standard Practice for Sampling Freshly Mixed Concrete.
      m. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

n. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
o. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
p. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
q. C494, Standard Specification for Chemical Admixtures for Concrete.
r. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
s. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
t. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
u. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
v. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
w. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
x. D1709, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
y. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
z. E96, Standard Test Methods for Water Vapor Transmission of Materials.
aa. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

3. Corps of Engineers (COE):
   a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink).
4. National Ready Mixed Concrete Association (NRMCA).
5. National Sanitation Foundation (NSF):
   a. 61, Drinking Water System Components - Health Effects.

B. Quality Control:
1. Concrete testing agency:
   a. Contractor to employ and pay for services of a testing laboratory to:
      1) Perform materials evaluation.
      2) Design concrete mixes.
   b. Concrete testing agency to meet requirements of ASTM E329.
2. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
   a. Approval of concrete mix design by Engineer does not relieve Contractor of his responsibility to provide concrete that meets the requirements of this Specification.
3. Adjust concrete mix designs when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
   a. Do not use revised concrete mixes until submitted to and approved by Engineer.

4. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.

C. Qualifications:
1. Ready mixed concrete batch plant certified by NRMCA.
2. Formwork, shoring and reshoring for slabs and beams except where cast on ground to be designed by a professional engineer currently registered in the state where the Project is located.

1.3 DEFINITIONS

A. Per ACI CT-13 except as modified herein:
1. Concrete fill: Non-structural concrete.
2. Concrete Testing Agency: Testing agency employed to perform materials evaluation, design of concrete mixes or testing of concrete placed during construction.
3. Exposed concrete: Exposed to view after construction is complete.
4. Indicated: Indicated by Contract Documents.
5. Nonexposed concrete: Not exposed to view after construction is complete.
6. Required: Required by Contract Documents.
7. Specified strength: Specified compressive strength at 28 days.
8. Submitted: Submitted to Engineer.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Concrete mix designs proposed for use.
a. Concrete mix design submittal to include the following information:
1) Sieve analysis and source of fine and coarse aggregates.
2) Test for aggregate organic impurities.
3) Test for deleterious aggregate per ASTM C1293.
4) Proportioning of all materials.
5) Type of cement with mill certificate for cement.
6) Type of fly ash with certificate of conformance to specification requirements.
7) Slump.
8) Air content.
9) Brand, type, ASTM designation, and quantity of each admixture proposed for use.
10) 28-day cylinder compressive test results of trial mixes per ACI 318 and as indicated herein.
3. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Manufacturers and types:
1) Joint fillers.
2) Curing agents.
3) Chemical sealer.

4) Bonding and patching mortar.
5) Construction joint bonding adhesive.
6) Nonshrink grout with cure/seal compound.

4. Reinforcing steel:
   a. Show grade, sizes, number, configuration, spacing, location and all fabrication and placement details.
   b. In sufficient detail to permit installation of reinforcing without having to make reference to Contract Drawings.
   c. Obtain approval of Shop Drawings by Engineer before fabrication.
   d. Mill certificates.
5. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint dimensions.
6. Strength test results of in place concrete including slump, air content and concrete temperature.
7. Certifications:
   a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
   b. Certification that the material and sources submitted in the mix design will be used in the concrete for this project.
8. Test reports:
   a. Cement mill reports for all cement to be supplied.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:
1. Cement and pozzolan:
   a. Store in moistureproof, weathertight enclosures.
   b. Do not use if caked or lumpy.
2. Aggregate:
   a. Store to prevent segregation and contamination with other sizes or foreign materials.
   b. Obtain samples for testing from aggregates at point of batching.
   c. Do not use frozen or partially frozen aggregates.
   d. Do not use bottom 6 IN of stockpiles in contact with ground.
   e. Allow sand to drain until moisture content is uniform prior to use.
3. Admixtures:
   a. Protect from contamination, evaporation, freezing, or damage.
   b. Maintain within temperature range recommended by manufacturer.
   c. Completely mix solutions and suspensions prior to use.
4. Reinforcing steel: Support and store all rebars above ground.

B. Delivery:
1. Concrete:
   a. Prepare a delivery ticket for each load for ready-mixed concrete.
   b. Truck operator shall hand ticket to [Owner's Representative] [Engineer] at the time of delivery.
   c. Ticket to show:
      1) Mix identification mark.

2) Quantity delivered.
3) Amount of each material in batch.
4) Outdoor temp in the shade.
5) Time at which cement was added.
6) Numerical sequence of the delivery.
7) Amount of water added.

2. Reinforcing steel:
   a. Ship to jobsite with attached plastic or metal tags with permanent mark numbers.
   b. Mark numbers to match Shop Drawing mark number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
   1. Nonshrink, nonmetallic grout:
      a. Sika "SikaGrout 212."
      b. Euclid Chemial "NS Grout."
      c. BASF Admixtures, Inc. "Masterflow 713."
   2. Expansion joint fillers:
      a. Permaglaze Co.
      b. Rubatex Corp.
      c. Williams Products, Inc.
   3. Form coating:
      a. Richmond "Rich Cote."
      b. Industrial Lubricants "Nox-Crete Form Coating."
      c. Euclid Chemical "Kurez DR VOX."
   4. Cementitious concrete coating:
      a. Aquafin International.
      b. BASF Building Systems.
      c. Euclid Chemical Company.
   5. Chemical sealer:
      a. L&M Construction Chemicals, Inc.
      b. Euclid Chemical Company.
      c. Dayton Superior.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Portland Cement: Conform to ASTM C150 [Type I] [Type I/II] [Type II] [Type V].

B. Fly Ash:
   1. ASTM C618, Class F or Class C.
   2. Nonstaining.
      a. Hardened concrete containing fly ash to be uniform light gray color.
   3. Maximum loss on ignition: [4] [6] PCT.
   4. Compatible with other concrete ingredients.
   5. Obtain proposed fly ash from a source approved by the State Highway Department in the state where the Project is located for use in concrete for bridges.

C. Admixtures:
   1. Air entraining admixtures: ASTM C260.

2. Water reducing, retarding, and accelerating admixtures:
   a. ASTM C494 Type A through E.
   b. Conform to provisions of ACI 212.3R.
   c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no cost to Owner.
   d. Follow manufacturer's instructions.
   e. Use chloride free admixtures only.
3. Maximum total water soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials and admixtures by weight percent of cement:
   a. 0.10 [all] [all other] concrete.
4. Do not use calcium chloride.
5. Pozzolanic admixtures: ASTM C618.
6. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.

D. Water: Potable, clean, free of oils, acids and organic matter.

E. Aggregates:
1. Normal weight concrete: ASTM C33, except as modified below.
2. Fine aggregate:
   a. Clean natural sand.
   b. No manufactured or artificial sand.
3. Coarse aggregate:
   a. Crushed rock, natural gravel, or other inert granular material.
   b. Maximum amount of clay or shale particles: 1 PCT.
4. Gradation of coarse aggregate:
   a. Lean concrete and concrete topping: Size #7.
   b. All other concrete: Size #57 or #67.

F. Concrete Grout:
1. Nonshrink, nonmetallic grout:
   a. Nonmetallic, noncorrosive, nonstaining, premixed with only water to be added.
   b. Grout to produce a positive but controlled expansion.
   c. Mass expansion not to be created by gas liberation.
   d. Minimum compressive strength of nonshrink grout at 28 days: 6500 PSI.
   e. In accordance with COE CRD-C621.
2. Epoxy grout:
   a. 3-component epoxy resin system.
      1) Two liquid epoxy components.
      2) One inert aggregate filler component.
   b. Each component packaged separately for mixing at jobsite.

G. Reinforcing Steel:
1. Reinforcing bars: ASTM A615, Grade 60.
2. Welded wire reinforcement:
   a. ASTM A185 or ASTM A1064.
   b. Minimum yield strength: 60,000 PSI.
3. Column spirals: ASTM A82 or ASTM A1064.

H. Forms:
1. Prefabricated or job built.
2. Wood forms:

a. 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
b. Built-in-place or prefabricated type panel.
3. Metal forms:
a. Metal forms may be used except for aluminum in contact with concrete.
b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
4. Chamfer strips: Clear white pine, surface against concrete planed.

I. Form Ties:
1. Commercially fabricated for use in form construction.
a. Field fabricated ties are unacceptable.
2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
3. 3/4 IN minimum [to 1 IN maximum] diameter cones on both ends.
4. Embedded portion of ties to be not less than [1-1/2 IN] [1 IN] from face of concrete after ends have been removed.
5. Cone size:
a. 3/4 IN minimum [to 2 1/2 IN maximum] diameter cones on both ends.
b. Depth of cone not to exceed the concrete reinforcing cover.
6. Form release: Nonstaining and shall not prevent bonding of future finishes to concrete surface.

J. Chairs, Runners, Bolsters, Spacers, and Hangers:
1. Stainless steel, epoxy coated, or plastic coated metal.
a. Plastic coated: Rebar support tips in contact with the forms only.

K. Chemical Floor Sealer:
1. Colorless low VOC water-based solution containing acrylic copolymers.
a. ASTM C1315, Class B, minimum 30 PCT solids.
2. L&M Construction Chemicals Inc. Dress & Seal WB 30.

L. Cementitious Concrete Coating:
1. Polymer modified Portland cement based coating for concrete and masonry.
a. Waterproof.
b. Resistant to both positive and negative hydrostatic pressure.
c. Breathable.
2. BASF “Masterseal 581 Thoroseal”.
a. Color:
1) Interior surfaces: Standard gray.
2) Exterior surfaces: Custom color to match concrete surface.
3) Texture: Fine.

M. Membrane Curing Compound:
1. ASTM C309, Type 1D, Class A or B.
2. Fugitive dye shall dissipate over time and exposure.
3. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.

N. Expansion Joint Filler:
1. In contact with water or sewage:

a. Closed cell neoprene.
b. ASTM D1056, Class SC (oil resistant and medium swell) of 2 to 5 PSI compression deflection (Grade SCE41).

2. Exterior driveways, curbs and sidewalks:
a. Asphalt expansion joint filler.
b. ASTM D994.

3. Other use:
a. Fiber expansion joint filler.
b. ASTM D1751.

## 2.3 CONCRETE MIXES

A. General:
1. All concrete to be ready mixed concrete conforming to ASTM C94/C94M.
2. Provide concrete of specified quality capable of being placed without segregation and, when cured, of developing all properties required.
3. All concrete to be normal weight concrete [except where lightweight concrete is indicated on Drawings].
4. Provide pozzolan content for all cast-in-place construction.

B. Strength:
1. Provide specified strength and type of concrete for each use in structure(s) as follows:

| TYPE | WEIGHT | SPECIFIED STRENGTH* |
|---|---|---|
| All other general use concrete | Normal weight | [4000] [5000] PSI |

* Minimum 28-day compressive strength.

C. Air Entrainment:
1. Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:

| MAX AGGREGATE SIZE | TOTAL AIR CONTENT PERCENT |
|---|---|
| 1 IN or 3/4 IN | 6 ±1-1/2 |
| <3/4 IN | 6-1/2 ±1-1/2 |

2. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.

D. Slump - 4 IN maximum, 1 IN minimum:
1. Measured at point of discharge of the concrete into the concrete construction member.
2. 8 IN maximum after addition of superplasticizer (if used).
3. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
4. Pumped concrete:
a. Provide additional water at batch plant to allow for slump loss due to pumping.
b. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified and the maximum specified water-cement ratio is not exceeded.
5. Slump may be adjusted in the field through the use of water reducers.

a. Coordinate dosage and mixing requirements with concrete supplier.
6. Determine slump per ASTM C143.

E. Selection of Proportions:
1. General:
a. Proportion ingredients to:
1) Produce proper workability, durability, strength, and other required properties.
2) Prevent segregation and collection of excessive free water on surface.
2. Minimum cement contents and maximum water cement ratios for concrete to be as follows:

| SPECIFIED STRENGTH | [MINIMUM] [TARGET] CEMENT, MAXIMUM AGGREGATE SIZE | | | MAXIMUM WATER CEMENT RATIO BY WEIGHT |
|---|---|---|---|---|
| | 1/2 IN | 3/4 IN | 1 IN | |
| 4000 | 564 | 564 | 564 | 0.45 |
| 4500 | 611 | 611 | -- | 0.42 |

3. Fly ash:
a. For cast-in-pace concrete only, a maximum of 25 PCT by weight of Portland cement content per cubic yard may be replaced with fly ash at rate of 1 LB fly ash for 1 LB of cement.
b. When fly ash is used, the water to cementitious materials ratio shall not exceed the maximum value specified herein.
4. Concrete mix proportioning methods for normal weight concrete:
a. Proportion mixture to provide desired characteristics using one of methods described below:
1) Method 1 (Trial Mix):
a) Per ACI 318, Chapter 5, except as modified herein.
b) Air content within range specified above.
c) Record and report temperature of trial mixes.
d) Proportion trial mixes per ACI 211.1.
2) Method 2 (Field Experience):
a) Per ACI 318, Chapter 5, except as modified herein:
b) Field test records must be acceptable to Engineer to use this method.
c) Test records shall represent materials, proportions and conditions similar to those specified.
5. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of Chapter 5 of ACI 318 using the standard deviation of the proposed concrete production facility.

PART 3 - EXECUTION

3.1 FORMING AND PLACING CONCRETE

A. Formwork:
1. Contractor is responsible for design and erection of formwork.

2. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.
   a. Allowable tolerances: As recommended in ACI 347.
3. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs or elevated floor slabs to drains.
   a. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.
   b. Do not place floor drains through beams.
4. Openings:
   a. Provide openings in formwork to accommodate work of other trades.
   b. Accurately place and securely support items built into forms.
5. Chamfer strips: Place 3/4 IN chamfer strips in forms to produce 3/4 IN wide beveled edges on permanently exposed corners of members.
6. Clean and adjust forms prior to concrete placement.
7. Tighten forms to prevent mortar leakage.
8. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

B. Reinforcement:
1. Position, support and secure reinforcement against displacement.
2. Locate and support with chairs, runners, bolsters, spacers and hangers, as required.
3. Set wire ties so ends do not touch forms and are directed into concrete, not toward exposed concrete surfaces.
4. Lap splice lengths: ACI 318 Class B top bar tension splices unless indicated otherwise on the Drawings.
5. Extend reinforcement to within 2 IN of concrete perimeter edges.
   a. If perimeter edge is earth formed, extend reinforcement to within 3 IN of the edge.
6. Minimum concrete protective covering for reinforcement: As shown on Drawings.
7. Do not weld reinforcing bars.
8. Welded wire reinforcement:
   a. Install welded wire reinforcement in maximum practical sizes.
   b. Splice sides and ends with a splice lap length measured between outermost cross wires of each fabric sheet not less than:
      1) One spacing of cross wires plus 2 IN.
      2) 1.5 x development length.
      3) 6 IN.
   c. Development length: ACI 318 basic development length for the specified fabric yield strength.

C. Construction, Expansion, and Contraction Joints:
1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
   a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph below, submit proposed construction joint location in conformance with this Specification Section.

2. Unplanned construction joints will not be allowed.
3. Locate wall vertical construction joints at [30] [50] FT maximum.
4. Locate construction joints in floor slabs and foundation base slabs so that concrete placements are approximately square and do not exceed [2500] [4000] SQFT.
5. Locate construction joints in columns and walls:
   a. At the underside of beams, girders, haunches, drop panels, column capitals, and at floor panels.
   b. Haunches, drop panels, and column capitals are considered part of the supported floor or roof and shall be placed monolithically therewith.
   c. Column based need not be placed monolithically with the floor below.
6. Install construction joints perpendicular to main reinforcement with all reinforcement continued across construction joints.
7. At least [48] [72] HRS shall elapse between placing of adjoining concrete construction.
8. Thoroughly clean and remove all laitance and loose and foreign particles from construction joints.
9. Before new concrete is placed, dampen concrete surfaces.

D. Embedments:
1. Set and build in anchorage devices and other embedded items required for other work that is attached to, or supported by concrete.
2. See Specification Section 03 15 19 - Anchorage to Concrete.
3. Use setting diagrams, templates and instructions for locating and setting.

E. Placing Concrete:
1. Place concrete in compliance with ACI 304R and ACI 304.2R.
2. Place in a continuous operation within planned joints or sections.
3. Begin placement when work of other trades affecting concrete is completed.
4. Place concrete by methods which prevent aggregate segregation.
5. Do not allow concrete to free fall more than 4 FT.
6. Where free fall of concrete will exceed 4 FT, place concrete by means of tremie pipe or chute.

F. Consolidation: Consolidate all concrete using mechanical vibrators supplemented with hand rodding and tamping, so that concrete is worked around reinforcement and embedded items into all parts of forms.

G. Protection:
1. Protect concrete from physical damage or reduced strength due to weather extremes.
2. In cold weather comply with ACI 306.1 except as modified herein.
   a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice or snow.

   b. Do not place heated concrete that is warmer than 80 DEGF.

c. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50 DEGF for seven days or 70 DEGF for 3 days.
d. Do not allow concrete to cool suddenly.

3. In hot weather comply with ACI 305.1 except as modified herein.
   a. At air temperature of 90 DEGF and above, keep concrete as cool as possible during placement and curing.
   b. Do not allow concrete temperature to exceed 90 DEGF at placement.
   c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
   d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 LBS/SF/HR as determined from ACI 305.1, Figure 2.1.5.

H. Curing:
1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.
2. Cure concrete by use of moisture retaining cover, burlap kept continuously wet or by membrane curing compound.
3. Provide protection as required to prevent damage to concrete and to prevent moisture loss from concrete during curing period.
4. Provide curing for minimum of [seven] [14] days.
5. Form materials left in place may be considered as curing materials for surfaces in contact with the form materials except in periods of hot weather.
6. In hot weather follow curing procedures outlined in ACI 305.1.
7. In cold weather follow curing procedures outlined in ACI 306.1.
8. Curing vertical surfaces with a curing compound:
   a. Cover vertical surfaces with a minimum of two coats of the curing compound.
   b. Allow the preceding coat to completely dry prior to applying the next coat.
   c. Apply the first coat of curing compound immediately after form removal.
   d. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
   e. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

I. Form Removal:
1. Remove forms after concrete has hardened sufficiently to resist damage from removal operations or lack of support.
2. Where no reshoring is planned, leave forms and shoring used to support concrete until it has reached its specified 28-day compressive strength.

## 3.2 CONCRETE FINISHES

A. Tolerances:
1. Class A: 1/8 IN in 10 FT.
2. Class B: 1/4 IN in 10 FT.

B. Surfaces Exposed to View:

1. Provide a smooth finish for exposed concrete surfaces and surfaces that are:
   a. To be covered with a coating or covering material applied directly to concrete.
   b. Scheduled for grout cleaned finish.
2. Remove fins and projections, and patch voids, air pockets, and honeycomb areas with cement grout.
3. Cementitious concrete coating:
   a. Form facing material shall produce a smooth, hard, uniform texture.
      1) Use forms specified for surfaces exposed to view.
   b. Prepare the surface in accordance with manufactures printed installation instructions.
   c. Brush on coating to entire surface.
      1) As a mixing liquid for the coating, use bonding agent and water mixture as recommended by the manufacture.
      2) Apply two (2) coats at 2 LB/SQYD per coat.
   d. When second coat is set, float to a uniform texture with a sponge coat.
   e. Provide this finish at the following locations:
      1) Walls, columns, exposed to view.

C. Surfaces Not Exposed to View:
1. Patch voids, air pockets and honeycomb areas with cement grout.
2. Fill tie holes with nonshrink, nonmetallic grout.

D. Slab Float Finish:
1. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
2. Do not use water to aid in finishing.
3. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operation.
4. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
5. Cut down all high spots and fill all low spots during this procedure to produce a surface within Class B tolerance throughout.
6. Refloat slab immediately to a uniform sandy texture.

E. Troweled Finish:
1. Float finish surface.
2. Next power trowel, and finally hand trowel.
3. Do not use water to aid in finishing.
4. Produce a smooth surface which is relatively free of defects with first hand troweling.
5. Perform additional trowelings by hand after surface has hardened sufficiently.
6. Final trowel when a ringing sound is produced as trowel is moved over surface.
7. Thoroughly consolidate surface by hand troweling.
8. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
9. On surfaces intended to support floor coverings remove any defects of sufficient magnitude that would show through floor covering by grinding.

F. Broom Finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom across surface.

3.3 GROUT

A. Preparation:
1. Nonshrinking, nonmetallic grout:
a. Clean concrete surface to receive grout.
b. Saturate concrete with water for 24 HRS prior to grouting.

B. Application:
1. Nonshrinking, nonmetallic grout:
a. Mix in a mechanical mixer.
b. Use no more water than necessary to produce flowable grout.
c. Place in accordance with manufacturer's instructions.
d. Completely fill all spaces and cavities below the bottom of baseplates.
e. Provide forms where baseplates and bedplates do not confine grout.
f. Where exposed to view, finish grout edges smooth.
g. Except where a slope is indicated on Drawings, finish edges flush at the baseplate, bedplate, member, or piece of equipment.
h. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.
i. Wet cure grout for seven days, minimum.

3.4 FIELD QUALITY CONTROL

A. Owner will employ and pay for services of a concrete testing laboratory to perform testing of concrete placed during construction.
1. Contractor to cooperate with Owner in obtaining and testing samples.

B. Tests During Construction:
1. Strength test:
a. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
1) Cylinder size: Per ASTM C31.
a) 4 IN cylinders may not be used for concrete mixes with concrete aggregate size larger than 1 IN.
2) Quantity:
a) 6 IN DIA by 12 IN high: Four cylinders.
b) 4 IN DIA by 8 IN high: Six cylinders.
b. Field cure one (1) cylinder for the seven day test.
1) Laboratory cure the remaining.
c. Test cylinders in accordance with ASTM C39.
1) 6 IN DIA cylinders:
a) Test two cylinders at 28 days for strength test result and the one field cured sample at seven days for information.
b) Hold remaining cylinder in reserve.
2) 4 IN DIA cylinders:
a) Test three cylinders at 28 days for strength test result and the one field cured cylinder at seven days for information.
b) Hold remaining cylinders in reserve.

d. Strength test result:
   1) Average of strengths of two 6 IN DIA cylinders or three 4 IN DIA cylinders from the same sample tested at 28 days.
   2) If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
   3) Should all cylinders in any test show any of above defects, discard entire test.
e. Frequency of tests:
   a) One strength test to be taken not less than once a day, nor less than once for each 60 CUYD or fraction thereof placed in any one day.
   b) Once for each 5000 SQFT of slab or wall surface area placed each day.
   c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five strength tests for each concrete mix, tests shall then be made from at least five randomly selected batches or from each batch if fewer than five batches are provided.

2. Slump test:
   a. Per ASTM C143.
   b. Determined for each strength test sample.
   c. Additional slump tests may be taken.
3. Air content:
   a. Per ASTM C231, ASTM C173, and ASTM C138.
   b. Determined for each strength test sample.
4. Temperature: Determined for each strength test sample.

C. Evaluation of Tests:
   1. Strength test results:
      a. Average of 28-day strength of two cylinders from each sample.
         1) If one cylinder manifests evidence of improper sampling, molding, handling, curing or testing, strength of remaining cylinder will be test result.
         2) If both cylinders show any of above defects, test will be discarded.

D. Acceptance of Concrete:
   1. Strength level of each type of concrete shall be considered satisfactory if both of the following requirements are met:
      a. Average of all sets of three consecutive strength tests equals or exceeds the required specified 28-day compressive strength.
      b. No individual strength test falls below the required specified 28-day compressive strength by more than 500 PSI.
   2. If tests fail to indicate satisfactory strength level, perform additional tests and/or corrective measures as directed by Engineer.
      a. Perform additional tests and/or corrective measures at no additional cost to Owner.

E. Concrete tolerances per ACI 117.

3.5 SCHEDULES

A. Form Types:
   1. Surfaces exposed to view:
      a. Prefabricated or job-built wood forms.
      b. Laid out in a regular and uniform pattern with long dimensions vertical and joints aligned.
      c. Produce finished surfaces free from offsets, ridges, waves, and concave or convex areas.
      d. Construct forms sufficiently tight to prevent leakage of mortar.
   2. Surfaces normally submerged or not normally exposed to view: Wood or steel forms sufficiently tight to prevent leakage of mortar.
   3. Other types of forms may be used:
      a. For surfaces not restricted to plywood or lined forms.
      b. As backing for form lining.

B. Grout:
   1. Nonshrinking, nonmetallic grout: General use.

C. Concrete:
   1. Normal weight concrete: [All other locations] [All concrete].
   2. General use concrete: All other locations.

D. Concrete Finishes:
   1. Slab finishes:
      a. Use following finishes as applicable, unless otherwise indicated:
         1) Floated finish: Surfaces intended to receive roofing, concrete topping, lean concrete, concrete fill and waterproofing.
         2) Troweled finish: Interior floor slabs, exposed roof slabs and base slabs of structures, equipment bases, and column bases.
         3) Broom finish: Sidewalks, docks, concrete stairs, and ramps.

END OF SECTION

# SECTION 03 05 05
CONCRETE TESTING AND INSPECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Contractor requirements for testing of concrete and grout.
2. Definition of Owner provided testing.
3. Acceptance criteria for concrete.

B. Related Specification Sections include but are not necessarily limited to:

1. Section 03 21 00 - Reinforcement.
2. Section 03 31 30 - Concrete, Materials and Proportioning.
3. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.
4. Section 03 41 33 - Precast and Prestressed Concrete.
5. Section 03 42 00 - Precast and Prestressed Concrete Buildings.

### 1.2 RESPONSIBILITY AND PAYMENT

A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.

1. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
3. Strength testing on concrete required by the Engineer or Special Inspector when the water-cement ratio exceeds the water-cement ratio of the typical test cylinders.
4. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
5. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may re-removed.
6. Owner will pay for services defined in Paragraph 1.2A.1.
7. See Specification Section 01 42 00.

B. Hire a qualified testing agency to perform the following testing and provide test results to the Engineer.

1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
3. Pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.
4. Reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.
5. See Specification Section 01 42 00.

C. Duties and Authorities of Testing Agency/Service Provider:

1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or

release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.

2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.
3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.
   a. All test reports to include exact location in the work at which batch represented by a test was deposited.
   b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

## 1.3 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 318, Building Code Requirements for Structural Concrete.
   2. ASTM International (ASTM):
      a. ASTM Cement and Concrete Reference Laboratory (CCRL).
      b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
      c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
      e. C94, Standard Specification for Ready-Mixed Concrete.
      f. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
      g. C172, Standard Practice for Sampling Freshly Mixed Concrete.
      h. C1019, Standard Test Method for Sampling and Testing Grout.
      i. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
      j. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Qualifications:
   1. Contractor’s Testing Agency:
      a. Meeting requirements of ASTM E329 and ASTM C94.
      b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.

C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

## 1.4 DEFINITIONS

A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

## 1.5 SUBMITTALS

A. Shop Drawings:
   1. Product technical data including:

a. Concrete materials and concrete mix designs proposed for use.
   1) Include results of all testing performed to qualify materials and to establish mix designs.
   2) Place no concrete until approval of mix designs has been received in writing.
   3) Submittal for each concrete mix design to include:
      a) Sieve analysis and source of fine and coarse aggregates.
      b) Test for aggregate organic impurities.
      c) Proportioning of all materials.
      d) Type of cement with mill certificate for the cement.
      e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
      f) Slump.
      g) Brand, type and quantity of air entrainment and any other proposed admixtures.
      h) Shrinkage test results.
      i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
      j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.

2. Certifications:
   a. Testing Agency qualifications.

## PART 2 - PRODUCTS - (NOT USED)

## PART 3 - EXECUTION

### 3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY

A. The following concrete testing will be performed by the Service Provider/Testing Agency:

1. Concrete strength testing:
   a. Secure concrete samples in accordance with ASTM C172.
      1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
   b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
      1) Record any deviations from requirements on test report.
      2) Cylinder size: Per ASTM C31.
         a) 4 inches cylinders shall not be used for concrete mixes with maximum aggregate size larger than 1 inch.
         b) Use the same size cylinder for all tests for each concrete mix.
      3) Quantity:
         a) 6 inches diameter by 12 inches high: [Four] [Five] cylinders.
         b) 4 inches diameter by 8 inches high: Six cylinders.
   c. Field cure one cylinder for the seven day test.
      1) Laboratory cure the remaining.
   d. Test cylinders in accordance with ASTM C39.
      1) 6 inches diameter cylinders:

a) Test two cylinders at 28 days for strength test result and the one field cured sample at seven days for information.
b) Hold remaining cylinder in reserve.

2) 4 inches diameter cylinders:
a) Test three cylinders at 28 days for strength test result and the one field cured cylinder at seven days for information.
b) Hold remaining cylinders in reserve.

e. Strength test result:
1) Average of strengths of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
2) If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
3) Should all cylinders in any test show any of above defects, discard entire test.

f. Frequency of tests:
1) Concrete sand cement grout: One strength test for each 4 hour period of grout placement or fraction thereof.
a) Test grout in accordance with ASTM C1019.
2) Concrete topping, concrete fill and lean concrete: One strength test for each [10] [60] CUYD of each type of concrete or fraction thereof placed.
3) Precast concrete: Frequency per Specification Section [03 41 33] [03 42 00].
4) All other concrete:
a) One strength test to be taken not less than once a day, nor less than once for each 60 cubic yards or fraction thereof placed in any one day.
b) Once for each 5000 square feet of slab or wall surface area placed each day
c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five strength tests for each concrete mix, tests shall then be made from at least five randomly selected batches or from each batch if fewer than five batches are provided.

2. Slump testing:
a. Determine slump of concrete sample for each strength test.
1) Determine slump in accordance with ASTM C143.
b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.

3. Air content testing: Determine air content of concrete sample for each strength test in accordance with [ASTM C231][, ASTM C173][, or] [ASTM C138.]

4. In-place concrete testing (if required).

## 3.2 SPECIAL INSPECTIONS

A. See Section 01 45 33.

1. Special Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.

B. Formwork Special Inspections:

1. Shape, location, and dimensions.

a. Inspect in accordance with dimensions and details on Drawings.
b. Frequency: Inspect prior to each concrete pour.

C. Reinforcing Special Inspections:

1. Reinforcing size, spacing, lap length and concrete cover.
   a. Inspect in accordance with Drawings and Specification.
   b. Frequency: Inspect prior to each concrete pour.
2. Reinforcing adhesive anchoring system:
   a. Inspect in accordance with ICC-ES report.
   b. Frequency:
      1) Inspect all adhesive anchors for the first [4] hours of installation.
      2) Inspect approximately [25]% of adhesive anchors thereafter.
      3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
3. Mechanical splices:
   a. Inspect in accordance with ICC-ES report.
   b. Frequency:
      1) Inspect all mechanical splices [prior to placing concrete] [for the first [4 hours] of installation].
      2) Inspect approximately [25]% of mechanical splices thereafter.
      3) Additional inspection will be required for different installer or if the quality of installation appears to vary.

D. Mixing, Placing, Jointing, and Curing Special Inspections:

1. Perform concrete tests per the requirements of this Specification Section.
2. Verification of proper mix design.
   a. Frequency: Periodically, prior to [each] concrete pour.
3. Proper concrete placement techniques.
   a. Inspect per requirements of Section 03 31 31.
   b. Frequency: During [each] concrete pour.
4. Proper curing temperature and techniques.
   a. Inspect per requirements of Section 03 31 31.
   b. Frequency: Periodically, but not less than [every third day].
5. Joints:
   a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
   b. Frequency: Prior to each concrete pour.
6. Waterstops:
   a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.
   b. Frequency:
      1) Prior to each concrete pour.

E. Anchorage to Concrete Special Inspection:

1. Post installed anchors as required by the building code, ICC-ES Evaluation Reports, and as specified by the Engineer.
   a. Frequency: Per ICC-ES Report.

2. Cast-in-place concrete anchors, including anchor size, embedment, material and location.
   a. Frequency: Prior to each concrete pour.

## 3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

A. To facilitate testing and inspection, perform the following:
   1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
   2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 hours as required by ASTM C31.
   3. Take samples at point of placement into concrete member.

B. Notify [Engineer] [and Owner's Testing Agency] [Contractor's Testing Agency] sufficiently in advance of operations (minimum of 24 hours) to allow for assignment of personnel and for scheduled completion of quality tests.

## 3.4 ACCEPTANCE

A. Completed concrete work which meets applicable requirements will be accepted without qualification.

B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.

C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
   1. In this event, modifications may be required to assure that concrete work complies with requirements.
   2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

D. Dimensional Tolerances:
   1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
   2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
      a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
   3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
   4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
      a. Repair or remove and replace if required.
   5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
      a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.

E. Appearance:
   1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.

2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.

F. High Water-Cement Ratio:

1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.
2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.

G. Strength of Structure:

1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
   a. Low concrete strength:
      1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
         a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
         b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests.
         c) A strength test shall be the average of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
      2) Acceptance:
         a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
            (1) Average of all sets of three consecutive strength tests equal or exceed the required specified 28 day compressive strength.
            (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 psi.
   b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 21 00 or requirements of the Contract Drawings or approved Shop Drawings.
   c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
   d. Curing time and procedure not meeting requirements of this Specification Section.
   e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
   f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
   g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.
2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
   a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
      1) Such tests shall not be used as a basis for acceptance or rejection.
   b. Core tests:

1) Where required, test cores will be obtained in accordance with ASTM C42.
   a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60%) for seven days before test then test dry.
   b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 hours and test wet.
   c) Testing wet or dry to be determined by Engineer.
2) Three representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
   a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
   b) If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
3) Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85% of specified strength and no single core is less than 75% of specified strength.
4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.

4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

**END OF SECTION**

# SECTION 03 15 19
# ANCHORAGE TO CONCRETE

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Requirements for all cast-in-place anchor bolts, anchor rods, reinforcing adhesive anchorage, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
2. Design of all concrete anchors not indicated on the Drawings including, but not limited to, installation of anchors into concrete for the following structural and nonstructural components:
   a. Structural members and accessories.
   b. Metal, wood, and plastic fabrications.
   c. Architectural components.
   d. Mechanical and electrical equipment and components.
   e. Plumbing, piping, and HVAC work.
   f. All other components requiring attachment to concrete.

B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 03 05 05 - Concrete Testing and Inspection.
4. Section 26 05 36 - Cable Tray.
5. Section 40 05 07 - Pipe Support Systems.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards:
1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete and Commentary.
2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
   a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
3. American Institute of Steel Construction (AISC):
   a. 303, Code of Standard Practice for Steel Buildings and Bridges.
4. ASTM International (ASTM):
   a. A36, Standard Specification for Carbon Structural Steel.
   b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.

g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
i. F436, Standard Specification for Hardened Steel Washers.
j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
k. F594, Standard Specification for Stainless Steel Nuts.
l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

5. ICC Evaluation Service (ICC-ES):
   a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

B. Qualifications:
   1. Anchor designer for Contractor-designed post-installed anchors [and cast in place anchorage] shall be a professional [structural] [civil] engineer licensed in the State that the Project is located in.
   2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.

C. Post-installed anchors and related materials shall be listed by the following agencies:
   1. ICC-ES.
   2. Engineer approved equivalent.

1.3 DEFINITIONS

A. Adhesive Anchors:
   1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
   2. Includes anchors using acrylics, epoxy and other similar adhesives.

B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.

C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.

D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.

E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

F. Hardware: As defined in [ASTM A153] [ASTM F2329].

G. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

2. Installer and applicator are synonymous.

H. MPII: Manufacturer’s printed installation instructions.

I. Mechanical Anchors:
1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
3. Drop-in anchors and other similar anchors are not allowed.

J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that submitted products meet requirements of referenced standards.
b. Manufacturer material data sheet for each anchor.
1) Clearly indicate which products on the data sheet are proposed for use on the Project.
c. Manufacturer's printed installation instructions.
d. Current ICC-ES report for each post-installed anchor system indicating the following:
1) Certification that anchors meet all requirements indicated in this Specification.
2) Performance data showing that anchor is approved for use in cracked concrete.
3) Seismic design categories for which anchor system has been approved.
4) Required installation procedures.
5) Special inspection requirements for installation.
e. Anchorage layout drawings and details:
1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
2) Drawings showing location, configuration, spacing and edge distance.
f. Contractor Designed Post-Installed Anchors:
1) Show diameter and embedment depth of each anchor.
2) Indicate compliance with ACI 318, Appendix D [ACI 318, Chapter 17], [ACI 350 Appendix D].
3) Design tension and shear loads used for anchor design.
4) Engineering design calculations:
a) Indicate design load to each anchor.
b) When the design load is not indicated on Drawings, include calculations to develop anchor forces based on Design Criteria listed herein.
c) Sealed and signed by contractor’s professional [structural] engineer.
d) Calculations will be submitted for information purposes only.
5) Type of post-installed anchor system used.

a) Provide manufacturer's ICC-ES report for the following:
(1) Mechanical anchorage per ICC-ES AC193.
(2) Adhesive anchorage per ICC-ES AC308.

B. Samples:
1. Representative samples of concrete anchors may be requested by Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Contractor.

C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Certification of qualifications for each installer of post-installed anchors.
a. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.
b. Provide one of the following for each type of anchor, as required by this specification section:
1) Letter from manufacturer documenting successful training completion [for mechanical anchors only].
2) Certification of completion for Engineer approved program.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer’s or distributor’s packaging undamaged and complete with installation instructions.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

C. Protect and handle materials in accordance with manufacturer’s recommendations to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cast-in-place Concrete Anchors:
1. Building, nonbuilding structures, and equipment:
a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized [or non-galvanized] threaded rods.
b. ASTM A307, Grade A for galvanized headed bolts.
2. All other cast-in-place concrete anchors:
a. Stainless steel with matching nut and washer.
b. Submerged application: ASTM F593, Type 316.
c. Non-submerged application: ASTM F593, Type 304 or Type 316.

B. Post-Installed Mechanical and Adhesive Concrete Anchors:
1. Stainless steel with matching nut and washer.
2. Submerged application: ASTM F593, Type 316.
3. Non-submerged application: ASTM F593, Type 304 or Type 316.

C. Reinforcement: See Section 03 21 00.

D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.

E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.

F. Washers:
1. ASTM F436 unless noted otherwise.
2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
3. Plate washers: Minimum [1/2] [3/4] IN thick fabricated ASTM A36 square plates as required.
4. Follow manufacturer’s requirements for all post-installed anchorage.

G. Nuts:
1. ASTM A563 for all cast-in-place anchorage.
2. If stainless steel anchorage is being used for cast-in-place anchorage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
3. Follow manufacturer’s requirements if using post-installed anchorage.

H. Galvanizing Repair Paint:
1. High zinc dust content paint for regalvanizing welds and abrasions.
2. ASTM A780.
3. Zinc content: Minimum 92 PCT in dry film.
4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

I. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.2 CONTRACTOR DESIGNED ANCHORAGE

A. Manufacturers:
1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Engineer.
   a. Hilti.
   b. Dewalt.
   c. Simpson Strong-Tie.
2. Submit request for substitution in accordance with Specification Section 01 25 13.

B. Design the anchorage when any of the following occur:
1. Design load for concrete anchorage is shown on the Drawings.
2. When specifically required by the Contract Documents.
3. When an anchorage is required but not specified in the Drawings.
4. When anchorage is shown on Drawings other than Structural Drawings.

C. Anchorage Design Loads:
1. Determine all of the design loads, including wind and seismic loads, per the building code.

a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.

D. When Contract Drawings, other than the Structural Drawings, indicate an anchor diameter or length, the Contractor design shall incorporate these as "minimums."

E. Cast-in-Place Concrete Anchors:
1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the building code including ACI 318, Appendix D[, ACI 350, Appendix D].
2. Design assuming cracked concrete.

F. Post-installed Concrete Anchors:
1. Provide the manufacturer's system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified [or calculated] load based on requirements given in the building code, [ACI 318, Appendix D][ACI 318, Chapter 17][, ACI 350, Appendix D] and current ICC-ES report, for the anchor to be used.
2. Design assuming cracked concrete.

2.3 ENGINEER DESIGNED ANCHORAGE

A. When the size, length and details of anchorages are shown on Contract Structural Drawings, Contractor design of anchorage is not required [unless otherwise indicated].

B. Manufacturers:
1. Additional newer post-installed anchor systems for the listed manufacturers will be considered only if a current evaluation agency report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section, the anchor system is certified by ICC-ES for cracked concrete conditions, and if approved by the Engineer.
2. Mechanical Anchors:
a. Hilti:
1) Kwik Bolt TZ (ICC-ES ESR-1917).
3. Adhesive Concrete Anchors:
a. Hilti:
1) HIT RE 500 V3 (ICC ESR-3814).
4. Concrete Screw Anchors:
a. Hilti:
1) Kwik HUS-EZ Screw (ICC-ES ESR-3027).
5. Submit request for substitution in accordance with Specification Section 01 25 13.
a. Substitution request to indicate the proposed anchor has the at least the same tension and shear strength as the specified anchor installed as indicated in the Contract Drawings.
b. Calculations to be stamped by a Professional Engineer registered in the state that the Project is located in.

PART 3 - EXECUTION

3.1 GENERAL

A. Cast-in-Place Anchorage:
   1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Engineer.
   2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.

B. Adhesive Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
   2. May be used where subjected to vibration or where buried or submerged.
   3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.
   4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

C. Mechanical Anchorage:
   1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
   2. Do not use where subjected to vibration.
   3. May be used in overhead applications.
   4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.

D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Engineer or specified in Contract Documents.

3.2 PREPARATION

A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.

B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
   1. Notify Engineer of conditions detrimental to proper and timely completion of work.
   2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

C. Special Inspection is required in accordance with the building code for all concrete anchorage.
   1. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
   2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.

D. Post-installed anchor manufacturer’s representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
   1. Follow such procedures to assure acceptable installation.

2. Adhesive anchors must be installed in concrete aged a minimum of 21 days.

3.3 INSTALLATION

A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
   1. Tack welding of anchorage is prohibited.
   2. Coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
   3. Anchorage location tolerance shall be in accordance with AISC 303.
   4. Provide steel or durable wood templates for all column and equipment anchorage.
      a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.

B. Unless noted or specified otherwise:
   1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
      a. Provide dissimilar materials protection per Specification Section 09 96 00.
   2. Provide washers for all anchorage.
   3. Where exposed, extend threaded anchorage [a maximum of 3/4 IN and] a minimum of 1/2 IN above the top of the fully engaged nut.
      a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.

C. Do the following after nuts are snug-tightened down:
   1. If using post-installed anchorage, follow MPII.
   2. Upset threads of anchorage to prevent nuts from backing off.
      a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
   3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn to prevent nuts from backing off.
   4. If two nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two nuts together.
   5. If using post-installed anchorage, follow manufacturer’s installation procedures.

D. Assure that embedded items are protected from damage and are not filled in with concrete.

E. Secure architectural components such that it will not be aesthetically distorted nor fasteners overstressed from expansion, contraction or installation.

F. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.

G. Repair damaged galvanized surfaces in accordance with ASTM A780.
   1. Prepare damaged surfaces by abrasive blasting or power sanding.
   2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.

H. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
   1. Use hammer drills to create holes.
   2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Special Inspector.

3.4 FIELD QUALITY CONTROL

A. Special Inspection:
   1. See Section 01 45 33.
   2. See Section 03 05 05.

3.5 CLEANING

A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.

B. Provide surface acceptable to receive field applied paint coatings when specified in Specification Section [09 91 10] [09 96 00].

END OF SECTION

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# SECTION 03 45 00
# ARCHITECTURAL PRECAST CONCRETE (APC)

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Architectural Precast Concrete (APC) in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Fabricator Qualifications:
1. Firm experienced in producing architectural precast concrete units similar to those indicated and with a record of successful performance.
2. PCI Certified for Group A, Category A1-Architectural Cladding and Load Bearing Units or designated as an APA certified plant for production of architectural precast concrete products.
3. Capacity to produce required units without delaying Work.
4. Assume responsibility for engineering of APC units to comply with Building Code requirements as locally adopted.

B. Engineer Qualifications:
1. Comply with Section 01 71 21, Specialty Engineering Requirements.

C. Erector Qualifications:
1. Certificate of Compliance furnished by PCI designating qualification in Category A (Architectural Systems) for non-loadbearing members.
2. Certify welders according to AWS D1.1: Structural Welding Code – Steel and AWS D1.4: Structural Welding Code – Reinforcing Steel.

D. Testing Agency Qualifications:
1. An independent testing agency, acceptable to authorities having jurisdiction and qualified to conduct the testing indicated.

E. Reference Standards:
1. ACI 318 Building Code Requirements for Structural Concrete
2. PCI MNL117 Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products
3. ASTM A27/A27M Steel Castings, Carbon for General Application
4. ASTM A36/A36M Carbon Structural Steel
5. ASTM A47/A47M Ferritic Malleable Iron Castings
6. ASTM A108 Steel Bar, Carbon and Alloy, Cold Finished
7. ASTM A123/A123M Zinc (Hot-Dipped Galvanized) Coatings of Iron and Steel Products
8. ASTM A185 Steel Welded Wire Fabric, Plain for Concrete Reinforcement.
9. ASTM A283/A283M Low and Intermediate Tensile Strength Carbon Steel Plates

10. ASTM A307 Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
11. ASTM A500/A500M Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
12. ASTM A563 Carbon and Alloy Steel Nuts
13. ASTM A572/A572M High-Strength Low-Alloy Columbium-Vanadium Structural Steel
14. ASTM A615/A615M Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
15. ASTM A1064/A1064M Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
16. ASTM C33/C33M Concrete Aggregates
17. ASTM C39/C39M Compressive Strength of Cylindrical Concrete Specimens
18. ASTM C231/C231M Test for Air Content of Freshly Mixed Concrete by the Pressure Method
19. ASTM C260/C260M Specifications for Air-Entraining Admixtures for Concrete
20. ASTM C494/C494M Specifications for Chemical Admixtures for Concrete
21. ASTM C578 Rigid, Cellular Polystyrene Thermal Insulation
22. ASTM C642 Test for Density, Absorption, and Voids in Hardened Concrete
23. ASTM C979/C979M Pigments for Integrally Colored Concrete
24. ASTM C1107/C110M Standard Specification for Packaged Dry, Hydraulic Cement Grout (Nonshrink)

F. Testing:
1. Test one set of cylinders for each 50 cubic yards 38 cubic meters of concrete, but not less than one set for each day's pour.
   a. Test for air content each time cylinders are made, in accordance with ASTM C231.
   b. Test for water absorption in accordance with ASTM C642 or PCI MNL 117.
   c. Test cylinders in accordance with ASTM C39. One at 7 days and two at 28 days.

G. Fabrication Tolerances:
1. Refer to Part 2.

H. Erection Tolerances:
1. Refer to Part 3.

1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
1. For each type of material and accessory.

C. Shop Drawings:
1. Detail fabrication and installation of architectural precast concrete units including:
   a. Member locations, plans, elevations, dimensions, shapes and cross sections.
   b. Details at joints, reveals, and surface finish.
   c. Loose and cast-in hardware, connections and anchorage devices.

d. Locations of dry joints if two-stage casting is proposed.
e. Sequence of erection for special conditions.
f. Identification mark on each panel.
g. Relationship of architectural precast concrete units to adjacent materials.

D. Samples:
1. Three, 12 x 12 x 2 IN 300 x 300 x 50 MM, samples, replicating each of the colors and textures indicated, approval of appearance.
a. Provide samples for each color/texture combination.
b. Label samples to indicate name of project; fabricator; finish; type, color and source of cement and aggregate.
2. Mockup Panel on-site: As described herein.

E. Project Information:
1. Test reports signed by certified testing agency.
2. Design Mixes: For each concrete mix including compressive strength and water absorption tests.
3. Design Calculations:
a. Submit calculations signed and sealed by Specialty Structural Engineer, as described in Quality Assurance, Design Requirements.
b. Submit concurrent with shop drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Architectural Precast Concrete (APC):
1. Base:
a. _____.
2. Optional:
a. Enterprise Precast Concrete.
b. Coreslab Structures Inc.
c. Clark Pacific.

B. Rust inhibitive paint:
1. Base:
a. Tnemec.
b. ZRC Worldwide.

C. Other materials listed:
1. Base:
a. As indicated.

D. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

A. Comply with ACI 318 and the design recommendations of PCI MNL 120: PCI Design Handbook - Precast and Prestressed Concrete, applicable to types of architectural precast concrete units indicated.

B. Design units and connections to satisfy requirements of building codes.

C. Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
   1. Include effect from adjacent attached construction.
   2. Wind pressure, and/or earthquake lateral forces.
   3. Live Loads.
   4. Dead load of unit plus superimposed loads.
   5. Handling, transportation, and erection forces.
   6. Temperature stresses appropriate for project site and conditions.
   7. Shrinkage stresses.

D. Design framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
   1. Upward and downward movement of L/300 for floors and L/200 for roofs.

E. Show, by engineering calculations, embedded connections can adequately support anticipated loads.
   1. When approved by Architect, load tests may be substituted for calculations.

F. Design, detail and provide internal reinforcing and embedded connection hardware.

G. Reinforce units with welded wire fabric or reinforcing bars as needed to satisfy design criteria or provide following minimum reinforcing, whichever is greater:
   1. Unit thickness up to 4 IN 100 MM: One layer 4 x 4 - W4.0 x W4.0 102x102 - MW9.1/MW9.1.
   2. Unit thickness over 4 IN 100 MM: Two layers 4 x 4 - W4.0 x W4.0 102x102 - MW9.1/MW9.1.

H. When unit is supported from rigid base, design connections to permit reasonable amount of independent vertical movement of structural frame.

I. Attach connections placing lateral loads on structural members to elements capable of resisting forces without reinforcing, unless such reinforcing is provided by erector at no additional cost to Owner and in manner acceptable to Architect, unless detailed and accommodated otherwise.

J. Design, detail and provide connection hardware and anchors to be set in CIP Concrete and for Structural Steel frames associated with precast unit connections.

K. Design units and connections to load supporting steel sections at centerline of web creating no torsion in supporting member unless detailed otherwise.

## 2.3 FORM MATERIALS

A. Forms:
   1. Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast concrete surfaces within fabrication tolerances indicated.

2. Non-reactive with concrete and suitable for producing required finishes.

B. Release Agents:
1. Commercially produced liquid release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

2.4 REINFORCING MATERIALS

A. Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and wire in place.

B. Use products with Corrosion Resistant Coatings of type indicated below when concrete cover on exterior face is less than 1-1/2 IN 38 MM or interior face is less than 3/4 IN 19 MM. Otherwise, uncoated reinforcing may be used.

C. Reinforcing Bars:
1. Welded bars: ASTM A706.

D. Welded Wire Reinforcement:
1. Galvanized and chromate wash treated.
2. Plain: ASTM A185, flat sheet.

E. Corrosion Resistant Coatings:
1. Hot dip Galvanizing (HDG) Coating:
a. Reinforcing bars and wire mesh: ASTM A123 applied after welding/fabrication.
b. ASTM A767, Class II zinc coated, hot dip galvanized (HDG) and chromate wash treated after fabrication and bending.

2.5 CONCRETE MATERIALS

A. Design Reference Sample:

B. Portland Cement:
1. ASTM C150, Type I or III.
2. Same type, brand, and mill source throughout production.
3. Cement Color:
a. Face Mixes (portions of units exposed to view):
1) As necessary to reproduce coloration of Design Reference Sample.
b. Backup mixes (portions of units not exposed to view):
1) Contractor’s option.

C. Normal Weight Aggregates:
1. Comply with ASTM C33 except as modified by PCI MNL 117:
a. Employ coarse aggregates complying with Class 5S.
2. Stockpile fine and coarse aggregates for each type of exposed finish from a single source for entire project.
3. Face Mix Coarse Aggregates:
a. Selected, hard, and durable; free of material that reacts with cement or causes staining.
b. Color: To match selected Design Reference Sample.
c. Gradation:
1) To match selected Design Reference Sample.
4. Face Mix Fine Aggregates:

a. Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by Architect.
b. Color: To match selected Design Reference Sample.

D. Coloring Admixture:
1. Pigment: As required by Design Reference Sample.
2. ASTM C979, synthetic or natural mineral oxide pigments or colored water reducing admixtures, temperature stable and non-fading.
3. Lime and alkali resistant.
4. Limit type and amount used so as not to reduce quality of concrete.

E. Water:
1. Potable; clean, fresh, free from oil, acid, organic matter or other deleterious substances that may affect color, stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air Entraining Admixture:
1. ASTM C260, certified by manufacturer to be compatible with other required admixtures.

G. Water Reducing Admixture: ASTM C494, Type A.

H. Retarding Admixture: ASTM C494, Type B.

I. Water Reducing and Retarding Admixture: ASTM C494, Type D

J. Water Reducing and Accelerating Admixture: ASTM C494, Type E.

K. High Range, Water Reducing Admixture: ASTM C494, Type F.

L. High Range, Water Reducing and Retarding Admixture: ASTM C494, Type G.

M. Plasticizing Admixture for Flowable Concrete: ASTM C1017.

N. Admixtures containing calcium chloride, or more than 0.15 PCT chloride ions or other salts by weight of admixture are not permitted.

2.6 CARBON STEEL CONNECTION MATERIALS

A. Carbon Steel Shapes and Plates:
1. ASTM A36 except silicon content in the range of 0 to 0.03 PCT.
a. 0.15 to 0.25 PCT for materials to be galvanized.
b. Steel with chemistry conforming to the formula Si + 2.5P less than or equal to 0.09 is also acceptable.
2. ASTM A283 for Carbon Steel Plate.

B. Carbon Steel Headed Studs:
1. ASTM A108, Grades 1018 through 1020, cold finished and bearing the minimum mechanical properties for studs as indicated under MNL 117, Table 3.2.3.; AWS D1.1, Type A or B, with arc shields.

C. Malleable Iron Castings: ASTM A47, Grade 32510 or 35028.

D. Carbon Steel Castings: ASTM A27, Grade U-60-30.

E. High Strength, Low Alloy Structural Steel:

1. ASTM A572 except silicon content in the range of 0 to 0.03 PCT.
   a. 0.15 to 0.25 PCT for materials to be galvanized.
   b. Steel with chemistry conforming to the formula Si + 2.5P less than or equal to 0.09 is also acceptable.

F. Carbon Steel Structural Tubing: ASTM A500, Grade B.

G. Wrought Carbon Steel Bars: ASTM A675, Grade 65.

H. Deformed Steel Wire or Bar Anchors: ASTM A1064/A1064M or ASTM A706.

I. Carbon Steel Bolts and Studs:
   1. Hex head bolts and studs: ASTM A307, Grade A.
   2. Nuts: ASTM A563, Grade A.
   3. Flat, unhardened steel washers: ASTM F844.
   4. Headed studs or deformed bar anchors:
      a. Headed studs having minimum tensile strength of 60,000 PSI 415 MPa, minimum yield strength of 52,000 PSI 360 MPa, ASTM A108.
      b. Deformed bar anchors having minimum tensile strength of 80,000 PSI 550 MPa, minimum yield strength of 70,000 PSI 485 MPa, ASTM A1064/A1064M.

J. High Strength Bolts and Nuts:
   1. Heavy structural steel hex bolts: ASTM A325 or ASTM A490, Type 1,
   2. Heavy carbon steel hex nuts: ASTM A563.
   3. Hardened carbon steel washers: ASTM F436.

K. Protective Finish:
   1. Exterior steel items and items indicated for galvanizing:
      a. Apply zinc coating by hot dip process according to ASTM A123 after fabrication or ASTM A153 as applicable.

2.7 BEARING PADS AND OTHER ACCESSORIES

A. Provide bearing pads for architectural precast concrete units as follows:
   1. Elastomeric Pads:
      a. AASHTO M 251, plain, vulcanized, 100 PCT neoprene.
      b. Surface hardness: 50 to 70 Shore A durometer according to ASTM D2240.
      c. Minimum tensile strength: 2250 PSI 15.5 MPa per ASTM D412.
   2. Fiber Reinforced Elastomeric Pads:
      a. Preformed, randomly oriented synthetic fibers set in elastomer.
      b. Surface hardness: 70 to 90 Shore A durometer according to ASTM D2240.
      c. Capable of supporting a compressive stress of 3300 PSI 27.7 MPa with no cracking, splitting or delaminating in the internal portions of the pad.
      d. Test one specimen for each 200 pads used in the project.
   3. Fabric Reinforced Elastomeric Pads:
      a. Preformed, horizontally layered cotton duck fabric bonded to an elastomer.

b. Surface hardness: 80 to 100 Shore A durometer according to ASTM D2240.
c. Conforming to Division II, Section 18.10.2 of AASHTO LRFD Bridge Design Specifications, or Military Specification, MIL-C-882D.

4. Frictionless Pads:
   a. Teflon, glass fiber reinforced; bonded to stainless or mild steel plates, of type required for in-service stress.
5. High-Density Plastic:
   a. Multimonomer, non-leaching, plastic strip

B. Reglets and Counterflashing:
1. Specified in Section 07 62 00.
2. Fabricator to obtain reglet material specified and cast reglets into APC pieces.

C. Accessories:
1. Provide clips, hangers, plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.8 THIN BRICK UNITS AND ACCESSORIES

A. Thin Brick Units:
1. Face Dimensions, actual:
   a. Modular: 7-5/8 IN long x 2-1/4 IN tall 194 MM long x 57 MM tall
   b. Utility: 11-5/8 IN long x 3-5/8 IN tall 295 MM long x 92 MM tall
   c. Closure: 7-5/8 IN long x 3-5/8 IN tall 194 MM long x 92 MM tall
   d. Norman: 11-5/8 IN long x 2-1/4 IN tall 295 MM long x 57 MM tall
   e. Engineer Modular: 7-5/8 IN long x 2-3/16 IN tall 194 MM long x 56 MM tall

2.9 CONCRETE MIX DESIGN

A. Maximum Water Absorption:
1. 6 PCT by weight, equal to 14 PCT by volume, tested according to PCI MNL 117.

B. Air-Entrainment:
1. Provide concrete containing air-entraining admixture producing air content between 6 and 8 PCT including entrapped air.

C. Normal Weight Concrete Face and Backup Mixes:
1. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on project, to provide normal weight concrete with the following properties:
   a. Minimum Compressive Strength (28 Days): 5000 PSI 34.5 MPa.
   b. Maximum Water-Cementitious Materials Ratio: 0.45.

D. Lightweight Concrete (for Backup Mixes only):

1. Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:

2.10 MOLD FABRICATION

A. Molds:
1. Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete placement and vibration operations and temperature changes and for prestressing and de-tensioning operations.
2. Coat contact surfaces of molds with release agent before reinforcement is placed.
3. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Form Liners:
1. Place form liners accurately to provide finished surface texture indicated.
2. Provide solid backing and supports to maintain stability of liners during placing of concrete.
3. Coat form liner with form-release agent.

C. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

D. Form joints are not permitted on faces exposed to view in the finished work.

2.11 PANEL FABRICATION

A. Mark each unit for identification and date of casting.

B. Locate holes, inserts and other lifting mechanisms in non-finished surfaces.

C. APC Panel-to-Panel Joints:
1. Typical:
a. Unless otherwise shown provide for uniform joint widths of 3/4 IN 19 MM.
2. Corners:
a. 3/4 IN 19 MM wide quirk miter joints where panel joint occurs at external angles.

D. Panel Edge and Corner Treatment:
1. Uniformly chamfered or as otherwise indicated.

E. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware:
1. Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements.
2. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

F. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on drawings.
1. Cast-in openings larger than 10 IN 250 MM in any dimension.
2. Do not drill or cut prestressing strand.

G. Reinforcement:

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
   a. When damage to epoxy coated reinforcing exceeds limits specified ASTM A775 repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support and secure reinforcement during concrete placement and consolidation operations.
   a. Completely conceal support devices to prevent exposure on finished surfaces.
3. Install welded wire reinforcement in lengths as long as practicable.
   a. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design.
   b. Offset laps of adjoining widths to prevent continuous laps in either direction.

H. Prestress tendons for architectural precast concrete units by either pre-tensioning or post-tensioning methods.
   1. De-tension or post-tension prestressed architectural precast concrete units after concrete has reached its indicated minimum design release compressive strength as established by test cylinders.
   2. Protect strand ends and anchorages to prevent corrosion and rust spots.

I. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

J. Comply with ACI 305R recommendations for hot weather concrete placement.

K. Comply with ACI 306.1 procedures for cold weather concrete placement.

L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings as indicated on erection drawings.

M. Repair damaged architectural precast concrete units to meet acceptability requirements of PCI MNL 117.

2.12 PRE-TESTING - ANCHORS FOR STONE FACED PANELS

A. Stone Anchor Shear and Tensile Testing:

2.13 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with the following product tolerances.
   1. Overall Height and Width of Units, Measured at the Face Exposed to View:
      a. 10 FT 3 M or under: Plus or minus 1/8 IN 3 MM.
      b. 10 FT 3 M to 20 FT 6 m: Plus 1/8 IN 3 MM, minus 3/16 IN 4.5 MM.
      c. 20 FT 6 M to 40 FT 12 m: Plus 1/8 IN 3 MM, minus 1/4 IN 6 MM.

d. Each additional 10 FT 3 m: Plus or minus (1 IN 2000) to maximum 1/16 IN per 10 FT 1.5 MM per 3 m.

2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
   a. 10 FT 3 M or under: Plus or minus 1/4 IN 6 MM.
   b. 10 FT 3 M to 20 FT 6 m: Plus 1/4 IN, minus 3/8 IN 9.5 MM.
   c. 20 FT 6 M to 30 FT 9 m: Plus or minus 3/8 IN 9.5 MM.
   d. Each additional 10 FT: Plus or minus 1/8 IN 3 MM.
3. Total Thickness or Flange Thickness: Plus 1/4 IN 6 MM, minus 1/8 IN 3mm.
4. Rib Thickness: Plus or Minus 1/8 IN 3 MM.
5. Rib to Edge of Flange: Plus or Minus 1/8 IN 3 MM.
6. Distance between Ribs: Plus or Minus 1/8 IN 3 MM.
7. Alignment of ribbed members:
   a. 3/16 IN 4.5 MM up to 40 FT 12 m.
   b. 1/4 IN 6 MM in 40 FT 12 M or more.
8. Variation from Square: Plus or Minus 1/8 IN per 72 IN 3 MM per 1800 MM up to 1/4 IN 6 MM.
9. Length and Width of Block outs and Openings within One Unit: Plus/minus 1/4 IN 6 MM.
10. Location and Dimension of Block outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or Minus Plus/minus 3/4 IN 19 MM.
11. Dimensions of Haunches: Plus or Minus 1/4 IN 6 MM.
12. Haunch Bearing Surface Deviation from Specified Plane: Plus or Minus 1/8 IN 3 MM.
13. Difference in Relative Position of Adjacent Haunch Bearing Surfaces from Specified Relative Position: Plus or Minus 1/4 IN 6 MM.
14. Bowing: Plus or Minus L/360, maximum 3/4 IN 19 MM.
    a. Differential bowing between adjacent members: 1/4 IN 6 MM.
15. Angular deviation of plane of side mold: (1 IN 100) to maximum 1/16 IN 1.5 MM.
16. Jog in alignment of edge: 1/4 IN 6 MM.
17. Local Smoothness: 1/4 IN 6 MM per 10 FT 3 m.
18. Maximum Warp (One corner out of plane of other three): (1 IN 200) 1/16 IN per foot 1 MM per 200 MM from nearest adjacent corner.
19. Tipping and Flushness of Plates: Plus or Minus 1/4 IN 6 MM.
20. Dimensions of Architectural Features and Rustications: Plus or Minus 1/8 IN 3 MM.
21. Dimensions not listed above: In any length: (1 IN 2000) to maximum 1/8 IN 3 MM.

B. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.
   1. Weld Plates: Plus or Minus 1 IN 25 MM.
   2. Inserts: Plus or Minus 1/2 IN 13 MM.
   3. Handling Devices: Plus or Minus 3 IN 75 MM.
   4. Reinforcing Steel and Welded Wire Reinforcement: Plus or Minus 1/4 IN 6 MM where position has structural implications or affects concrete cover; otherwise, Plus or Minus 1/2 IN 13 MM.
   5. Reinforcing Steel Extending out of Member: Plus or Minus 1/2 IN 13 MM of plan dimensions.

6. Tendons: Plus or Minus 1/4 IN 6 MM, vertical; Plus or Minus 1 IN 25 MM horizontal.
7. Location of Rustication Joints: Plus or Minus 1/8 IN 3 MM.
8. Location of Opening within Panel: Plus or Minus 1/4 IN 6 MM.
9. Location of Flashing Reglets: Plus or Minus 1/4 IN 6 MM.
10. Location of Flashing Reglets at Edge of Panel: Plus or Minus 1/8 IN 3 MM.
11. Reglets for Glazing Gaskets: Plus or Minus 1/8 IN 3 MM.
12. Electrical Outlets, Hose Bibs: Plus or Minus 1/2 IN 13 MM.
13. Location of Bearing surface from End of Member: Plus or Minus 1/4 IN 6 MM.
14. Allowable Rotation of Plate, Channel Inserts, Electrical Boxes: 2-degree rotation or 1/4 IN 6 MM maximum over the full dimension of the unit.
15. Position of Sleeve: Plus or Minus 1/2 IN 13 MM.
16. Location of Window Washer Track or Buttons: Plus or Minus 1/8 IN 3 MM.

2.14 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects.

B. Corners, including false joints shall be uniform, straight and sharp.

C. Exposed Face and Edge Surfaces:
1. Match colors and textures of Design Reference Sample

D. Finishes of other Exposed Surfaces:
1. Panel Tops Returns (i.e. parapet and sill): Finish to match face surface finish.
2. Panel Bottom Returns (i.e. soffits): Finish to match face surface finish.
3. Back of Panel (i.e. interior): Finish to be steel trowel with light sandblast.

E. Unexposed surfaces:
1. Smooth steel trowel finish.

2.15 SOURCE QUALITY CONTROL

A. Quality Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements.
1. If using self-consolidating concrete: Also test and inspect according to PCI Guidelines for the Use of Self-Consolidating Concrete.

B. Strength of precast concrete units will be considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

C. Testing:
1. If there is evidence that the concrete strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, APC Fabricator will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42.
2. Procedural Requirements:

a. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Architect.
b. Cores will be tested in an air dry condition.
c. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 PCT of the 28 day design compressive strength and no single core is less than 75 PCT of the 28 day design compressive strength.
d. Test results will be made in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator.

3. Reports:
   a. Test reports will include the following:
      1) Project identification name and number.
      2) Date when tests were performed.
      3) Name of precast concrete fabricator.
      4) Name of concrete testing agency.
      5) Identification letter, name, and type of precast concrete units or units represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length/diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
4. Patching:
   a. If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

D. Defective Work:
1. Architectural precast concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range are unacceptable.
2. Chipped, spalled or cracked units may be repaired, if repaired units match the visual mockup.
3. The Architect reserves the right to reject any unit if it does not match the accepted samples and visual mockup.
4. Replace unacceptable units with precast concrete units that comply with requirements.

2.16 RELATED ITEMS SPECIFIED ELSEWHERE

A. Cast-in-Place Concrete: Specified in elsewhere in Division 03.

B. Structural Steel for connection attachment to structural steel framing: Specified in Section 05 12 00 or Section 05 12 10.

C. Sheet Metal Flashing and Trim: Specified in Section 07 62 00.

D. Backer Rod and Sealants: As specified in Section 07 92 13.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
   2. Start of installation constitutes acceptance of surfaces and conditions.

B. Do not install precast concrete units until supporting cast-in place concrete building structural framing has attained minimum allowable design compressive strength or supporting steel or other structure is structurally ready to receive loads from precast.

3.2 ERECTION

A. Perform erection under supervision of qualified superintendent.

B. Employ only skilled and experienced personnel and equipment capable of properly installing units.

C. Erect architectural precast concrete level, plumb and square within the specified allowable tolerances.

D. Connect APC units in position by bolting, welding, grouting, or as otherwise indicated on approved erection drawings.
   1. Remove temporary shims, wedges, and spacers as soon as practical after connecting and/or grouting are completed.
   2. Disruption of roof flashing continuity by connections is not permitted; concealment within roof insulation is acceptable.

E. Welding:
   1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.
   2. Welds not specified shall be continuous fillet welds, using not less than the minimum fillet as specified by AWS.
   3. Protective Coating Repair:
      a. Clean weld affected metal surfaces with chipping hammer followed by brushing then apply a minimum 0.004 IN 0.1 MM thick coat of galvanized repair paint to galvanized surfaces in conformance with ASTM A780.

F. Bolted Connections:
   1. At bolted connections, use lock washers, tack welding, or other acceptable means to prevent loosening of nuts after final adjustment.

G. Grouting Connections:
   1. Grout connections where required or indicated.
   2. Retain grout in place until hard enough to support itself.
   3. Pack spaces with stiff grout material, tamping until voids are completely filled.
   4. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces.

5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and true, without exceeding the following non-cumulative erection tolerances;
   1. Total deviation equal to maximum allowance specified for the structural frame.
   2. Plan Location from Building Grid Datum: Plus or Minus 1/2 IN 13 MM.
   3. Plan Location from Centerline of Steel: Plus or Minus 1/2 IN 13 MM.
   4. Top Elevation from Nominal Top Elevation:
      a. Exposed Individual Panel: Plus or Minus 1/4 IN 6 MM.
      b. Non-exposed Individual Panel: Plus or Minus 1/2 IN 13 MM.
      c. Exposed Panel Relative to Adjacent Panel: 1/4 IN 6 MM.
      d. Non-exposed Panel Relative to Adjacent Panel: 1/2 IN 13 MM.
   5. Support Elevation from Nominal Support Elevation: As follows:
      a. Maximum Low: 1/2 IN 13 MM.
      b. Maximum High: 1/4 IN 6 MM.
   6. Maximum Plumb Variation:
      a. Over the Lesser of Height of Structure or 100 FT 30 m: 1 IN 25 MM.
      b. Plumb in Any 10 FT 3 M of Element Height: 1/4 IN 6 MM.
   7. Maximum Jog in Alignment of Matching Edges: 1/4 IN 6 MM.
   8. Joint Face Width (governs over Joint Taper):
      a. Maximum deviation from Specified Width: Plus or Minus 3/16 IN 4.5 MM.
      b. Step in face: 1/4 IN 6 MM.
   9. Maximum Joint Taper:
      a. Total: 3/8 IN 9.5 MM.
      b. In 10 FT 3 m: 1/4 IN 6 MM.
   10. Maximum Jog in Alignment of Matching Faces: 1/4 IN 6 MM.
   11. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 IN 6 MM.
   12. Opening Height between Spandrels: Plus or Minus 1/4 IN 6 MM.

3.4 JOINT SEALANTS

A. Seal architectural precast concrete work as specified in Section 07 92 13.

3.5 FIELD QUALITY CONTROL

A. Field Testing:
   1. Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
   2. Testing agency will report test results promptly and in writing to Contractor and Architect.
   3. Repair or remove and replace work that does not comply with specified requirements.
   4. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of corrected work with specified requirements.

B. Field Welds:
   1. Subject to visual inspections and non-destructive testing in accordance with ASTM E165 or ASTM E709.

3.6 REPAIRS

A. Repairs will be permitted provided structural adequacy of units and appearance are not impaired.

B. Replace units which exhibit damage to surfaces, finish, corners or edges which will be exposed to view after setting in place, or which is broken or cracked due to shrinkage, temperature, transportation, handling or erection.
   1. When approved in writing by Architect, unit may be repaired in place.
   2. Perform such work at no additional expense to Owner.

C. Acceptance of units, repaired pursuant to written approval, is contingent upon repairs being skillfully done so as to be sound, permanent, flush with adjacent surfaces and of color and texture matching similar adjoining surfaces and indicating no apparent line of demarcation between original and repaired work, when viewed from a distance of 20 FT 6 MM.

D. Remove and replace other work damaged by removal of defective precast members, at no additional cost to Owner.

E. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.

F. Remove and replace damaged APC units when repairs do not meet requirements.

3.7 CLEANING

A. Clean surfaces of precast concrete to be exposed to view prior to shipping.

B. Clean mortar, plaster, fireproofing, weld slag, and any other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
   1. Protect other work from staining or damage due to cleaning operations.
   2. Coordinate cleaning of precast units with cleaning of glass and other work.
   3. Pre-clean soiled surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water.
   4. Perform cleaning procedures using product specified in Section 04 05 10 or as otherwise recommended by precast concrete fabricator.
      a. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.
   5. Start at top of building and proceed downward.
   6. Leave precast units clean, free of traces of cleaning compound and with joints watertight.

END OF SECTION

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# SECTION 04 05 10
# MASONRY CLEANING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Masonry Cleaning in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
   1. For each type of material and accessory.

C. Project Information:
   1. Name of proposed product and manufacturer.
   2. Certification that the proposed products are compatible with materials on subject project.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Cleaners:
   1. Base:
      a. ProSoCo.
   2. Optional:
      a. EaCo Chem.

B. Other manufacturers desiring approval comply with Section 01 61 00.

### 2.2 MATERIALS

A. Use only products which are recommended by manufacturer of material to be cleaned.

B. Brick Masonry Cleaner:
   1. Verify compatibility with brick manufacturer.
   2. Red Brick:
      a. Base Product: Sure Klean Lime Solvent 101 by ProSoCo.
   3. Light-colored, Chocolate-colored, Brown, Gray and others which are subject to metallic staining:
      a. Base Product: Sure Klean Vana Trol by ProSoCo.

C. Concrete Masonry (CMU) Cleaners:
   1. Clean CMU which will remain exposed to view (including CMU walls which are scheduled for painting).
   2. Lightweight and Normal Weight CMU:
      a. Base Product: Sure Klean Custom Masonry Cleaner by ProSoCo.

D. Cast-in-Place Concrete Cleaner:

1. Clean Cast-in-Place concrete walls which will remain exposed to view (including CIP walls which are scheduled for painting).
2. Clean with most effective products which are appropriate for texture and color specified.
3. Abrasive blasted, Etched, and Exposed-aggregate Textures:
   a. Base Product: Sure Klean Custom Masonry Cleaner or Heavy-duty Concrete Cleaner both by ProSoCo.

E. Architectural Precast Concrete (APC) Cleaner:
1. Clean with most effective products which are appropriate for texture and color specified.
2. Base Product: Sure Klean Light Duty Concrete Cleaner by ProSoCo.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine surfaces to be cleaned.
1. If necessary point with mortar.

B. Waiting Time before cleaning:
1. Mortar Type N: Allow mortar to cure for 14 to 28 days prior to cleaning.
2. Mortar Types M and S: Allow mortar to cure for 7 to 14 days prior to cleaning.
3. Colored Mortar: Allow mortar to cure for 28 days prior to cleaning.

C. Remove excess mortar using wooden paddles and scrapers.

D. Do not proceed with cleaning until unsatisfactory conditions have been corrected.

E. Test 4 x 4 FT 1.2 x 1.2 M area of each surface type for compatibility with cleaner, using recommended dilutions, prior to full scale cleaning operations.

F. Cleaning indicates acceptance of surfaces and responsibility for performance.

3.2 PREPARATION

A. Protect adjacent surfaces, not scheduled for cleaning.

B. Prepare surfaces as recommended by manufacturer.

3.3 CLEANING

A. Clean surfaces as recommended by manufacturer.

B. Do not use wire brushes.

C. Thoroughly rinse and pre-soak walls.

D. Flush loose mortar and dirt from surface.

E. Wet to prevent runoff streaking.

F. Apply solution using fibered wall washing brush or low-pressure spray.
1. Maximum Pressure: not to exceed 400 PSI 2,750 kPa.
2. Tip spray angle: Not less than 25 DEG.
3. Maximum rate of flow: 4 to 6 GPM 15 to 23 LPM.

4. Tip shall be held at least 12 IN 300 MM from surface of masonry.
5. Comply with manufacturer’s recommendations, where more restrictive.

G. Scrape off mortar and re-apply cleaning solution.

H. After scrubbing, clean thoroughly with low pressure water.
1. Comply with low-pressure spray criteria listed above.

END OF SECTION

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# SECTION 04 05 16
# MASONRY GROUTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Portland Cement - Lime Mortars and Grout, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Definitions:
   1. PCL Mortar: Portland Cement-Lime Mortar.
   2. PCL Grout: Portland Cement-Lime Grout.
   3. Pre-Blended: Factory blend mortar mix dry ingredients including; sand, cement, lime, pigments, and approved additives.

B. Referenced Standards:
   1. ASTM International (ASTM):
      a. ASTM C143 Standard Test Method for Slump of Hydraulic-Cement Concrete.
      b. ASTM C144 Standard Specification for Aggregate for Masonry Mortar.
      c. ASTM C150 Standard Specification for Portland Cement.
      d. ASTM C207 Standard Specification for Hydrated Lime for Masonry Purposes.
      e. ASTM C270 Specification for Unit Masonry.
      f. ASTM C404 Standard Specification for Aggregates for Masonry Grout.
      g. ASTM C476 Standard Specification for Grout for Masonry.
   2. American Concrete Institute (ACI):
      a. ACI 530.1 Building Code Requirements and Specification for Masonry Structures.
   3. Brick Industry Association (BIA):
      a. Technical Notes.

C. Use of masonry cement alone, or in combination with PCL mixes, is prohibited.

D. The use of blended hydraulic cements, including: Portland blast-furnace slag cement, Portland-pozzolan cement, slag cement, and natural cement is not permitted.

E. Cold Weather Procedures:
   1. Specified in Section 04 05 05.

F. Hot Weather Procedures:
   1. When ambient temperature is over 100 DEGF 38 DEGC, or over 90 DEGF 32 DEGC with a wind over 8 MPH 13 kph:
      a. Monitor mortar temperature and maintain it between 70 to 120 DEGF 21 to 49 DEGC.
      b. Limit spreading of bed mortar to 4 FT 1.2 m, maximum, and place masonry units within 1 minute of spreading.

1.3 SUBMITTALS

A. Product Data:
   1. Material certificates for each material used in proposed mix designs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Factory Pre-blended PCL Mortar:
   1. Base:
      a. Spec Mix
   2. Optional:
      a. Amerimix (Bonsal)
      b. Ash Grove Cement Company
      c. U-Mix
      d. US Mix Company

B. Site Mixed PCL Grout:
   1. Base:
      a. Products as indicated.

C. Integral Waterproofing Mortar admixture, for mortar mixes used with Glass Unit Masonry Units at Exterior and/or Interior wet areas:
   1. Base:
      a. Sonneborn Building Products; Hydracide Powder.
   2. Optional:
      a. Master Builders; MasterPel 235.
      b. Laticrete 8510.

D. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Factory Pre-blended Mortar Mix:
   1. Use approved mix designs which comply with ASTM C270, Property Method.
   2. Blend cementitious materials, aggregate and admixtures in factory under controlled conditions, which requires only addition of water at project site.
   3. Oven-dry aggregates prior to measuring and include in pre-blended mix.

B. Portland Cement: ASTM C150, Type I, II or III.
   1. Air-entraining cement is not permitted.
   2. Portland Cement Color: As indicated below for each application.
   3. Maximum percent of alkalis: 0.60.

C. Hydrated Lime:
   1. ASTM C207, Type S.

D. Mortar Aggregate:
   1. ASTM C144.
   2. Aggregate Color: As indicated below for each application.

E. Water: Potable.

F. Do not use the following ingredients:

1. Do not use antifreeze additives.
2. Do not use calcium chloride, thiocyanates, or other materials containing chloride ions.
3. Other admixtures: Not permitted without prior approval by Architect.
4. Do not use ready mix mortar.
5. Do not use masonry cement.

G. PCL mortar mixes to comply with ASTM C270, property specification using component materials listed above:
1. Limit air content to 10 PCT, maximum.
2. Use appropriate type as indicated by following Table 4110A, for each condition.
3. Four types of mortar - only three are typically used:

**TABLE 4110A - Basic Mortar Type Selection**

| Location | Building Segment | Mortar Type per ASTM C270 |
|---|---|---|
| Exterior Masonry at or below grade | Foundation walls<br>Retaining walls<br>Sewers & manhole, and paving | **M** |
| Exterior Masonry above grade | Reinforced or Load Bearing brick / block walls<br>Glass Unit Masonry<br>Veneer Masonry, Parapets, and Chimneys greater than 30 FT above grade<br>Other areas with severe exposure | **S** |
| | Non-load bearing brick/block walls<br>Veneer Masonry, where less than 30 FT above grade | **N** (or S) |
| | Parapets and chimneys where less than 30 FT above grade | **N** |
| Interior Masonry | Load bearing brick/block walls<br>Non-load bearing brick/block walls<br>Glass Unit Masonry<br>Brick/block veneers | **N** |

**Mortar Selection Based on Brick Properties (IRA)**

| Initial Rate of Absorption (IRA) of Brick Units (Gallons per minute per 30 SQIN) | PCL Mortar |
|---|---|
| Up to 10 | **S** (N) |
| 10 to 30 | **N** or S |
| over 30 laid dry | **N** (S) |
| over 30 laid wet | **N** (S) |

Optimal PCL Mortar Type in **bold**, Alternate types are indicated in parentheses.

H. Use following mortar colors in conjunction with Table 4110A to determine mixes of appropriate combinations of type and color for each project condition.
1. Mortar Color MC-1:
   a. Location used:
      1) Typical at face brick veneer, See Section 04 21 13.
   b. Method:
      1) Factory pre-blended mortar.
   c. Mortar Color:
      1) Natural Grey (no pigment).

d. Portland Cement Color:
1) Natural.
e. Aggregate Color:
1) Natural.
2. Mortar Color MC-2:
a. Location used:
1) CMU walls. See Section 04 22 00.
b. Method:
1) Factory pre-blended mortar.
c. Mortar Color:
1) Natural Grey, no pigment.
d. Portland Cement Color:
1) Natural.
e. Aggregate Color:
1) Natural.

I. Grout:
1. Site Mixed PCL Grout:
a. Use approved mix designs.
b. Mix on-site using approved materials as indicated.
c. Factory pre-blended dry grout mixes may be used at contractor’s option.
d. Ready-mixed product, delivered to site for direct placement in walls, may be used at contractor’s option.
2. Factory pre-blended PCL grout mix:
a. Use approved mix designs.
b. Blend cementitious materials, aggregate and admixtures in factory under controlled conditions, which requires only the addition of water at the project site.
c. Oven-dry aggregates prior to measuring and include in the pre-blended mix supplied to the site.
3. PCL Grout Mixes:
a. Comply with ASTM C476.
b. Portland Cement: ASTM C150, Type I, II or III.
1) Air-entraining cement is not permitted.
2) Maximum percent of alkalis: 0.60.
c. Grout aggregate: ASTM C404.
1) Maximum Aggregate Size: 3/8 IN 9.5 MM.
2) The use of blast furnace slag is not permitted.
d. Hydrated lime:
1) ASTM C207, Type S.
e. Water: Clean and potable.
f. Other admixtures: Not permitted without prior approval by Architect.
g. Compressive Strength: As indicated by GROUT MIX SCHEDULE, below, for each type.
h. Slump for Grout Measured in accordance with ASTM C143:
1) Minimum: 8 IN 200 MM.
2) Maximum: 10 IN 250 MM.
4. Grout Mix GM-1:
a. Site mixed grout.
1) Redi-mixed or factory pre-blended may be used at contractor’s option.
2) Gypsum is not allowed in grout mixtures.
b. Compressive strength, 28-day:
1) Minimum 2000 PSI 13.8 MPa.
c. Location used:

1) Fill for CMU walls.
2) Hollow metal door frames.
3) Elevator frames and sills.
4) Other indicated locations.

d. Grout color: Natural grey, no pigment.
e. Portland cement color: Natural.
f. Aggregate color: Natural.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with provisions of ACI 530 and ACI 530.1, except where exceeded by requirements of the contract documents.

3.2 MORTAR INSTALLATION

A. Mix materials minimum of 5 minutes, but not more than 10 minutes.

B. Adjust consistency to satisfaction of mason subject to compliance with specified criteria.

C. Install in accordance with BIA Standards.

D. Strike joints to create a uniformly concave final joint.

E. Strike joints flush on wall surfaces scheduled to receive an air barrier.

F. If mortar begins to stiffen, it may be re-tempered in accordance with ASTM C270, Subparagraph 7.4.

G. Use mortar within 2-1/2 HRS of initial mixing.

H. Remove units which are disturbed after laying. Clean off original mortar and reset with fresh mortar.

3.3 GROUT INSTALLATION

A. Mix materials minimum of 5 minutes, but not more than 10 minutes.

B. Use grout within 1-1/2 HRS after initial mixing.

C. Use coarse grout in spaces larger than 2 IN 50 MM in both directions.

D. Use fine grout in spaces with least dimension is less than 2 IN 50 MM.
   a. Grout hollow metal door frames where the net opening is 4 FT 1.2 M and greater.

E. Grout installation - Walls:
   1. See Section 04 22 00.

END OF SECTION

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# SECTION 04 05 23
# MASONRY ACCESSORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Masonry Accessories, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Design Responsibility:
1. Assume responsibility for design, manufacturing and installation of masonry accessories:
   a. Comply with Section 01 71 21, Specialty Engineering requirements.
   b. Load combinations as specified by the building code.
   c. Where special loads only are shown, combine with typical loads or capacities.

B. ASTM International (ASTM):
1. ASTM A240 Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for General Applications.
2. ASTM A580 Stainless Steel Wire.
3. ASTM A641 Zinc-Coated (Galvanized) Carbon Steel Wire.
4. ASTM A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

C. Brick Industry Association (BIA):
1. Technical Notes.

D. TMS 402/ACI 530/ASCE 5 - Building Code Requirements for Masonry Structures

E. American Welding Society (AWS):
1. AWS Structural Welding Code D1.1.

F. Movement Joints:
1. Expansion Joints per BIA Technical Notes 18A.
2. Control Joints by NCMA Tek 10-2B.

### 1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
1. For each type of material and accessory.

C. Samples:
1. Provide samples of materials where specified.

D. Project Information:
1. Manufacturer literature for products proposed for use.
2. Engineering calculations anchors with special loading or connection requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Masonry Anchors:
   1. Base:
      a. Hohmann & Barnard, Inc.
   2. Optional:
      a. Wire-Bond

B. Adjustable Wall Ties:
   1. Base:
      a. Hohmann & Barnard, Inc.
   2. Optional:
      a. Wire-Bond

C. Through-Wall Flashing:
   1. Base:
      a. Hohmann & Barnard, Inc.
   2. Optional:
      a. Prosoco
      b. York Manufacturing

D. Termination Bars:
   1. Base:
      a. Tru-Fast Corporation.
   2. Optional:
      a. Heckmann Building Products, Inc.
      b. Hohmann & Barnard, Inc.

E. Cavity Protection Material:
   1. Base:
      a. Mortar Net Solutions

F. Horizontal Reinforcing:
   1. Base:
      a. Hohmann & Barnard, Inc.
   2. Optional:
      a. Wire-Bond
      b. Heckmann Building Products, Inc.

G. Pre-molded Control Joint Strips:
   1. Provide at control joints in CMU walls:
   2. Base:
      a. Hohmann & Barnard, Inc.
   3. Optional:
      a. Williams Products, Inc.
      b. Wire-Bond
      c. Heckmann Building Products, Inc.

H. Galvanizing Repair Paint:
   1. Base:
      a. ZRC Worldwide
   2. Optional:
      a. Tnemec, Inc.

I. Compressible Filler:
   1. Base:
      a. Hohmann & Barnard, Inc.

J. Air Barrier: Specified in Division 07.

K. Loose Lintels: Specified in Section 05 50 00.

L. Structural Steel Lintels and Shelf Angles: Specified in Section 05 12 00 or Section 05 12 10.

M. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

A. Design anchorage to meet Design Loads.
   1. Wind Loads: Use the greater of the following:
      a. Wind Pressures as required per local building code based on wind speed, exposure factor and importance factor noted in Structural Drawings.
      b. 30 PSF minimum
   2. Earthquake Loads:
      a. Wall and wall components shall be designed to satisfy requirements of Building Code and ASCE 7 Chapter 13 Seismic Design Requirements for Nonstructural Components based on the Seismic Design Category, and Importance Factor listed on the structural drawings.
   3. Deflection Values: Use the greater of following:
      a. Limit deflection to values specified for Uniform Design Load Test.
      b. Limit deflection to comply with Building Code as locally adopted and amended.
      c. Limit deflection as follows:
   4. Structural movements of building structure:
      a. Inter-story drift caused by wind or earthquake forces.
         1) h/400 or 1/2 IN maximum for wind
      b. Live load deflection of the supporting members
         1) Live Load L/600 or 3/8 IN maximum
         2) Post Composite Super imposed Dead Load + Live Load L/500 or 1/2 IN maximum.
      c. Load Transfer Limitations:
         1) Building structural frame is designed for gravity loads of wall system to be transferred to frame, floor by floor.
   5. Develop details defining method of fastening throughout system.
   6. Comply with provisions of ACI 530 and ACI 530.1, except where exceeded by requirements of Contract Documents.

2.3 MATERIALS

A. Masonry Veneer Anchors:
   1. Lateral movement, out-of-plane:
      a. Maximum free play: 1/16 IN 1.5 MM.
      b. Maximum deflection: 0.05 IN 1.25 MM when exposed to a load of 100 LBS a load of 45 kg inward or outward.
   2. Select wire ties to span cavity and provide a minimum embedment of 2 IN 50 MM in masonry facing.
   3. Stainless steel ties: Type 304.
   4. Masonry veneer anchors for metal stud back-up:
      a. Tape Seal:
         1) Use with Strap Anchors.
         2) Peel-n-stick, self-healing where screws or prongs penetrate Air Retarder and Sheathing.

3) Apply to substrate wall in continuous vertical strips prior to installation of strap anchors.
4) Base Product: X-Seal Tape by Hohmann & Barnard, Inc.

b. Offset Strap-type Anchor:
1) Base Product: X-Seal Anchor by Hohmann & Barnard, Inc.
2) 14 GA 2 MM type 304 stainless steel
3) Depth of prongs: As required for application.
4) Minimum vertical movement: 3-1/2 IN 90 MM total.
5) Wire Ties:
a) Base Product: Vee Byna-Tie by Hohmann & Barnard, Inc.
b) Type 304 stainless steel
c) Diameter:
(1) 3/16 IN 5 MM
d) Length: As required for application.
6) Fasteners:
a) Base Product: Hohmann & Barnard, Inc.
b) Self-drilling
c) Type 304 stainless steel
d) Hex head, with washer flange
e) Neoprene sealing washer

5. Masonry Veneer Anchors - CIP Concrete Backup:
a. Utilize following type of anchor devices where masonry veneer is scheduled over cast-in-place concrete back-up, including:
1) Cast-in-place concrete walls, columns, footings, spandrel beams.

b. Dovetail Anchor Slots:
1) Base Product: 305 by Hohmann & Barnard, Inc.
2) Type 304 stainless steel
3) Material Thickness: Minimum 22 GA 0.8 MM.
4) Nominal Size: 1 x 1 x 5/8 IN 25 x 25 x 16 MM throat with foam filler.
5) Wire Ties:
a) Base Product: 315-BT by Hohmann & Barnard, Inc.
b) Compatible with width and depth of dovetail slots
c) 12 GA 2.8 MM type 304 stainless steel
d) Dovetail thickness:
(1) Diameter: 3/16 IN 5 MM.
(2) Length: As required for conditions.

c. Strap-type Anchor:
1) Base Product: DW10HS by Hohmann & Barnard, Inc.
2) Mechanically attached
3) Installed to face of conventionally reinforced, cast-in-place concrete structural elements including sheer walls, spandrel beams, and columns
4) 12 GA 2.8 MM type 304 stainless steel
5) Size: 3/4 IN x 7 IN 19 MM x 180 MM
6) 4 IN 100 MM of vertical adjustability
7) Wire Ties:
a) Type 304 stainless steel
b) Diameter: 3/16 IN 5 MM.
c) Length: As required for conditions.
d) Base Product: Vee Byna-Tie by Hohmann & Barnard, Inc.
8) Fasteners:
a) Power-driven or expansion type

b) Type 304 stainless steel
c) Diameter: 1/4 IN 6 MM
d) Embedment: 2 IN 50 MM
e) Pull-out: 120 LBS 55 kg per fastener
f) Minimum of 2 fasteners per anchor strap

6. Masonry veneer anchors - Steel columns and spandrel beams:
   a. Use following anchor devices where masonry veneers bypass steel columns and spandrel beams.
   b. Offset Strap Anchor:
      1) Base Product: 359FH by Hohmann & Barnard, Inc.
      2) Type 304 stainless steel
      3) Mechanically attach to steel column/beams.
      4) Wire Ties:
         a) Base Product: Vee Byna-Tie by Hohmann & Barnard, Inc.
         b) Type 304 stainless steel
         c) Diameter: 3/16 IN 5 MM
         d) Length: As required for conditions.
7. Masonry wall anchors:
   a. Use the following type of anchor devices where terminal ends of masonry walls abut steel columns:
   b. Offset Strap anchor:
      1) Base Product: 359FH by Hohmann & Barnard, Inc.
      2) Type 304 stainless steel
      3) Mechanically attach to steel column.
      4) Wire tie:
         a) Type 304 stainless steel
         b) Width: As required for width of CMU.
         c) Length: 12 IN 300 MM.
         d) Diameter: 3/16 IN 5 MM.
         e) Base Product: 302W by Hohmann & Barnard, Inc.
8. Rigid Steel Anchors (where CMU walls intersect other CMU walls):
   a. 1/8 IN x 1 IN x 12 IN 3 MM x 25 MM x 300 MM
   b. Galvanized G90 Z275
   c. Ends bent 90 DEG in opposing directions.
      1) Length of end prongs: 2 IN 50 MM.

B. Horizontal Reinforcing:
   1. In interior walls:
      a. Cold drawn steel wire, mill galvanized, Class 3.
   2. In walls surrounding wet areas with humidity over 70 PCT:
      a. Type 304 stainless steel
   3. In exterior walls:
      a. Type 304 stainless steel
   4. Free standing, single-wythe CMU walls:
      a. Horizontal reinforcing composite:
         1) Width as required
      b. Base Product: 220 Ladder Mesh by Hohmann & Barnard, Inc.
      c. Base Product: 120 Truss Mesh by Hohmann & Barnard, Inc.
   5. CMU walls serving as back-up wall for masonry veneers:
      a. Horizontal reinforcing pattern for CMU back-up, with projecting wire loops to accommodate vertically adjustable veneer wire ties.
         1) Length of projection as required for cavity width indicated.
         2) Include compatible wire ties for masonry veneer.

b. Interlock veneer anchor wire ties with the ladder/truss reinforcing.
   1) Base Product: 270 Ladder Adjustable Eye Wire by Hohmann & Barnard, Inc.
   2) Eye and pintle or similar design which permits vertical movement while restraining lateral movement
   3) Ties to allow for vertical adjustability during and movement after installation
   4) Eye Wire:
      a) Type 304 stainless steel
      b) Diameter: 3/16 IN 5 MM.

C. Vertical Reinforcing:
   1. Reinforcing Bars:
      a. Grade 60 carbon steel
      b. Size: No. 4 bars minimum, or as indicated
      c. Refer to Section 03 20 00, and Drawings

D. Miscellaneous Anchorages:
   1. Include miscellaneous anchorages as required or indicated to secure stone, architectural precast concrete copings and sills and like components.
   2. Type:
      a. As indicated.
   3. Material: Same as indicated for veneer anchors above.

E. Through Wall Flashing System:
   1. Flexible Stainless Steel Flashing:
      a. Polymeric fabric laminated to type 304 or 316 stainless steel.
      b. Membrane Thickness: 40 MIL 1 MM
      c. Stainless Steel Thickness: 3 MIL .07 MM
      d. Width as required.
      e. Non-asphaltic adhesive.
      f. Termination bar.
      g. Base Product: Mighty-Flash SA by Hohmann & Barnard, Inc.
      h. Corners and end dams:
         1) 26 GA type 304 stainless steel
         2) Provide at ends of runs, inside and outside corners.
         3) Base Product: Corners & End Dams by Hohmann & Barnard, Inc.
   2. Termination Bar:
      a. Base Product: TB-100 Series by Trufast, LLC
      b. Use to secure top edge of Flexible Membrane flashing to back-up wall.
      c. Stainless steel or rigid plastic.
      d. 1/8 IN x 1 IN x 10 FT 3 MM x 25 MM x 3 m.
   3. Flashing Adhesive:
      a. As recommended by manufacturer for bedding, sealing laps, and sealing to vertical surfaces.

F. Cavity Vents and Weeps:
   1. Head Vent:
      a. Base Product: QV - Quadro-Vent by Hohmann & Barnard, Inc.
      b. Polypropylene honeycomb vent/weep for head joints
      c. Provides ventilation of cavity and weeping of cavity moisture while restricting ingress of insects and debris.
      d. Standard size: 3/8 x 2-1/2 x 3-3/8 IN
      e. Color: Gray

G. Rope Wicks:
   1. Field- fabricated cotton sash cord.
   2. Nominal diameter: 3/8 IN 9.5 MM.

H. Cavity Protection Materials:
   1. Base Product: Mortar Net.
   2. Non-directional nylon or polyester fiber:
   3. Thickness:
      a. Provide thickness to fill cavity.
   4. Height: 10 IN 250 MM high.

I. Galvanizing Repair Paint:
   1. Zinc rich paint for re-galvanizing welds and abrasions in galvanized steel.
   2. Base Product: ZRC Galvilite by ZRC Worldwide.
   3. Optional: Organic Zinc Coating 90-93 by Tnemec.

J. Compressible Filler:
   1. Closed cell neoprene sponge
   2. Thickness: 1/4 IN 6 MM
   3. Thickness: 3/8 IN 9.5 MM
   4. Base Product: NS by Hohmann & Barnard, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Keep vertical joint behind weeps free of mortar.

B. Comply with provisions of ACI 530 and ACI 530.1, except where exceeded by requirements of the contract documents.

C. Anchoring Masonry Veneers to Back-up:
   1. Attach offset anchor straps to back-up wall.
      a. Use types suitable for condition.
      b. Apply flexible membrane flashing to walls prior to attachment of strap anchor.
      c. Where masonry walls bypass concrete or steel structural elements including shear walls, columns, and spandrel beams, anchor thereto with specialized anchors types indicated.
   2. Select wire ties of length to span cavity and provide a minimum embedment of 2 IN 50 MM in masonry facing.
      a. Where cavity width exceeds 4-1/2 IN 114 MM, increase wire ties to 1/4 IN 6 MM diameter.
   3. Provide minimum of one anchor per 1.77 SQFT 0.16 m2 of wall area with vertical and horizontal spacing not to exceed 16 IN 400 MM OC.
      a. Where stud spacing is less than 16 IN 400 MM OC, stagger ties in alternating courses.
   4. Where 2 IN 50 MM thick masonry facing units are used as furring against columns or walls, anchor furring units to backing with adjustable metal ties designed for condition.

D. Anchor CMU walls to building structure and intersecting CMU walls.

E. Provide specialized anchors types where masonry walls abut concrete or steel structural elements including shear walls, columns, and spandrel beams.

F. Where bearing walls meet or intersect erect walls separately and anchor together with rigid steel anchors spaced not more than 24 IN 600 MM apart vertically.
   1. Embed end bends of anchors in cores of masonry units filled with mortar or grout.

G. Where non-bearing walls meet or intersect other walls, erect walls separately and anchor together with wire mesh ties spaced not more than 16 IN 400 MM apart vertically.
   1. Embed ties centered in mortar within joint.

H. Fill solid with mortar or grout masonry unit cells within vertical planes of anchors, or use solid masonry units above and below anchors.

I. Dovetail Anchors:
   1. Coordinate anchor type to permit vertical differential movement and resist movement perpendicular to wall plane.
   2. Provide dovetail anchors in cast-in-place concrete at locations including but not limited to:
      a. Concrete Shear walls
      b. Concrete Columns
      c. Concrete Spandrel Beams
      d. Intersection of CMU walls and concrete walls
      e. Intersection of CMU walls and concrete columns or structural elements
      f. Elements where indicated.
   3. Masonry Veneer Spacing:
      a. Provide minimum of one anchor per 1.77 SQFT 0.16 m2 of veneer wall area with vertical and horizontal spacing at 16 IN 400 MM OC maximum.
   4. Horizontal Spacing of slots:
      a. Concrete Walls and Spandrel Beams:
         1) Locate at 16 IN 400 MM on center maximum.
         2) Start first vertical row 4 IN 100 MM of external corners.
         3) Start first vertical row 8 IN 200 MM of internal corners.
      b. Concrete Columns:
         1) Column width less than 24 IN 600 MM: Locate vertical row 6 IN 150 MM from each corner.
         2) Column width greater than 24 IN 600 MM: Locate vertical row 6 IN 150 MM from each corner.
   5. Vertical Positioning of Slots:
      a. Terminate bottom and top edges of dovetail slots 4 IN 100 MM from sills, heads, lintels, parapets, shelf angles, through-wall flashing and similar horizontal elements.
   6. Edge Condition Spacing:
      a. Locate horizontally 8 IN 200 MM from corners, control joints, expansion joints, jambs of doors, jambs of windows, and other similar edges of masonry veneer walls.

J. Reinforcing for CMU Walls:
   1. See Section 04 22 00.

K. Through-Wall Flashing:
   1. Install to provide positive drainage of cavity moisture.
   2. Coordinate with built in items and brick ledges.
   3. Flashing membrane:

a. Extend bottom edge of flashing to face of wall.
b. Lap and bond flashing ends minimum 6 IN 150 MM.
c. Extend top edge of flashing membrane up face of wall minimum 6 IN 150 MM above the top of Cavity Protection.

4. Termination bar:
   a. Metal stud with gypsum sheathing:
      1) Bond flashing membrane directly to face of sheathing
      2) Mechanically secure top edge with termination bar.
      3) Lap air retarder 6 IN 150 MM over flashing membrane
   b. Masonry:
      1) Install upper edge of flashing using a termination bar
      2) Reglet may be used in lieu of termination bar
   c. Cast-in-place concrete:
      1) Secure upper edge of flashing with termination bar
      2) Reglet may be used in lieu of termination bar
   d. Caulk top edge of termination bar to wall.
   e. Provide end dams.
5. Seal gap below ledge angles with backer and sealant.
6. Seal gap below relieving angles with compressible filler
7. Seal items penetrating through-wall flashing system
8. Verify compatibility of sealants with membranes, adhesives and flashing.
9. End Dams:
   a. Configuration:
      1) Extend ends of flashing beyond openings.
      2) Return flashing up into head joints
      3) Bond to face of masonry units
      4) Install sill after end dam is in place.
      5) Minimum height at sides: 4 IN 100 MM
      6) Comply with BIA Tech Note 21B and 7
   b. Provide end dams at following locations:
      1) Jamb edges of sills for doors, windows, louvers and similar openings.
      2) Jamb edges of lintels for doors, windows, louvers and similar openings.
      3) Step flashing where flashing follows grade.
      4) Terminal ends of masonry veneer walls.
10. Head Vents and Rope Wick combination:
   a. Rope Wicks:
      1) Minimum Length: 16 IN 400 MM.
      2) Set outer end of ropes flush with exposed face of masonry veneer.
      3) Loose-lay inner end of ropes at bottom of cavity, running parallel to back face of masonry veneer.
      4) Leave rope wicks in place after mortar has set.
   b. Locations:
      1) Base of brick masonry cavity wall and through-wall flashings:
         a) Rope Wicks:
            (1) Locate in first brick course above through-wall flashing at base of wall.
            (2) Space 16 IN 400 MM O.C. horizontally.
         b) Head Vent:
            (1) Locate in second brick course above through wall flashing at base of wall.
            (2) Install head vent at 24 IN 600 MM O.C. horizontally.
      2) Brick masonry cavity walls at shelf angles and through-wall flashing:
         a) Rope Wicks:

(1) Locate in first brick course above shelf angle and through-wall flashing.
(2) Space 16 IN 400 MM apart horizontally.

b) Head Vent:
(1) Locations:
(a) Locate in second brick course above shelf angle and through-wall flashing.
(b) Locate in third brick course below shelf angle and through-wall flashing:
(2) Install head vent at 24 IN 600 MM apart horizontally.
(3) Align head vents installed above and below shelf angle and through-wall flashing with each other.

3) Brick masonry cavity walls at continuous lintel angles and through-wall flashing:
a) Rope Wicks:
(1) Locate in first brick course above continuous lintel angle and through-wall flashing.
(2) Space 16 IN 400 MM apart horizontally.

b) Head Vent:
(1) Locate in second brick course above continuous lintel angle and through-wall flashing.
(2) Install head vent at 24 IN 600 MM apart horizontally.

4) Brick masonry joints at top of brick cavity wall:
a) Head Vent:
(1) Locate in second brick course below coping and through-wall flashing, or metal cap flashing.
(2) Install head vent at 24 IN 600 MM apart horizontally.

L. Cavity Protection Material:
1. Install per manufacturer's recommendations at ledge angles and bottom of wall.

M. Galvanizing Repair Paint:
1. Apply at welds of galvanized masonry accessories or where galvanic coating is missing or damaged.

END OF SECTION

# SECTION 04 42 00
# DIMENSION STONE CLADDING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Dimension Stone Cladding, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Materials, Anchors and Installation Standards:
   1. Marble Institute standards and recommendations.
   2. Indiana Limestone Institute standards.
   3. Installer; Company specializing in installing cut stone approved by the manufacturer.
   4. Provide Dimension Stone Cladding engineered to support dead, live, and lateral (wind or seismic) loads indicated.
      a. Comply with Section 01 71 21, Specialty Engineering Requirements.
      b. Design anchors and connection hardware for dead load, wind load and seismic load in accordance with applicable building codes.
      c. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.
   5. Comply with provisions of ACI 530 and ACI 530.1, except where exceeded by requirements of the contract documents.

B. Mock Up Wall:
   1. Construct minimum 4 x 6 FT 1.2 x 1.8 M mock-up wall showing typical details, treatment and anchoring.
   2. Accepted mockup may remain part of building.

### 1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
   1. For each type of material and accessory.

C. Shop Drawings:
   1. Setting drawings.
   2. Indicate on shop drawings layout, pertinent dimensions, anchorages, and jointing methods.

D. Samples:
   1. Minimum 12 IN 300 MM square samples of each type of material proposed for use.
      a. Submit samples in sufficient quantity to show extreme variation which may reasonably occur in each kind of stone, regarding color, texture and quality.

E. Project Information:

1. Structural calculations for Cold Formed Metal Framing indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
   a. Submit concurrent with Shop Drawings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Base:
   1. Cold Spring Granite.

B. Optional:
   1. _____.

C. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Granite: _____.
   1. Granite name: _____.
   2. Color: _____.
   3. Opalescent, sound and free from defects which would materially impair strength, durability or appearance.
   4. Uniform in texture, free from freak colorations.
   5. Non-absorbent, free from reads, rifts, seams, spalls, chips and minerals which by weathering would tend to discolor, deteriorate, streak or stratify.
   6. Polish finish exposed surfaces.
   7. Thickness: 7/8 IN 22 MM, or as indicated.

B. Marble: _____.
   1. Marble name: _____.
   2. Quarry: _____.
   3. Color: _____.
   4. Sound, dense and free from defects which might impair strength or durability.
   5. Polish finish exposed surfaces.
   6. Thickness: 7/8 IN 22 MM, or as indicated.

C. Mortars and grout: See Section 04 05 16.

D. Anchors and similar items:
   1. Material for all anchor types: Type 304 or 316 Stainless Steel unless otherwise noted.
   2. Anchors for general use:
      a. Of sufficient length to anchor to backing.
      b. Of sufficient size and configuration for support of stone and applicable superimposed loads.
   3. Cramps:
      a. 3/16 x 1 x 8 IN 5 x 25 x 200 MM long after ends are turned up 1-1/2 IN 38 MM.
      b. Where doweling is required in addition to cramping, form cramps with dowel welded to underside of cramp.
   4. Suspension anchorage or bolt hangers:
      a. Minimum Diameter: 3/4 IN 19 MM min.
      b. Lewis or Cinch anchor type with sufficient depth of anchorage in stone to develop hanger strength.

5. Use special anchors as approved for projecting pieces of stone or for anchorage to structural steel.
6. Dowels: Size and length as required.
7. Spacing: Provide 1 anchor per 1.77 SQFT 0.16 m2 or wall area.
8. Bolts, nuts, and washers: Stainless steel type 304.

E. Sealant:
1. Exterior: See Section 07 92 13.
2. Interior: See Section 07 92 16.

2.3 FABRICATION

A. Make arises sharp and true with edges slightly eased.

B. Perform cutting, dressing, drilling, fitting, and other preparations of stone.
1. Include work as required to accommodate or fit work of other trades, such as cutting and fitting for pipes, conduits, structural work, etc.
2. Do not cut stone until shop drawings are approved.

C. Completely cut and finish before delivery to site except as necessary for fitting.

D. Cut accurately to shape and dimensions with joints as indicated.
1. Lay stone with 3/16 IN 5 MM face joints.
2. Form exposed faces true and without wind.
3. Make beds and joints straight, at right angles to face.

E. Saw or dress backs parallel to wall face.
1. Where bonding occurs, arrange backs to fit lay of masonry backing.
2. Shape beds for stone resting on structural work to fit support.
3. Solidly back check stone coming in contact with structural steel or fireproofing.
4. Do not impair strength or stone bearing capacity.

F. Cut stone to set on its natural bed.

G. Cut holes and sinkages in stone for anchors, dowels or cramps specified or required to execute work properly.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify suitability of substrates to accept installation of stone work.

B. Start of installation constitutes acceptance of substrate conditions and responsibility for performance.

3.2 PREPARATION

A. Prior to setting, waterproof back of stone using non-staining material approved for use by manufacturer and satisfactory to Architect.

B. When ready for setting, clean stones, removing dirt or foreign matter from edges and surfaces.

C. Do not use wire brushes.

3.3 INSTALLATION

A. Erect stone in accordance with stone supplier’s instructions and erection drawings.

B. Arrange stone pattern to provide a consistent joint width of 1/4 IN 6 MM throughout.

C. Provide setting bed and pointing mortar in accordance with Section 04 05 16.

D. Place setting buttons and set stone in full mortar setting bed to support stone over full bearing surface and to establish joint dimensions.

E. Shore and maintain panel in position without movement for seven days after setting.

F. Fill dowel, clevis, and lifting holes with mortar.

G. Rake joints 5/8 to 3/4 IN 16 MM x 19 MM and brush mortar joint clean to accommodate pointing mortar.

H. Rake joints ___ IN mm to accommodate sealant and backing rod.

I. Install sealant and backing rod at joints.

J. Fill Joints with pointing mortar.

K. Tool surface to a concave joint.

L. Install flashings of longest practical length, lap end joint minimum 6 IN 150 MM and seal watertight to back-up.

M. Install cavity vents in vertical joints immediately above horizontal flashings and supports and at top of cavity spaces to provide cavity space venting.

3.4 TOLERANCES

A. Positioning of elements: Maximum 1/4 IN 6 MM from true position.

B. Maximum variation from plan of wall: 1/4 IN 6mm in 10 FT 3 m; 1/2 IN 13 MM in 50 FT 15 m.

C. Maximum variation between face planes of adjacent panels: 1/16 IN 1.5 MM.

D. Maximum variation from plumb: 1/4 IN per story non-cumulative; 1/2 IN 25 MM in any two stories.

E. Maximum variation from level coursing: 1/8 IN 1.5 MM in 3 FT 1 m; in 1/4 IN 6 MM in 10 FT 3 m; 1/2 IN 25 MM maximum.

F. Maximum variation of joint thickness 1/8 IN 3 MM in 3 FT 1 M or 1/4 the joint width, whichever is less.

3.5 PROTECTION AND CLEANING

A. Box and maintain projecting stone sills and stonework.

B. Just before project is completed, remove boxing and clean with fiber brushes, mild detergent and water.

C. Remove and replace units having stains which cannot be removed by cleaning.

D. Remove and replace units requiring patching or repairing.

END OF SECTION

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# SECTION 05 12 00
# STRUCTURAL STEEL

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Structural steel, including the fabrication and erection of support and bracing members, including connections.
   2. Connection detail design as required.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 15 19 - Anchorage to Concrete.
   4. Section 09 96 00 - High Performance Industrial Coatings.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC):
      a. 303, Code of Standard Practice for Steel Buildings and Bridges.
      b. 360, Specifications for Structural Steel Buildings.
      c. Quality Certification Program for Fabricators.
   2. American Society of Mechanical Engineers (ASME):
      a. B18.21.1, Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series).
   3. ASTM International (ASTM):
      a. A2, Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types.
      b. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
      c. A36/A36M, Standard Specification for Carbon Structural Steel.
      d. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      e. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
      f. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      h. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      i. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      j. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      k. A992/A992M, Standard Specification for Structural Steel Shapes.

l. A1064/A1064M, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
m. F436, Standard Specification for Hardened Steel Washers.
n. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
o. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
p. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 KSI (830 MPa) and 150 KSI (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

4. American Welding Society (AWS):
   a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
   c. A5.17/A5.17M, Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   d. A5.18/A5.18M, Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding.
   e. A5.20/A5.20M, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   f. A5.23/A5.23M, Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding.
   g. A5.28/A5.28M, Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding.
   h. A5.29/A5.29M, Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding.
   i. D1.1/D1.1M, Structural Welding Code - Steel.
      1) Steel stud connectors and their installation to comply with requirements of AWS D1.1/D1.1M.
5. National Institute of Steel Detailing (NISD).
6. Research Council on Structural Connections (RCSC):
   a. Specification for Structural Joints Using High-Strength Bolts.

B. Qualifications:
   1. Steel fabricator:
      a. Minimum of [10] years of experience in fabrication of structural steel [or] [and] participate in the AISC Certification program and is designated an AISC Certified Plant, Category [BU (formally known as STD), SBR] at time of bid.
      b. Fabricator plant quality control and inspection program: Meet requirements of the building code and/or be an Approved Fabricator.
      c. Plants that are not an Approved Fabricator may be acceptable, provided:
         1) Plant meets all remaining qualifications.
         2) Contractor reimburses the Owner the cost of required Special Inspection services.
   2. Steel erector:

a. Minimum of [10] years of experience in erection of structural steel similar in the scope of this project [or certified as CSE under the AISC Quality Certification Program].
b. With an active and enforced quality assurance program in place, as described in the applicable Codes.
3. Qualify welding procedures and welding operators in accordance with AWS.

1.3 DEFINITIONS

A. Owner: May mean the Owner's Designated Representative for Construction as defined by the AISC 303.

B. Galvanizing: Hot-dipped galvanizing per ASTM A153/A153M and/or ASTM A123/A123M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by aforementioned standards.

C. Approved Fabricator: Approved by the Building Official to perform the building code required Special Inspections.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Detailed supplemental specification relating to load indicator washers or high-strength bolts.
1) Alternate design for Engineer approval (submitted at Contractor's option if desired by Contractor for use).
d. Source and certification of quality for high-strength bolts, nuts and washers.
3. Fabrication and/or layout drawings:
a. Prepare Shop Drawings under NISD Quality Procedures Program certification.
b. Complete Shop Drawings for all of the work showing clearly all pieces, sizes, dimensions, details, connections materials and shop coatings.
1) All Shop Drawings must be checked and signed "approved" before submittal.
2) Show all cuts, copes, and holes.
3) Indicate all shop and field bolts.
4) Indicate all shop and field welds using AWS symbols.
c. Prepare complete erection drawings showing the location and marks of all pieces.
1) Copies of up-to-date erection drawings shall accompany the Shop Drawings.
2) Use match marks on the erection drawings to indicate the sheet number on which each particular member is detailed.
d. Correct any incorrect or unacceptable material or fabrication due to incorrect detailing, shop work, or erection, without additional charge.
4. Certifications:

a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
b. Copies of current welding certificates for each welder assigned to perform welding indicating compliance with testing specified by AWS.
c. Welder qualification data and prequalified procedures.
d. Special Inspections reports.
e. Source Quality Control Documentation, including certificate of compliance stating that the work performed in the fabrication shop was done in accordance with the approved construction documents.
1) Certification is required only if the fabricator is fabricator approved by the Building Official.

5. Test reports:
a. Certified copies of mill tests.
b. Manufacturer's load test and temperature sensitivity data for post-installed anchor bolts.
c. Test reports for all structural steel work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store steel members above ground on skids or other supports.
1. Keep free of dirt and other foreign material and protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. High-strength bolts:
a. Portland Bolt and Manufacturing Company.
b. Lewis Bolt & Nut Company.
c. Nucor Fasteners.
d. St. Louis Screw and Bolt Company.
2. Load indicator washers for high-strength bolts:
a. Portland Bolt and Manufacturing Company.
b. Mid-South Bolt and Screw Co., Inc.
c. J and M Turner, Inc.
3. Alternate design high-strength bolts:
a. T. C. Bolt Corporation.
b. Construction Fastener Systems Division of Bristol Machine Company.
c. LeJuene Bolt Co.
4. Headed studs and deformed bar anchors:
a. Nelson Stud Welding Division, TRW, Inc.
b. Stud Welding Products, Inc.
5. Mechanical anchor bolts:
a. See Section 03 15 19.
6. Adhesive anchors bolts:
a. See Section 03 15 19.
7. Anchor bolt sleeves:
a. Sinco/Wilson.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Steel, Structural Shapes and Plate (unless noted otherwise on Drawings):
   1. All W-shapes and WT-shapes: ASTM A992/A992M.
   2. All other plates, bars and rolled shapes: ASTM A36/A36M.

B. Pipe: ASTM A53/A53M, Grade B (Type E or S) (Fy=35).

C. Hollow Structural Sections (HSS):
   1. Round: ASTM A500/A500M, Grade B (Fy=42).
   2. Square or rectangular: ASTM A500/A500M, Grade B (Fy=46).

D. High-Strength Bolts, Nuts and Washers:
   1. ASTM F3125, [Grade A325][, Grade F1852] [or Grade A490] with ASTM A563 nuts [galvanized]:
   2. High-strength bolts:
      a. Provide two ASTM F436 washers for all bolts [galvanized].
      b. Provide beveled washers at connections of sloped/tapered sections.
   3. High-strength bolts with compressible washer type direct tension indicators (DTI), ASTM F959.
      a. Provide at Contractor's option and subject to approval of Engineer.
   4. Alternate high-strength design: Provide at Contractor's option and subject to approval of Engineer.

E. Bolts, Non-high Strength: ASTM A307, Grade A.

F. Threaded Rod: ASTM F1554, Grade 36.

G. Washers, Plain (for Non-high Strength Bolts): ASME B18.22.1, Type B.

H. Welding Electrodes:
   1. Shielded metal arc: AWS A5.1/A5.1M or AWS A5.5/A5.5M, E70XX or E801X-X.
   2. Submerged arc: AWS A5.17/A5.17M or AWS A5.23/A5.23M, F7XX-EXXX or F8XX-EXXX-XX.
   3. Gas metal arc: AWS A5.18/A5.18M, E70S-X or E70U-1 or AWS A5.28/A5.28M, ER80S-XX, E80C-XXX.
   4. Flux cored arc: AWS A5.20/A5.20M, E7XT-X (except 2, 3, 10, GS), AWS A5.29/A5.29M, E7XT-X or E8XTX-X, E8XTX-XM.

I. Anchor Rods and Bolts:
   1. See Section 03 15 19.

J. Headed Studs and Deformed Bar Anchors:
   1. Headed studs:
      a. ASTM A108, complying with AWS D1.1/D1.1M, Section 7, Type B; minimum yield strength 50,000 PSI, minimum tensile strength 60,000 PSI.
      b. Uniform diameter.
      c. Heads: Concentric and normal to shaft.
      d. Weld end: Chamfered and solid flux.
   2. Deformed bar anchor:
      a. ASTM A1064/A1064M, complying with AWS D1.1/D1.1M, Section 7, Type C.
      b. Minimum yield strength: 70,000 PSI.
      c. Minimum tensile strength: 80,000 PSI.
      d. Straight, unless indicated otherwise.

e. Solid flux.
3. After welding, remove ceramic ferrules and maintain free from any substance which would interfere with function, or prevent bonding to concrete.

K. Nonshrink Grout: See Specification Section [_____].

L. Crane Rails:
1. Controlled-cooled, open-hearth carbon steel ASCE (American Society of Civil Engineers) rails per ASTM A2, Class A, #1 rails, unless noted otherwise, of size and weight indicated.
a. Furnish rails with milled tight end joints suitable for crane service, with standard drilling, removable end stops and all related accessories required, including:
1) Joint bars: Match rail section and properties, drilled to match rail drilling.
2) Joint bar bolts and nuts: High strength.
3) Hardened washer: ASTM F436 for bar bolts.
4) Except as indicated otherwise, two-bolt type fixed or floating rail clamps to suit the conditions, of forged or pressed steel, complete with Grade A325 bolts, reversible fillers, and self-locking nut or nut and lock washer.

M. Mechanical and Adhesive Anchor Bolts for Fastening to Concrete:
1. See Specification Section 03 15 19.

2.3 FABRICATION

A. Comply with requirements of applicable building code and AISC 360 with modifications and additional requirements specified herein.
1. Identify high-strength steel material in fabricated members in accordance with ASTM A6/A6M.

B. Minimize the amount of field welding.
1. Shop assemble components into largest size possible commensurate with transportation and handling limitations.
2. Shop connections: Bolted with high-strength bolts or welded.

C. Connection Details:
1. Provide as a minimum, two, 3/4 IN DIA, high-strength bolts for all bolted connections unless otherwise specified.

D. Provide bearing type connections for all bolted connections, unless otherwise noted.

E. Field Connections:
1. Provide bolts for all field connections except where shown otherwise on the Drawings.
2. Use high-strength bolts unless shown or specified otherwise.
3. Use of high-strength bolts: Conform to RCSC Specification for Structural Joints Using High-Strength Bolts.
4. Unfinished bolts may be used for attaching stair treads to stringers.
5. If structural steel details (field welds versus shop welds, etc.) shown on design Drawings are not compatible with selected erection procedures, submit proposed modifications for review.

6. Connections to structural steel provided by others: Provide all connectors and coordinate location of bolt holes to match connection holes in steel provided by others.

F. Accurately mill column end bearing surfaces to true plane.

G. Fabricate and erect beams with non-specified camber in accordance with AISC 360, Chapter L1.

H. Cut, drill, or punch holes at right angles to surface of metal.
   1. Do not make or enlarge holes by burning.
   2. Make holes clean cut, without torn or ragged edges.
   3. Remove outside burrs resulting from drilling or reaming operations with tool making 1/16 IN bevel.
   4. Provide holes in members to permit connection of work of other trades or contractors.

I. Make allowance for draw in all cross bracing to provide small amount of initial tension in members.

J. Make splices only where indicated or where approved.

K. Wall Girts:
   1. Extend past columns and miter ends unless noted otherwise.
   2. Connect girts to each other at corners unless noted otherwise.

L. Cope at 45 DEG, corners of stiffener plates at junction of member flanges with webs.

M. Flame cut bevels for welds, provided such cutting is done automatically.
   1. Leave free of burrs and slag by grinding or planing the cut edges.

N. Grind smooth all rough welds and sharp steel edges shall be ground to approximately 1/8 IN radius.

O. Tolerances (unless noted otherwise on Drawings):
   1. When material received from the mill does not satisfy ASTM A6/A6M tolerances for camber, profile, flatness or sweep, Contractor is permitted to perform corrective work by the use of controlled heating, and mechanical straightening, subject to the limitations of the AISC 360.
   2. Fabrication tolerance:
      a. Member length:
         1) Both ends finished for contact bearing: 1/32 IN.
         2) Framing members: [30 FT or less: 1/16 IN] [Over 30 FT: 1/8 IN].
      b. Member straightness:
         1) Compression members: 1/1000 of axial length between points laterally supported.
         2) Non-compression members: ASTM A6/A6M tolerance for wide flange shapes.
      c. Specified member camber (except compression members):
         1) 50 FT or less: -0/+1/2 IN.
         2) Over 50 FT: -0/+1/2 IN (+1/8 IN per 10 FT over 50 FT).
         3) Members received from mill with 75 PCT of specified camber require no further cambering.
         4) Fabricate beams/trusses without specified camber so after erection, camber is upward.

5) Measure camber in fabrication shop in unstressed condition.
d. Use filler plates at bolted splices to take up depth deviation.
1) At welded joints, adjust weld profile to conform to variation in depth.
2) Slope weld surface per AWS requirements.
e. Free finished members from twists, bends and open joints.
1) Sharp kinks, bends and deviation from the above tolerances are cause for rejection of material.

2.4 WELDING

A. Comply with AWS D1.1/D1.1M, and other requirements indicated herein, for all welding, techniques of welding employed, appearance and quality of welds, and methods used to correct defective work.
1. Qualify joint welding procedures or test in accordance with AWS qualification procedures.

B. Test and qualify welders, welding operators and tackers in compliance with AWS D1.1/D1.1M for position and type of welding to which they will be assigned.
1. Conduct tests in presence of approved testing agency.
2. Certification within previous 12 months will be acceptable, provided samples of the welder's work are satisfactory.

C. Before Starting Welding:
1. Carefully plumb and align members in compliance with specified requirements.
2. Fully tighten all bolts.
3. Comply with AWS D1.1/D1.1M, Section 5 for assembly and surface preparation.
4. Preheat base metal to temperature stated in AWS D1.1/D1.1M.
a. When no preheat temperature is given in AWS D1.1/D1.1M and base metal is below 50 DEGF, preheat base metal to at least 70 DEGF.
b. Maintain temperature during welding.
c. Preheat surface of all base metal within distance from point of welding equal to thickness of thicker part being welded or 3 IN, whichever is greater, to specified preheat temperature.
d. Maintain this temperature during welding.
5. Mark welds with an identifying mark unique to each welder.

D. Make flange welds before making web welds.

E. Where groove welds have back-up plates, make first three passes with 1/8 IN round electrodes.
1. Use backup plates in accordance with AWS D1.1/D1.1M, extending minimum of 1 IN either side of joint.

F. Flame cut edges of stiffener plates at shop or field butt weld.
1. Do not shear.

G. Grind flush web fillets at webs notched to receive backup plates for flange groove welds.

H. Low Hydrogen Electrodes: Dry and store electrodes in compliance with AWS D1.1/D1.1M.

I. Do not perform welding when ambient temperature is lower than 0 DEGF or where surfaces are wet or exposed to rain, snow, or high wind, or when welders are exposed to inclement conditions.

J. Headed Studs and Deformed Bar Anchors:
1. Automatically end welded in accordance with the AWS D1.1/D1.1M and manufacturer's recommendations.
2. Fillet welding of headed studs and deformed bar anchors is not allowed unless approved by Engineer.

K. Test in-place studs in accordance with requirements of AWS D1.1/D1.1M to ensure satisfactory welding of studs to members.
1. Replace studs failing this test.

L. When headed stud-type shear connectors are to be applied, clean top surface of members to receive studs in shop to remove oil, scale, rust, dirt, and other materials injurious to satisfactory welding.
1. Do not shop paint or galvanize metal surfaces to receive field applied studs.

2.5 SHOP COATING

A. Refer to Specification Section 09 96 00 and coordinate shop primer, surface preparation and coating with field applied primers and coatings where specified.

B. Provide suitable methods of handling and transporting painted steel to avoid damage to coating.

C. Do not coat following surfaces:
1. Machined surfaces, surfaces adjacent to field welds, and surfaces fully embedded in concrete.
2. All other members for which no coating is specified.
3. Contact surfaces at bolted slip-critical connections, unless surface condition conforms to the RCSC Specification for Structural Joints Using High-Strength Bolts, Part 3.2.2.

D. Clean thoroughly all surfaces not coated before shipping.
1. Remove loose mill scale, rust, dirt, oil and grease.
2. Protect machined surfaces.

2.6 SOURCE QUALITY CONTROL

A. Special Inspection and Testing:
1. See Specification Section 01 45 33.
2. If the fabricator is not an Approved Fabricator, Owner will employ the services of an independent testing agency to inspect and test structural steel shop work for compliance with Specifications.
a. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
3. Contractor responsible for testing to qualify shop welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.

B. Approved Fabricator or Testing Agency Responsibilities:
1. Inspect shop and field welding in accordance with AWS D1.1/D1.1M, Section 6 including the following non-destructive testing:
a. Visually inspect all welds.

b. In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant.
c. Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.

2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
   a. Verify proper pretension for slip-critical bolted connection only.
   b. Verify direct tension indicator gaps for slip-critical bolted connection only.
3. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.
4. Prepare and submit inspection and test reports to Engineer.

2.7 GENERAL

A. Contractor is solely responsible for safety.
   1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
   2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, bracing or rigid connections are installed.
   3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
   4. Until all elements of the permanent structure and lateral bracing system are complete, provide temporary bracing designed, furnished, and installed by the Contractor for the partially complete structure.

B. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including wind, construction activities, and operation of equipment, is the responsibility of the Contractor.
   1. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
   2. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
   3. Design of the temporary bracing system and consideration of the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades, is the Contractor's responsibility.
      a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
   4. Remove and dispose of all temporary work and facilities off-site.

C. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
   1. Report defects in work-in-place which may influence satisfactory completion of the work.
   2. Absence of such notification will be construed as acceptance of work-in-place.

D. Field Measurement:
   1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
   2. Contractor is responsible for the accurate fit of the work.

E. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
   1. Notify Engineer of any errors or deviations found by such checking.

PART 3 - EXECUTION

3.1 ERECTION

A. Framing member location tolerances after erection shall not exceed the framing tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

B. Erect plumb and level; introduce temporary bracing required to support erection loads.

C. Use light drifting necessary to draw holes together.
   1. Drifting to match unfair holes is not allowed.

D. Welding:
   1. Conform to AWS D1.1/D1/1M and requirements of this Specification Section.
   2. Join two (2) sections of steel of different ASTM designations using welding techniques in accordance with a qualified AWS D1.1/D1.1M procedure.

E. Shore existing members when unbolting of common connections is required.
   1. Use new bolts for rebolting connections.

F. Clean stored material of all foreign matter accumulated during erection period.

G. Clean bearing and contact surfaces before assembly.

H. Set beam and column base and bearing plates accurately, as indicated, on nonshrink grout.
   1. Set and anchor each base plate to proper line and elevation.
   2. Use metal wedges, shims or setting nuts as required and tighten anchor bolts.
      a. Use same metal as base plate.
      b. Cut off protrusions of wedges and shims flush with edge of base plate.
   3. Fill sleeves around anchor bolts with nonshrink grout.
   4. Pack grout solidly between bottom of plate and bearing surface.

5. Refer to Specification Section [_____] for nonshrink grout requirements.

I. Cast-in-place Anchor Bolts:
1. See Specification Section 03 15 19.

J. Install high strength bolts with hardened washers.
1. Install and tighten in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.
2. Coordinate installation with inspection.
a. Do not start installation until coordination with Testing Agency is complete.
3. Bearing-type connections: High-strength bolts shall be tightened to snug-tight condition.
4. Slip-critical connections:
a. Perform calibration testing for all methods of installation of high-strength bolts in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.2.
b. Turn-of-nut tightening:
1) Inspector shall observe the pre-installation verification testing.
2) Subsequently, ensure by routine observation that the bolting crew properly rotates the turned element relative to the unturned element by the amount specified.
3) Alternatively, when fastener assemblies are match-marked after the initial fitup of the joint but prior to pretensioning, visual inspection after pretensioning is permitted in lieu of routine observation.
c. Calibrated wrench tightening: Calibrate on a daily basis.
d. Direct tension indicator tightening: If previously approved by Engineer.
e. Installation of alternate design bolts: If previously approved by Engineer.
5. In the event any bolt in a connection is found to be defective, check and retighten all bolts in the connection.

K. Do not use gas cutting to correct fabrication errors.
1. In case members do not fit or holes do not match, ream out the holes and insert the next larger size bolt.
a. Drill new holes if the connections require new holes.
b. Make no such corrections without prior approval of the Engineer.
2. Burning of holes is not permitted.

L. Prior to making field connections to existing structural steel, remove completely all paint from existing steel which will be in contact with new steel and new welds.

M. Tighten and leave in place erection bolts used in welded construction.

N. Provide beveled washers to give full bearing to bolt head or nut where bolts are to be used on surfaces having slopes greater than 1 in 20 with a plane normal to bolt axis.

O. After bolts are tightened, upset threads of non-high strength bolts and anchor bolts to prevent nuts from backing off.

P. After Erection:
1. Grind smooth all sharp surface irregularities resulting from field cutting or welding.
2. Power tool clean welds, bolts, washers and abrasions to shop coat removing all rust and foreign matter.

Q. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
1. See Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

A. Special Inspection and Testing:
1. See Specification Section 01 45 33.
2. Special Inspection to be in accordance with the building code.
3. Special Inspection is required for:
a. Material verification of high-strength bolts, nuts, and washers.
1) Frequency: All high-strength bolts, prior to being covered up or substantial completion.
b. Inspection of high-strength boltings:
1) Frequency:
a) All high-strength bolts, prior to being covered up or substantial completion.
b) Pretensioned and slip-critical joints using turn-of-nut without match marking or calibrated wrench methods of installation require continuous inspection.
c. Material verification of structural steel.
1) Frequency: Prior to being covered up or substantial completion,
d. Material verification of weld filler materials.
1) Frequency:
a) Prior to welding on site.
b) Randomly therafter.
e. Inspection of welding.
1) Frequency:
a) Visually inspect all welds.
b) In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant or magnetic particle.
c) Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
f. Inspect structural steel which has been erected.
1) Frequency: Prior to members being covered up or substantial completion.
g. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.

B. Erected Framing Tolerance, unless noted otherwise on the Drawings:
1. Do not exceed cumulative effect of rolling, fabrication and erection tolerance for overall finished dimensions.
2. Erection tolerances are defined relative to member working points and working lines as follows:
a. Actual centerline of top flange or surface at each end for horizontal members.
b. Actual center of member at each end for all other members.

c. Other points may be used, providing they are based on these definitions.
d. Working line is straight line connecting member working points.

3. Tolerances on position and alignment are as specified in the Code, unless otherwise modified.
   a. Provide "adjustable items" such as lintels, wall supports, curb angles, window mullions and similar members with adjustable connections to supporting structural framing.
4. Certification by steel erector:
   a. Certify the location of erected structural steel is acceptable for plumbness, level and aligned within tolerances specified.
   b. Provide certification upon completion of any part of work.
   c. Provide certification prior to start of work by other trades that may be supported; attach to structural steel work.

3.3 CLEANING AND REPAIR OF SHOP PRIMER PAINT

A. After erection, clean all steel of mud or other foreign materials, and repair any damage.
   1. Touchup coatings to comply with Specification Section 09 96 00.

END OF SECTION

# SECTION 05 50 00
# METAL FABRICATIONS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
   2. Design of all temporary bracing not indicated on Drawings.
   3. Design of systems and components, including but not limited to:
      a. Stairs.
      b. Landings.
      c. Ladders.
      d. Modular framing system.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 00 05 - Concrete.
   4. Section 03 15 19 - Anchorage to Concrete.
   5. Section 03 31 30 - Concrete, Materials and Proportioning.
   6. Section 05 12 00 - Structural Steel.
   7. Section 05 14 00 - Structural Aluminum.
   8. Section 06 82 00 - Fiberglass Reinforced Plastic Fabrication.
   9. Section 09 96 00 - High Performance Industrial Coatings.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM 1, Aluminum Design Manual.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB, Standard Specifications for Highway Bridges.
   3. American Institute of Steel Construction (AISC):
      a. 325, Manual of Steel Construction.
      b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
   4. The American Ladder Institute (ALI):
      a. A14.3, Ladders - Fixed - Safety Requirements.
   5. American Society of Civil Engineers (ASCE):
      a. 7, Minimum Design Loads for Buildings and Other Structures.
   6. ASTM International (ASTM):
      a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
      b. A36, Standard Specification for Carbon Structural Steel.
      c. A47, Standard Specification for Ferritic Malleable Iron Castings.
      d. A48, Standard Specification for Gray Iron Castings.

e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
i. A197, Standard Specification for Cupola Malleable Iron.
j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
n. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
o. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
p. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
q. A536, Standard Specification for Ductile Iron Castings.
r. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
s. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
y. A992, Standard Specification for Steel for Structural Shapes.
z. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
aa. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
hh. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
ii. F467, Standard Specification for Nonferrous Nuts for General Use.
jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
ll. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
mm. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
nn. F1789, Standard Terminology for F16 Mechanical Fasteners.
oo. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

7. American Welding Society (AWS):
   a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   b. D1.1, Structural Welding Code - Steel.
   c. D1.2, Structural Welding Code - Aluminum.
   d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. National Association of Architectural Metal Manufacturers (NAAMM):
   a. AMP 510, Metal Stairs Manual.
   b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
   c. MBG 531, Metal Bar Grating Manual.
9. NACE International (NACE).
10. Nickel Development Institute (NiDI):
   a. Publication 11 007, Guidelines for the welded fabrication of nickel-containing stainless steels for corrosion resistant services.
11. Occupational Safety and Health Administration (OSHA):
   a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

B. Qualifications:
1. Qualify welding procedures and welding operators in accordance with AWS.
2. Fabricator shall have minimum of 10 years of experience in fabrication of metal items specified.
3. Engineer for contractor-designed systems and components: Professional structural engineer licensed in the State of [_____].
4. NACE certified inspector shall have minimum of two years of experience performing inspections as indicated.
   a. Have a current Level III coating inspector certification.

1.3 DEFINITIONS

A. Fasteners: As defined in ASTM F1789.

B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

C. Hardware: As defined in ASTM A153/A153M.

D. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Qualifications:
a. NACE inspector qualifications.
3. Fabrication and/or layout drawings and details:
a. Submit drawings for all fabrications and assemblies.
1) Include erection drawings, plans, sections, details and connection details.
b. Identify materials of construction, shop coatings and third party accessories.
4. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Provide manufacturer's standard allowable load tables for the following:
1) Grating and checkered plate.
2) Castings, trench covers and accessories.
3) Modular framing systems.
5. Contractor designed systems and components:
a. Certification that manufactured units meet all design loads specified.
b. Shop Drawings and engineering design calculations:
1) Indicate design live loads.
2) Sealed by a licensed professional engineer, registered in the State of [_____].
3) Engineer will review for general compliance with Contract Documents.
c. Contractor designed systems and components include the following:

B. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Certification of welders and welding processes.
a. Indicate compliance with AWS.
3. NACE certification of surface preparation.
4. NACE certification of paint application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle fabrications to avoid damage.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Abrasive stair nosings (embedded in concrete stairs):
      a. American Safety Tread.
      b. Balco.
   2. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Div., TRW Inc.
      b. Stud Welding Products, Inc.
   3. Mechanical anchor bolts:
      a. See Section 03 15 19.
   4. Epoxy adhesive anchor bolts:
      a. See Section 03 15 19.
   5. Concrete screw anchors:
      a. See Section 03 15 19.
   6. Castings, trench covers and accessories:
      a. Neenah Foundry Co.
      b. Deeter Foundry Co.
      c. Barry Craft Construction Casting Co.
      d. McKinley Iron Works.
   7. Aluminum ladders:
      a. Any manufacturer capable of meeting the requirements of this Specification Section.
   8. Galvanizing repair paint:
      a. Clearco Products Co., Inc.
      b. ZRC Products.
   9. Modular framing system:
      a. Unistrut Building Systems.
      b. B-Line Systems.
      c. Kindorf.
      d. Superstrut.
   10. Ladder safety extension post:
      a. Bilco.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Steel:
   1. Structural:
      a. W-shapes and WT-shapes: ASTM A992, Grade 50.
      b. All other plates and rolled sections: ASTM A36.
   2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
   3. Structural tubing:
      a. ASTM A500, Grade B (46 KSI minimum yield).
   4. Bolts, high strength:
      a. ASTM F3125, Grade A325.
   5. Nuts, high strength:
      a. ASTM A563.
   6. Washers (hardened):

a. ASTM F436.
b. Provide two (2) washers with all bolts.
7. Bolts and nuts (unfinished):
a. ASTM A307, Grade A.
8. Welding electrodes: AWS D1.1, E70 Series.
9. Steel forgings: ASTM A668.

B. Iron:
1. Ductile iron: ASTM A536.
2. Gray cast iron: ASTM A48 (minimum 30,000 PSI tensile strength).
3. Malleable iron: ASTM A47, ASTM A197.

C. Stainless Steel:
1. Stainless steel in welded applications: Low carbon 'L' type.
2. Minimum yield strength of 30,000 PSI and minimum tensile strength of 75,000 PSI.
a. Bars, shapes: ASTM A276, Type [304].
b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
c. Strip, plate and flat bars: ASTM A666, Type 304 or 316.
d. Bolts and nuts: ASTM F593, Type 304 or 316.
3. Minimum yield strength of 25,000 PSI and minimum tensile strength of 70,000 PSI.
a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
4. Welding electrodes: In accordance with AWS for metal alloy being welded.

D. Aluminum:
1. Alloy 6061-T6, 32,000 PSI tensile yield strength minimum.
a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
b. Weir plates, baffles and deflector plates, ASTM B209.
2. Alloy 6063-T5 or T6, 15,000 PSI tensile yield strength minimum.
a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
3. ASTM B26 for castings.
4. ASTM F468, alloy 2024 T4 for bolts.
5. ASTM F467, alloy 2024 T4 for nuts.
6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.

E. Washers: Same material and alloy as found in accompanying bolts and nuts.

F. Embedded Anchor Bolts:
1. See Specification Section 03 15 19.

G. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
1. See Specification Section 03 15 19.

H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.

I. Deformed Bar Anchors: ASTM A1064 with a minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.

J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to be galvanized.

K. Galvanizing Repair Paint:
   1. High zinc dust content paint for regalvanizing welds and abrasions.
   2. ASTM A780.
   3. Zinc content: Minimum 92 PCT in dry film.
   4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

L. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.3 MANUFACTURED UNITS

A. Ladders:
   1. General:
      a. Fully welded type.
         1) All welds to be full penetration welds, unless otherwise specified.
      b. All ladders of a particular material shall have consistent construction and material shapes and sizes unless noted otherwise on the Drawings.
      c. Design ladder in accordance with OSHA Standards, ANSI A14.3, ASCE 7 and the building code.
      d. Ladders shall be designed to support a minimum concentrated live load of 300 LBS at any point to produce the maximum stress in the member being designed.
         1) Apply additional 300 LB loads for each section of ladder exceeding 10 FT.
      e. Maximum allowable stresses per AA ADM 1.
      f. Maximum lateral deflection: Side rail span/240 when lateral load of 100 LBS is applied at any location.
   2. Material:
      a. Aluminum.
      b. Finish:
         1) Mill.
   3. Rails:
      a. Round pipe or rectangular tubing:
         1) Round pipe:
            a) 1-1/2 IN nominal diameter.
            b) Schedule 80.
         2) Rectangular tubing:
            a) Cross-section: 3 by 2 IN maximum.
            b) Thickness: 0.125 IN minimum.
      b. Spacing:
         1) Minimum clear distance between rails to be 18 IN.
         2) Step-through ladder extensions: 24 IN, centerline to centerline.
      c. Provide cap at exposed top and bottom of side rails.
         1) Provide weep holes as necessary to prevent the accumulation of moisture within hollow members.
      d. Extend side rails of step-through ladders a minimum of 42 IN above the landing.
   4. Rungs:
      a. Minimum 1 IN DIA or 1 IN square solid bar.
         1) Integral non-slip finish on all sides.
            a) Non-slip finish: Coarse knurling or extruded serrations.

b) Shop or field-applied grit tape and cap type non-slip finishes are not acceptable.
b. Rungs shall penetrate inside wall of side rails.
1) Do not extend rungs beyond the outside face of the side rail.
2) Provide fillet weld all around rung at inside face of side rail and plug weld at outside face of side rail.
c. Rung spacing:
1) Equally spaced not less than 10 IN and not more than 14 IN as measured between the centerlines of the rungs.
a) Ladder rungs and steps in elevator shafts shall be spaced not less than 6 IN and not more than 16.5 IN as measured between the centerlines of the rungs.
2) Top rung shall be level with landing or platform.
a) Where top of ladder terminates at grating cover, floor access door, roof hatch or similar condition; locate top rung as close as practicable to, but not more than 6 IN below, adjacent walking surface.
5. Brackets:
a. Angle or bent plate brackets welded to side rails:
1) 3/8 IN by 2-1/2 IN by length required.
2) Provide punched holes for 3/4 IN bolts or anchors.
3) Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
4) Maximum spacing: [4] [6] FT OC.
b. For floor supported ladders, provide 3/8 by 2-1/2 by 4 IN rectangular bracket or 3/8 by 6 by 6 IN square plate welded to rails with punched holes for 3/4 IN bolts.
1) Provide wall brackets on floor supported units if vertical run is over 4 FT.
6. Landings:
a. Construct landing, railing and all supports of same material as the ladder.
b. Design live load for landing platform and supporting structure:
1) [100] PSF, uniform load.
2) [300] LBS concentrated load on 4 IN square area.
3) All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
4) Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.
c. Grating:
1) Per this Specification Section.
d. Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing from the side of the [structure] [building wall].
1) Weld or bolt all connections using [stainless steel] [galvanized] bolts, nuts and washers.
e. Guardrails:
1) Match ladder side rails.
a) Space intermediate rails equally between top rail and top of kickplate.
2) Provide 4 IN high x 3/8 IN thick toeboard each side of landing.
7. Gates:

a. Constructed of same material and sizes as the railing system.
b. Hinges:
1) Stainless steel.
2) Heavy-duty, self-closing.
c. Gate stop:
1) [Aluminum] [Galvanized steel] [Stainless steel].
8. Ladder safety extension post:
a. Telescoping tubular [aluminum] [galvanized steel] [stainless steel] section that automatically locks into place when fully extended.
b. Non-ferrous corrosion-resistant spring and hardware.
c. Factory assembled with all hardware necessary for mounting to ladder.
d. Bilco "LadderUp" safety post.
9. Deflector plate:
a. For aluminum ladders: Minimum 0.0625 IN aluminum plate, ASTM B209.
b. For stainless steel ladders: Minimum 0.0625 IN stainless steel plate, ASTM A666.
c. For steel ladders: Minimum 0.0625 IN steel plate, ASTM A6.
d. Profile as shown on Drawings.
e. Fabricate to shapes and sizes required to meet OSHA Standards.

B. Bollards:
1. 8 IN DIA extra strength steel pipe, ASTM A53.
a. Galvanized.
b. See Specification Section 09 96 00 for painting requirements.

C. Abrasive Stair Nosings:
1. Exterior cast-in-place concrete stairs:
a. One piece cast aluminum with wing anchors.
b. Diamond abrasive pattern.
c. Babcock Davis "BSTCA-C3W".
2. Interior stairs:
a. Two component consisting of an embedded subchannel and an abrasive tread plate [with integral photoluminescent strip].
b. Subchannel: 6063-T5 extruded aluminum.
1) Complete with concrete anchors.
c. Tread plate:
1) 6063-T5 extruded aluminum.
2) Solid epoxy abrasive filler.
a) Color: [Safety yellow] [Black] [Gray] [To be selected by Engineer].
d. [Balco "DXH-330"] ["DXH-330-PL-100"].
e. Finish: Mill.
3. Length:
a. Concrete stairs and landings:
1) 4 IN less than overall stair width.
2) Where tread mounted railing post occurs, hold nosing back 4 IN clear from railing centerline.
b. Concrete filled metal pan stairs: Full length of tread.
c. Concrete landings at metal stairs: 4 IN less than clear width between stringers.

D. Metal Stairs:
1. Treads: [Grating] [Checkered plate] as specified.
   a. Provide integral corrugated non-slip nosing.
2. Risers:
   a. Grating treads:
      1) Solid plate welded to trailing edge of tread or landing.
      2) Minimum 3/16 IN thick by 4 IN high.
   b. Checkered plate treads: Solid checkered plate riser integral with tread.
3. Landings:
   a. [Grating] [Checkered plate] as specified.
   b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
4. Design live load for landing platform and supporting structure:
   a. [100] PSF, uniform load.
   b. [300] LBS concentrated load [on 4 IN square area].
   c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
   d. Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.
5. Design, fabricate, and install in compliance with NAAMM and applicable codes.
   a. NAAMM AMP 510:
      1) Exterior at site structures and equipment: Industrial Class.
      2) Interior or exterior at buildings: Service Class.
6. Handrails and guardrails: Refer to Specification Section [05 52 02] [05 52 05].
7. Material:
   a. [Aluminum.] [Steel: ASTM A36, [galvanized after fabrication] [prime painted].]

E. Stairs, Concrete Filled Steel Pan:
1. Fabricated as indicated.
   a. ASTM A36 steel.
2. Treads: Minimum 14 GA pans with self-furring metal lath welded in pan.
3. Risers: Minimum 14 GA.
4. Landings: minimum 10 GA pans with angle supports as required to support loading indicated and concrete.
   a. Provide self-furring metal lath reinforcing welded in the pan.
5. Design live load for landing platform and supporting structure:
   a. [100] PSF, uniform load.
   b. [300] LBS concentrated load [on 4 IN square area].
   c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
   d. Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.
6. Design, fabricate, and install in compliance with NAAMM and applicable codes.
   a. NAAMM AMP 510: [Commercial Class] [Architectural Class].

b. ICC A117.1.
7. Nosings:
a. Abrasive nosings as specified.
b. Coordinate riser height to compensate for thickness of nosing.
8. Handrails and guardrails: Refer to Specification Section [05 52 02] [05 52 05].
9. Galvanize entire assembly after fabrication.

F. Steel Checkered Plate:
1. Provide galvanized checkered plate and edge supports.
2. Conform to ASTM A786.
a. Diamond pattern: No.3 (large) or No.4 (medium).
b. Use one pattern throughout Project.
c. Material: 36 KSI minimum yield strength.
3. Design live load (unless noted otherwise on Drawings):
a. 100 PSF, uniform load.
b. 300 LBS concentrated load on 4 IN square area.
c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
d. Maximum deflection: 1/300 of span under a superimposed live load of 50 PSF.
4. Reinforce as necessary with steel angles welded to underside of checkered plate.
5. Plate sections:
a. Maximum 3 FT wide.
b. Minimum 1/4 IN thick.
c. Maximum 100 LBS per section if required to be removable.
6. Provide joints at center of all openings unless shown otherwise.
a. Reinforce joints and openings with additional angles to provide required load carrying capacity.
7. Unless shown otherwise, frame for opening with steel checkered plate cover:
a. Steel support angles:
1) 3 by 2 by 1/4 IN minimum size with long leg vertical.
2) 5/8 IN DIA adhesive anchor bolts spaced at maximum of 24 IN OC along each side with not less than two anchor bolts per side.
b. Steel concrete insert seats:
1) 2 by 2 by 1/4 IN minimum size.
2) Auto-welded studs or strap anchors, ASTM A108 at 18 IN OC with not less than two studs or anchors per side.
c. Drill and tap frame to receive 3/8 IN DIA fasteners at not more than 24 IN OC with not less than two fasteners per side.
1) Fasteners: Flat countersunk cap screws, ASTM F835.
a) Galvanized, ASTM A153/A153M.

G. Aluminum Checkered Plate:
1. Conform to ASTM B632.
a. Diamond pattern: Use one pattern throughout Project.
b. Material: Type 6061-T6.
2. Design live load:
a. 100 PSF, uniform load.
b. 300 LBS concentrated load on 4 IN square area.

c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
d. Maximum deflection: 1/300 of span under a superimposed live load of 50 PSF.
3. Reinforce as necessary with aluminum angles.
4. Plate sections:
a. Maximum 3 FT wide.
b. Minimum 1/4 IN thick.
c. Maximum 100 LBS per section if required to be removable.
5. Provide joints at center of all openings unless shown otherwise.
a. Reinforce joints and openings with additional angles to provide required load carrying capacity.
6. Unless shown otherwise, frame for openings with aluminum checkered plate cover:
a. Aluminum support angles:
1) 3 by 2 by 1/4 IN minimum size with long leg vertical.
2) 5/8 IN DIA adhesive anchor bolts spaced at maximum of 24 IN OC along each side with not less than two anchor bolts per side.
b. Aluminum concrete insert seats:
1) 2 by 2 by 1/4 IN minimum size.
2) Auto-welded studs or strap anchors at 18 IN OC with not less than two studs or anchored per side.
c. Drill and tap frame to receive 3/8 IN DIA fasteners at not more than 24 IN OC with not less than two fasteners per side.
1) Fasteners: Stainless steel flat countersunk cap screws: ASTM F879.

H. Aluminum Grating:
1. NAAMM MBG 531.
2. Bearing bars: Rectangular, 1-1/2 by 3/16 IN at 1-3/16 IN OC spacing OR I-bar, 1-1/2 IN deep with minimum 1/16 IN thick bar and minimum 1/4 IN flange width at 1-3/16 IN OC spacing (unless noted otherwise on Drawings).
3. Cross bars:
a. Welded, swaged or pressure locked to bearing bars:
b. Maximum 4 IN/OC spacing.
4. Top edges of bars: Grooved or serrated.
5. Finish: Mill, standard.
6. Clips and bolts: Stainless steel.
7. Seat angles: Aluminum or stainless steel

I. Steel Grating:
1. NAAMM MBG 531.
2. Bearing bars:
a. Rectangular 1-1/2 by 3/16 IN unless otherwise noted on Drawings.
b. Maximum 1-3/16 IN OC spacing.
3. Cross bars:
a. Welded, swagged or pressure locked to bearing bars.
b. Maximum 4 IN OC spacing.
4. Top edges of bars: Serrated or grooved.
5. Removable grating sections: Not wider than 3 FT and not more than 100 LBS.
6. Finish:

a. Galvanized.
b. Clips and bolts: [Stainless steel] [Galvanized].
c. Seat angles: Galvanized steel.
7. Ends and perimeter edges: Banded.
8. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
9. Provide joints at openings between individual grating sections.

J. Heavy-Duty Castings, Trench Covers, and Accessories:
1. Prefabricated, [cast iron ASTM A48] [or ductile iron ASTM A536] [or cast aluminum ASTM B26].
2. Design load: AASHTO HS-20 wheel loading for indicated span.
3. Machine horizontal mating surfaces.

K. Access Cover:
1. Tank type manhole frame and solid lid: ASTM A48 or ASTM A536, cast iron.
2. Unless shown otherwise, design of cover shall be such that top of frame extends several inches above slab to prevent surface water from entering tank.
3. Equip lid with four stainless steel screws to secure lid to frame.

L. Loose Lintels:
1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.
2. Hot-dip galvanized per ASTM A123/A123M.

M. Modular Framing System:
1. Materials:
a. Steel: ASTM A1011, stainless steel, Grade 33.
1) Hot-dipped galvanized, ASTM A123 or ASTM A153.
b. Aluminum: ASTM B221 or ASTM B209.
c. Stainless steel: ASTM A666.
d. Fiberglass: See Specification Section 06 82 00.
2. Channels and inserts:
a. Steel or stainless steel: Minimum 12 GA.
b. Aluminum: Minimum 0.080 IN.
c. Channels to have one side with a continuous slot with in-turned lips.
1) Width: 1-5/8 IN.
2) Depth and configuration as necessary for loading conditions.
3. Fittings: Same material as system major components.
4. Fasteners:
a. Nuts: Toothed groves in top of nuts to engage the in-turned lips of channel.
b. Bolts: Hex-head cap screws.
c. Same material as system major components.
5. End caps:
a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 FT or less above the floor or platform.
a) Plastic for all exposed ends 7 FT or more above floor or platform.
b) Plastic or metallic for all other exposed ends.
6. Schedule:
a. Interior wet areas: [Aluminum] [Stainless steel].

1) Including the following rooms or areas:
a) [_____].
b. Interior corrosive areas: [Fiberglass] [Stainless steel].
1) Including the following rooms or area:
a) [_____].
c. Exterior areas: [Aluminum] [Stainless steel].
d. All other areas not listed above: Hot-dipped galvanized steel.
7. Provide dissimilar materials protection in accordance with Specification Section 09 96 00.
8. Repair all cut ends or otherwise damaged areas of galvanized steel in accordance with ASTM A780.

2.4 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
1. Grind smooth all rough welds and sharp edges.
a. Round all corners to approximately [1/32 - 1/16] IN nominal radius.

C. Provide drilled or punched holes with smooth edges.
1. Punch or drill for field connections and for attachment of work by other trades.

D. Weld Shop Connections:
1. Welds to be continuous fillet type unless indicated otherwise.
2. Full penetration butt weld at bends in stair stringers and ladder side rails.
3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
4. Weld aluminum in accordance with AWS D1.2.
5. Weld stainless steel in accordance with AWS D1.6 [and NiDI 11 007].
a. Treat all welded areas in accordance with ASTM A380.
6. All headed studs to be welded using automatically timed stud welding equipment.
7. Grind smooth welds that will be exposed.

E. Passivate stainless steel items and stainless steel welds after they have been ground smooth[, where indicated on Drawings].
1. ASTM A380.

F. Conceal fastenings where practicable.

G. Fabricate work in shop in as large assemblies as is practicable.

H. Tolerances:
1. Rolling:
a. ASTM A6.
b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
2. Fabrication tolerance:
a. Member length:
1) Both ends finished for contact bearing: 1/32 IN.

2) Framed members:
a) 30 FT or less: 1/16 IN.
b) Over 30 FT: 1/8 IN.

b. Member straightness:
1) Compression members: 1/1000 of axial length between points laterally supported.
2) Non-compression members: ASTM A6 tolerance for wide flange shapes.

c. Specified member camber (except compression members):
1) 50 FT or less: -0/+1/2 IN.
2) Over 50 FT: -0/+1/2 IN (+1/8 IN per 10 FT over 50 FT).
3) Members received from mill with 75 PCT of specified camber require no further cambering.
4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
5) Camber shall be measured in fabrication shop in unstressed condition.

d. At bolted splices, depth deviation shall be taken up by filler plates.
1) At welded joints, adjust weld profile to conform to variation in depth.
2) Slope weld surface per AWS requirements.

e. Finished members shall be free from twists, bends and open joints.
1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.

I. Fabricate grating, checkered plate, stairs, ladders and accessories using aluminum [prime painted steel] [galvanized steel] [stainless steel] unless shown otherwise on Drawings.
1. Finish:
a. Mill, unless noted otherwise.
b. Coat surfaces in contact with dissimilar materials.
1) See Specification Section 09 96 00.

J. Fabricate grating in accordance with NAAMM MBG 531.
1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 IN.
2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 IN.
a. Tolerance: NAAMM MBG 531.
3. Removable sections: Not wider than 3 FT and not heavier than 100 LBS.
4. Ends and perimeter edges: Banded, with alternate bearing bars welded to band.
a. Provide full depth banding unless noted otherwise.
b. Banding at trenches and sumps to be 1/4 IN less than grating depth to allow for drainage.
5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
6. Provide joints at openings between individual grating sections.
7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.

K. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.

1. Workmanship: Class 2 [Class 1] [Class 3] unless noted otherwise.

L. See Specification Section 09 96 00 for preparation and painting of ferrous metals and other surfaces.

2.5 SOURCE QUALITY CONTROL

A. Surface Preparation:
1. Refer to Specification Section 09 96 00 for surface preparation requirements.
2. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied coatings.
a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.

B. Shop Applied Coating Application:
1. Refer to Specification Section 09 96 00 for coating requirements.
2. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of coatings.
3. Application of coatings shall be observed and certified by NACE certified coatings inspector.

C. Shop Inspection and Testing:
1. [Owner will employ] [Employ] and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents.
2. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
3. Independent testing agency shall have a minimum of five years performing similar work and shall be subject to Owner's approval.

D. Responsibilities of Testing Agency:
1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
a. Visually inspect all welds.
b. In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant or mag particle.
c. Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
a. Verify direct tension indicator gaps, if applicable.
3. Inspect structural steel which has been erected.
4. Inspect stud welding in accordance with AWS Code.
5. Prepare and submit inspection and test reports to Engineer.
a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction in time to allow their installation.
   1. If such items are not provided in time for installation, cut in and install.

B. Prior to installation, inspect and verify condition of substrate.

C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
   1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

A. Set metal work level, true to line, plumb.
   1. Shim and grout as necessary.

B. Contractor is solely responsible for safety.
   1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
   2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing or rigid connections are installed.
   3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
   4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.

C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
   1. Plumb, align, and set structural steel members to specified tolerances.
   2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
   3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
   4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
      a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.

5. Remove and dispose of all temporary work and facilities off-site.

D. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
   1. Report defects in work-in-place which may influence satisfactory completion of the work.
   2. Absence of such notification will be construed as acceptance of work-in-place.

E. Field Measurement:
   1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
   2. Contractor responsible for the accurate fit of the work.

F. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
   1. Use surveyor's level.
   2. Notify Engineer of any errors or deviations found by such checking.

G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

H. Erect plumb and level; introduce temporary bracing required to support erection loads.

I. Use light drifting necessary to draw holes together.
   1. Drifting to match unfair holes is not allowed.

J. Welding:
   1. Conform to AWS D1.1 and requirements of the FABRICATION Article in PART 2 of this Specification Section.
   2. When joining two sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.

K. Shore existing members when unbolting of common connections is required.
   1. Use new bolts for rebolting connections.

L. Clean stored material of all foreign matter accumulated prior to the completion of erection.

M. Bolt Field Connections: Where practicable, conceal fastenings.

N. Field Welding:
   1. Follow AWS procedures.
   2. Grind welds smooth where field welding is required.

O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
   1. Replace entire section.

P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.

Q. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 IN DIA ASTM F3125, Grade A325 high strength bolts.

2. Connect aluminum to aluminum with 3/4 IN DIA stainless bolts.
3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts.
   a. Provide dissimilar metals protection.
4. Connect aluminum and steel members to concrete and masonry using stainless steel mechanical anchor bolts or adhesive anchor bolts unless shown otherwise.
   a. Provide dissimilar materials protection.
5. Provide washers for all bolted connections.
6. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the top of installed nut.
   a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.

R. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
   1. Provide hardened washers for all Grade A325 bolts.
      a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

S. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.

T. Secure metal to wood with lag screws of adequate size with appropriate washers.

U. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
   1. Provide full penetration welded splices where continuity is required.

V. Provide each fabricated item complete with attachment devices as indicated or required to install.

W. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.

X. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
   1. See Division 03 Specification Sections for non-shrink grout and anchorage.
   2. Set and anchor each base plate to proper line and elevation.
      a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
         1) Wedges, shims and setting nuts to be of same metal as base plate they support.
         2) Tighten nuts on anchor bolts.
      b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
         1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
      c. Do not remove wedges or shims.
         1) Where they protrude, cut off flush with edge of base plate.
      d. Fill sleeves around anchor bolts solid with non-shrink grout.

Y. Tie anchor bolts in position to embedded reinforcing steel using wire.
   1. Tack welding prohibited.
      a. Coat projecting bolt threads and nuts with heavy coat of clean grease.
   2. Anchor bolt location tolerance:
      a. Per Section 03 15 19.

Z. Install bollards as detailed on Drawings.
   1. Fill pipe with concrete and round off at top.

AA. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
   1. Center stair nosings in stair width.

BB. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
   1. Keep screw holes clean and ready to receive screws.

CC. Attach grating to end and intermediate supports with grating saddle clips and bolts.
   1. Maximum spacing: 2 FT OC with minimum of two per side.
   2. Attach individual units of aluminum grating together with clips at 2 FT OC maximum with a minimum of two clips per side.

DD. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.

EE. Repair damaged galvanized surfaces in accordance with ASTM A780.
   1. Prepare damaged surfaces by abrasive blasting or power sanding.
   2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.

FF. Anchor ladder to concrete structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.

GG. Anchor ladder to masonry structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.
   1. When anchoring into masonry, fill masonry cores with grout at anchor locations and each masonry core within 8 IN of anchor
   2. When anchoring into cavity wall construction, provide minimum 6 IN embedment into concrete or masonry back-up wall.
      a. At each anchor location, provide sleeve between back face of veneer and cavity face of concrete or masonry back-up wall.
      b. Cut cavity insulation as required and seal around sleeve.
         1) Sleeve to be 1 IN DIA schedule 40 stainless steel tubing, TP-304L, ASTM A269.
            a) Minimum wall thickness to be .065 IN.
         2) Continuously weld 4 by 4 by 1/4 IN Type 304 stainless steel, ASTM A666 flange onto each end of pipe.
            a) Drill 1 IN hole in flange to match pipe.
            b) Attach sleeve to concrete or masonry back-up with 1/4 IN concrete screw anchors.

3) Grout solid, area around bolt where bolt penetrates veneer.
4) Accurately locate sleeves to align with bolt locations on ladder.

HH. Anchor ladder to metal stud walls using minimum 1/2 IN stainless steel bolts, nuts and washers.
1. Verify that stud wall has been provided with adequate backing to accept ladder anchors.

II. Install ladder safety extension post in accordance with manufacturer's instructions.
1. Mount device opposite the climbing side.
2. Provide ladder safety extension device for all ladders unless noted otherwise.

JJ. Mount ladder fall protection system with rail offset from ladder side rail approximately 3 IN.

KK. Install factory pre-fabricated stairs in location indicated in the Contract Documents and approved submittals.

3.3 FIELD QUALITY CONTROL

A. Tolerances shall meet structural requirements of Specification Section 05 12 00 for erecting items of structural nature.

B. Tolerances (unless otherwise noted on the Drawings):
1. Frame placement, after assembly and before welding or tightening.
a. Deviation from plumb, level and alignment: 1 IN 500, maximum.
b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.

C. Owner Pays for Field Inspection and Testing:
1. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with this Specification Section.
2. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
3. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

3.4 CLEANING

A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.

B. All stainless steel products in addition to Paragraph A. above:
1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.

C. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09 96 00.

END OF SECTION

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# SECTION 06 10 00
# ROUGH CARPENTRY

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Rough carpentry.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.
   3. Section 03 15 19 – Anchorage to Concrete
   4. Section 07 54 19 - PVC Membrane Roofing - Fully Adhered.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. The Engineered Wood Association (APA):
      a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.
      b. U450, Storage and Handling of APA Trademarked Panels.
      c. Y510, Plywood Design Specification.
   2. ASTM International (ASTM):
      a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      b. D153, Standard Test Methods for Specific Gravity of Pigments.
      c. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
      d. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
      e. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
      f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. American Wood Protection Association (AWPA):
      a. M2, Standard for Inspection of Preservative Treated for Industrial Use.
      b. M3, Standard for the Quality Control of Preservative Treated Products for Industrial Use.
      c. M4, Standard for the Care of Preservative-Treated Wood Products.
      d. P5, Standard for Waterborne Preservatives.
      e. U1, Use Category System: User Specification for Treated Wood.
   4. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
      a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
   5. Environmental Protection Agency (EPA).
   6. FM Global (FM):
      a. 1-49, Property Loss Prevention Data Sheets - Perimeter Flashing.
   7. National Institute of Standards and Technology (NIST):

a. PS 1, Quantitative NMR (Benzoic Acid).
b. PS 20, American Softwood Lumber Standard.
8. Underwriters Laboratories, Inc. (UL):
a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.

B. Qualifications:
1. Wood Treatment Plant: AWPA M3.
2. Treated Wood Inspection: AWPA M2.

C. Miscellaneous:
1. Factory marking:
a. Lumber:
1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.
2) Marking may be omitted, as allowed by the building code, if certificate of inspection is provided for each shipment.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Fabrication drawings of all fabricated items.
3. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions for all products specified.
4. Certifications:
a. Chemicals used in treatment process are registered with and approved by EPA.
b. Moisture content of material prior to treatment: 25 PCT maximum.
c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
5. Documentation of treatment of treated material in accordance with standards referenced.

1.4 DELIVERY AND STORAGE

A. Delivery, storage and handling of untreated wood products:
1. Lumber: As recommended by the grading agency indicated on the grade stamp.
2. Plywood: APA U450.

B. Delivery, storage, handling and disposal of treated wood products: AWPA M4.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:
1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
a. NIST PS 20.
1) Treated material: As indicated in the appropriate AWPA standard.
a) Provide species of FRTM as necessary to achieve UL rating listed.
b. Grade:
1) For nominal sizes up to and including 2 x 4: Standard and better.
2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.
2. Non-structural plywood:
a. NIST PS 1.
b. ~~[~~C-C~~] [C-D]~~ plugged:
1) Exposure: ~~[~~EXT~~]~~ [EXP1] [INT].
2) Thickness: ~~[1/2 IN.] [~~5/8 IN. unless otherwise noted.~~]~~ ~~[3/4 IN.] [As indicated on Drawings.]~~
3) Touch sanded.
3. Moisture content:
a. Prior to treatment: 25 PCT.
b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
1) Lumber: 19 PCT maximum.
2) Plywood: 18 PCT maximum.
4. Preservative:
a. Waterborne: AWPA P5.
b. As indicated in the appropriate AWPA standard.
5. Pressure-treat material in accordance with AWPA U1.
6. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.

B. Fire-Retardant Treated Material (FRTM):
1. Acceptable manufacturer:
a. Hoover Treated Wood Products, Inc.:
1) Interior: "Pyro-Guard".
2) Exterior: "Exterior Fire-X".
2. Maximum moisture content:
a. Prior to treatment: 25 PCT.
b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
1) Lumber: 19 PCT (KDAT).
2) Plywood: 15 PCT (KD-15).
3. Fire-retardant preservative:
a. Provide protection against decay:
1) EPA registered for use as a wood preservative.
b. Shall not bleed-through or adversely affect bond of any finish.
4. Pressure-treat material in accordance with AWPA U1.
5. UL Classified:
a. FR-S, UL 723.
b. Exterior: No increase in classification when subjected to the Standard Rain Test, ASTM D2898.
c. Provide UL mark on each piece of FRTM.
6. Maximum flame spread rating: 25, ASTM E84.

7. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.

C. Fasteners and Anchors:
1. Nails and screws:
a. Dry, non-corrosive exposure: Hot dipped galvanized meeting ASTM D153 or Type 304 stainless steel.
b. Wet, corrosive, marine, and/or below grade: Type 316 stainless steel.
2. Adhesive anchors, expansion anchors, self-tapping concrete anchors, bolts, nuts, and washers: See Specification Section 03 15 19.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify measurements, dimensions, and shop drawing details before proceeding.

B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.

C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

3.2 ERECTION AND INSTALLATION

A. General:
1. Provide preservative treated material for all wood used:
a. Outside building.
b. Below grade.
2. Provide fire-retardant treated material for all wood used:
~~a. Inside building.~~
~~b. Exterior building walls.~~
~~c.~~a. Roof construction.
~~d. Parapet walls.~~
~~e.~~b. Roofing nailers.

B. Attach work securely by anchoring and fastening as indicated or required to support applied loading.
1. Anchor wood to concrete using adhesive or expansion anchors as specified in Specification Section 03 15 19.
a. Separate wood from direct contact to concrete with polyethylene foam gasket strip.
1) Size: 1/4 IN by width of wood member.
2) Owens Corning "SillSealR".
2. Anchor wood to metal using bolts and nuts as specified in Specification Section 03 15 19.
3. Provide flat washers under all bolt heads and nuts.
4. Fasten plywood in accordance with APA recommendations.
5. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
6. Install fasteners without splitting of wood; predrill as required.
7. Do not drive threaded friction type fasteners.
8. Tighten bolts and lag screws at installation and retighten as required.

C. Set work to required levels and lines, plumb, true.
   1. Shim as required.
   2. Cut and fit accurately.

D. Provide wood grounds, nailers, or blocking where required for attachment of other work and surface applied items.
   1. Form to shapes indicated or required.
      a. FRTM lumber:
         1) Do not rip or mill.
         2) Cross-cutting and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
         3) Resurfacing, planing or fabrication of special shapes or profiles shall be done prior to treatment.
      b. FRTM plywood:
         1) Cross-cutting, ripping and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
      c. Light sanding of FRTM as permitted by UL to remove raised grain or prepare for finishing is allowable.
      d. Field treat cuts and holes in preservative treated material in accordance with AWPA M4 and manufacturer's published recommendations.
   2. Grounds:
      a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face of ground even with finish material.
      b. Remove temporary grounds when no longer required.
   3. Install roofing nailers as necessary for attachment of flashing, curbs, fascia, coping, and related accessories:
      a. Match height of nailers to insulation.
      b. Anchor nailers to resist force of 300 PLF unless required otherwise by FM Global or roofing manufacturer.
         1) Metal decking attachment:
            a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304 stainless steel hex head bolts with nuts and washers.
            b) Countersink heads of bolts flush with top of nailer.
         2) Concrete decking attachment:
            a) Attach base nailer to concrete roof deck using minimum 3/8 IN stainless steel adhesive anchors with minimum 3 IN embedment.
            b) Countersink heads of bolts flush with top of nailer.
         3) Provide size and spacing of anchorage as required to meet loading criteria specified.
            a) Fasten blocking for perimeter flashing in accordance with ANSI/SPRI ES-1 and FM Global 1-49.
      c. Provide 1/2 IN vent spaces between lengths of nailers.
      d. Install nailers over vapor retarder.

E. When wood has been exposed to moisture allow to completely dry out prior to covering with additional wood or another material.

F. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.

END OF SECTION

# SECTION 07 62 00
# SHEET METAL FLASHING AND TRIM

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Flashing and Sheet Metal, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. ASTM International (ASTM):
1. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
3. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate
4. ASTM B221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
5. ASTM B308/B308M Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
6. ASTM F2329/F2329M Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

B. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
1. Architectural Sheet Metal Manual

### 1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
1. For each type of material and accessory.

C. Shop Drawings:
1. Dimensioned drawings of profiles and shapes.
2. Plans and elevations to show locations of each shape.

D. Samples:
1. For finish, color and color range selection.

E. Contract Closeout Information:
1. Warranty

### 1.4 WARRANTY

A. Furnish 20 year finish warranty on PVDF coated sheet metal, covering color, fade, chalking and film integrity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Formed Sheet Metal:
   1. Base:
      a. Ryerson Metals, ColorKlad.
   2. Optional:
      a. Berridge Manufacturing Company.
      b. Petersen Aluminum, PAC-CLAD.

B. Other materials:
   1. Base:
      a. Manufacturers as noted.

C. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Sheet Metal – Galvanized Steel with PVDF coating.
   1. ASTM A653/A653M galvanized steel, Z275 G90.
   2. Minimum thickness: 0.024 IN 0.6 MM or as noted for individual fabrications.
   3. Smooth
   4. PVDF coating: Minimum 1 MIL 0.025 MM fluorocarbon coating, 70 PCT PVDF.

2.3 SHEET METAL FABRICATIONS

A. Formed Roof Edge Flashing:
   1. Fabricate to size and profile indicated.
   2. Supply sections with minimum length of 96 IN 2440 MM, but not exceeding 10 FT 3 m.
   3. Joint Style:
      a. 1/4 IN 6 MM Butt Joint with 6 IN 150 MM wide, exposed cover plate
      b. Fabricate to dimensions indicated. Include a minimum 4 IN 100 MMwide flanges on 3 sides for embedment into roofing system.

| Hanging Gutters - Minimum Sheet Thickness / Weight | | | | |
|---|---|---|---|---|
| Material | Gutter Girth | | | |
| | **up to 20 IN**<br>up to 520 MM | **21 to 25 IN**<br>521 to 650 MM | **26 to 30 IN**<br>651 to 770 MM | **31 to 35 IN**<br>771 to 890 MM |
| PVDF coated Galvanized Steel | 0.024 IN<br>0.61 MM | 0.034 IN<br>0.864 MM | 0.040 IN<br>1.016 MM | 0.052 IN<br>1.132 MM |
| PVDF coated Galvanized Steel | 0.040 IN<br>1.016 MM | 0.050 IN<br>1.27 MM | 0.063 IN<br>1.6 MM | - |
| PVDF coated Galvanized Steel | 0.019 IN<br>0.483 MM | 0.025 IN<br>0.635 MM | 0.031 IN<br>0.787 MM | 0.038 IN<br>0.965 MM |

   4.

2.4 ACCESSORIES

A. Fasteners:

1. Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by flashing manufacturer.
2. Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
3. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
4. Blind Fasteners: High strength aluminum or stainless steel rivets suitable for metal being fastened.

5. Fastener Materials:
   a. Fasteners for Galvanized Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329/F2320M.

B. Cleats:
   1. 16 GA 1.6 MM galvanized or stainless steel.

C. Dissimilar metal and cementitious materials protection:
   1. Alkali resistant bituminous paint.
   2. Tnemec TnemeTar 46-413.

D. Base Flashing:
   1. Fabricate to size and profile indicated.

E. Sealants: Specified in Section 07 92 13.

2.5 FABRICATION

A. General:
   1. Fabricate true and sharp to profiles and sizes indicated.
   2. Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA Architectural Sheet Metal Manual, that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated.
   3. Shop fabricate items to greatest extent possible.
   4. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   5. Form sheet metal flashing and trim without oil canning, buckling, and tool marks, true to line and level indicated, with exposed edges folded back to form hems.
   6. Conceal fasteners and expansion provisions where possible. Exposed fasteners not allowed on faces exposed to view.

B. Fabrication Tolerances:
   1. Fabricate sheet metal flashing and trim to tolerance of 1/4 IN per 20 FT 6 MM per 6 M on slope and location lines as indicated and within 1/8 IN 3 MM offset of adjoining faces and alignment of matching profiles.

C. Sealed Joints: Form movable joints in metal to accommodate elastomeric sealant.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 IN 25 MM deep. Fill with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA Architectural Sheet Metal Manual for application, but not less than thickness of metal being secured.

G. Seams in metals with painted, coated or lacquered finishes:
   1. Fabricate nonmoving seams with flat-lock seams.
   2. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

H. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Verify suitability of substrates to accept work.
   1. Verify continuous wood blocking sloped 1:12, and covered with one layer of building paper or roofing membrane.

B. Installation constitutes acceptance of conditions and responsibility for performance.

3.2 INSTALLATION - GENERAL

A. Install in accordance with details and recommendations of SMACNA, current edition.

B. Set shop fabricated interior and exterior preformed corners and intersections.

C. Set top edges of flashings into reglets as indicated.

D. Fasten materials at recommended intervals.

E. Provide slip joints to allow for thermal movement.
   1. Use SMACNA Table 3-1, Design J9 - J12, with caulked lap.
   2. Maximum spacing: 10 FT 3 M on center.
   3. Provide slip joint in conjunction with splices and corners.

F. Caulk joints with 2 beads of sealant on each overlap: See Section 07 92 13.

G. Turn down cap flashing over base flashings 4 IN 100 MM and caulk.

H. Form flashings to provide spring action with exposed edges hemmed or folded.

I. Provide dissimilar metals and materials protection where dissimilar metals come in contact, or where sheet metal contacts mortar or concrete.

J. Provide miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.

3.3 CLEAN-UP

A. Upon completion of work, repair damaged areas.

B. Repair finish of PVDF coated flashing which fades or is damaged.

C. Clean stains and debris.

D. Remove protective coverings.

END OF SECTION

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# SECTION 07 92 13
# EXTERIOR JOINT SEALANTS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Exterior Joint Sealants, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Caulk and Caulking are synonymous with sealant work.

B. Paving Joints include joints in floor slabs, sidewalks, steps, ramps and curbs.

C. Seal joints which would otherwise permit penetration of moisture or air, unless sealant work is specifically required under other Section.

D. Provide sealant at following locations:
   1. Isolation joints.
   2. Joints between paving or sidewalks and structures.
   3. Joints between dissimilar materials, to provide visually acceptable closures.
   4. Other joints where caulking, or sealant is indicated.

E. ASTM International (ASTM):
   1. ASTM C510 Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealants
   2. ASTM C920 Standard Specification for Elastomeric Joint Sealants
   3. ASTM C1193 Standard Guide for Use of Joint Sealants

### 1.3 SUBMITTALS

A. Shop Drawings:
   1. Sealant Schedule with the following information:
      a. List type of sealant and name of product proposed for each location.
      b. Include a blank Color Column on schedule for selection.
      c. Architect to complete Color Column upon selection from submitted samples.

B. Product Data:
   1. Performance characteristics and limitations.
   2. Recommended installation.

C. Samples:
   1. Cured sample of each color. Submit with Sealant Schedule.

D. Contract Closeout Information:
   1. Warranty.

1.4 WARRANTY

A. Provide written warranty that sealant work will remain free of defects for a period of three (3) years from Date of Substantial Completion:
   1. Failure of water or air tightness constitutes defect.
   2. Loss of adhesion, cohesion or failure to cure constitutes defect.
   3. Remove defective work and materials and replace with new work and materials.
   4. Non- prorated warranty to include labor and material.
   5. Warranty signed by Installer, Contractor, or both.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Silicone Sealant:
   1. Base:
      a. Tremco.
      b. Dow Performance Silicones.
   2. Optional:
      a. Pecora.
      b. GE Silicone by Momentive Performance Materials.
      c. BASF Master Builders Solutions.
      d. Bondaflex Technologies.

B. Polyurethane Sealants:
   1. Base:
      a. Tremco.
   2. Optional:
      a. Pecora.
      b. BASF Master Builders Solutions.
      c. Sika.
      d. Bondaflex Technologies.

C. Silyl Terminated Polyether (STPE) Sealant:
   1. Base:
      a. BASF Master Builders Solutions.
   2. Optional:
      a. Pecora.
      b. GE Sealants by Momentive Performance Materials.

D. Other Sealants:
   1. Base: As indicated.

E. Pre-molded Compressible Sealant:
   1. Base:
      a. Emseal.
   2. Optional:
      a. Tremco
      b. Construction Specialties, (C/S).

2.2 MATERIALS

A. Elastomeric Sealants:
   1. ASTM C920 Type S or M, Grade-NS at vertical joints, Grade-P or –NS at horizontal joints, minimum Class as scheduled.
   2. Non-staining sealant complying with ASTM C510.

3. Where sealant is not exposed to view, use manufacturer's standard color which has best performance.
4. Use non-sag sealant in vertical joints.
5. Use self-leveling or non-sag sealant in horizontal joints.
6. Before use of sealant, investigate its compatibility with surfaces, fillers and other materials in joint system.
7. Refer to Sealant Selection Guide for Base Products.
8. Comply with VOC limits as required by local laws.
9. VOC content no greater than 250 g/L.

B. Sealants:
1. JS-1: Urethane Architectural Sealant
   a. Two part, non-sag, movement capability plus/minus 50 PCT.
   b. ASTM C920, Type M, Grade NS, Class 50.
   c. Base Product: Tremco Dymeric 240FC.
2. JS-2: Urethane Self Leveling Paving Sealant; Traffic Bearing
   a. Two part, movement capability plus/minus 25 PCT.
   b. ASTM C920, Type M, Grade P, Class 25. USDA approved.
   c. Base Product: Tremco THC-900.
3. JS-3: Urethane Non-Sag Paving Sealant, Slope Grade; Traffic Bearing
   a. Movement capability plus/minus 25 PCT.
   b. ASTM C920, Type S or Type M, Grade NS, Class 25.
   c. Base Product: Tremco Vulkem 116.
4. JS-4: Silicone Architectural Sealant
   a. One part, movement capability plus 100 PCT minus 50 PCT.
   b. ASTM C920, Type S, Grade NS, Class 100/50.
   c. Base Product: Tremco Spectrem 1.
5. JS-8: Pre-compressed Expanding Foam Sealant
   a. Movement capability of plus/minus 25 PCT.
   b. Color: Black.
   c. Base Product: Emseal 25V Expanding Foam Sealant.
6. JS-9: Pre-compressed Expanding Foam Sealant
   a. High density polyurethane, impregnated with polymer modified acrylic and faced with factory applied silicone.
   b. Movement capability plus/minus 25 PCT.
   c. Base Product: Emseal ColorSeal.

C. Pre-molded Compressible Sealant:
1. Foam backing: Multiple layers of acrylic-impregnated, expanding foam sealant and closed-cell (EVA) foam.
2. Weather Facing: Low-modulus silicone with bellows profile.
3. Movement capability: +/-50 PCT movement, 100 PCT total.
4. Material to be sized appropriately for joint widths indicated.
5. Select color from manufacturer's standard line.
6. Base Product: Seismic ColorSeal by Emseal.

D. Compressible Backer:
1. Foam backing with multiple layers of acrylic-impregnated, expanding foam sealant.
2. Provide behind conventional backer-rod and sealant where indicated.
3. Movement capability: +/- 25 PCT movement, 50 PCT total.
4. Material to be sized appropriately for joint widths indicated.
5. Base Product: Backerseal by Emseal.

E. Installation Adhesive:

1. As recommended by manufacturer of compressible sealants and backers.
2. Comply with VOC limits as required by local laws.

F. Epoxy Sealant:
1. VOC content shall be no greater than 250 g/L.

G. Joint Cleaner, Primer, Bond Breaker:
1. As recommended by sealant manufacturer.
2. Sealant primers for nonporous surfaces as recommended by manufacturer with a VOC content no greater than 250 g/L.
3. Sealant primers for porous surfaces as recommended by manufacturer with a VOC content no greater than 775 g/L.

H. Backer Rod:
1. Polyethylene, polyethylene jacketed polyurethane foam, flexible, non-absorbent, non-bituminous material recommended by sealant manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation of joint sealants under following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 DEGF 4.4 DEGC.
2. When joint substrates are wet.

B. Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Apply only to joints free of material which may inhibit bond.

D. Apply to cementitious materials only when thoroughly cured and dry.

3.2 PREPARATION

A. Clean joints and prime as required by sealant manufacturer.

B. Install sealant after finish coating or covering is scheduled to be applied.

C. Limit application to surfaces to receive sealants and mask edges of joints to protect adjacent surfaces.

3.3 INSTALLATION

A. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Control joint depth.
2. Break bond of sealant at bottom of joint.
3. Provide proper shape of sealant.
4. Do not leave gaps between ends of sealant backings.
5. Do not stretch, twist, puncture, or tear sealant backings.
6. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

B. Make depth of sealant not more than one-half width of joint, but not less than 1/4 IN 6 MM.

C. Sub-caulk joints without suitable backstop, to proper depth.

D. Install correctly sized backer rods.

E. Apply bond breaker as required or recommended by sealant manufacturer.

F. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

G. Make joints water and air tight.

H. Install sealants using proven techniques that comply with the following and at same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

I. Tooling of Non-sag Sealants:
   1. Tool immediately after sealant application and before skinning or curing begins, to form smooth, uniform beads, eliminate air pockets, and ensure contact and adhesion of sealant with sides of joint.
   2. Remove excess sealant adjacent to joints as the Work progresses with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.
   3. Use tooling agents that are approved by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   4. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.

J. At traffic joints, slightly recess sealant to avoid direct contact with wheeled traffic.

3.4 SEALANT USAGE GUIDELINES

| Guide to Sealant Types - Exterior | | | | |
|---|---|---|---|---|
| Location | Materials | Sealant Type | Base Product | Remarks / Exceptions |
| General Exterior | Cast in Place Concrete<br><br>Portland Cement Plaster<br> | Multi-part Polyurethane, chemically curing, epoxidized | Tremco Dymeric 240FC | Exception: Use Dymonic where used as bedding sealant for frames, sills, thresholds etc. |
| | <br>Joints in materials with high coefficients of linear expansion<br> | Silyl Terminated Polyether (STPE) | MasterSeal NP150 | -- |
| | <br> | Silicone or Silyl Terminated Polyether (STPE) | Tremco Spectrem 1 or Spectrem 3 or MasterSeal NP150 | -- |

| Guide to Sealant Types - Exterior | | | | |
|---|---|---|---|---|
| Location | Materials | Sealant Type | Base Product | Remarks / Exceptions |
| | | Silicone or Silyl Terminated Polyether (STPE) | Tremco Spectrem 3 or MasterSeal NP150 | Exception: Pre-test for staining potential per ASTM C1248, with stain-sensitive stone Note: MasterSeal will not stain. |
| | | | | |
| | | | | |
| | | | | |
| | | Secondary Seal: Silicone | Dowsil 982 | -- |
| | | | | |
| | | | | |
| | | | | |
| Exterior Flatwork | Concrete Paving and Parking Structures | Multi-part Polyurethane | Tremco THC 900 / 901 | Exception: Where subject to continual water emersion; use Vulkem 45 or 245 |
| | Concrete Walks | | | |
| | | | | |
| | | | | |

**Notes**
1. The above is intended to be an overall guide. Additional conditions and materials may be required. Notify Architect if additional Guidance is required to select unlisted items.
2. Optional sealant products shall offer same number of color choices as the Base Product listed.
3. All of the conditions and materials listed may not apply to subject project.

3.5 SCHEDULE

A. JS-2: Exterior paving joints, level.

B. JS-3: Exterior paving joints, sloping.

C. JS-4: Other Exterior joints except paving.

D. JS-8: Primary or secondary seal in concrete joints.

E. JS-9: Primary seal in metal substrates , or concrete joints.

END OF SECTION

# SECTION 09 67 75
# CONCRETE STAIN (CS)

## PART 1 -GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Concrete Stain (CS), as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Applicator's Qualifications:
   1. Company specializing in performing work of this Section approved by manufacturer for application, with three (3) years minimum experience and 5 successful chemically stained concrete projects.

B. Test Requirements:
   1. Test concrete for water vapor emission levels as recommended by manufacturer.
   2. Test concrete for proper absorbency as recommended by manufacturer.

### 1.3 SUBMITTALS

A. Product Data:
   1. Including chemical properties and percentage of solids, for each product.

B. Samples:
   1. 3 IN x 5 IN 75 MM x 125 MM samples of manufactures’ full line for Architect’s selection of color specified in Drawing Finish Schedule.

C. Project Information:
   1. Manufacturer's Instructions:
      a. Application instructions, including surface preparation and application rates for each type of substrate, methods, and techniques.

D. Contract Closeout Information:
   1. Maintenance data:
      a. See Section 01 78 23.
   2. Maintenance materials:
      a. See Section 01 78 43.
   3. Certificates:
      a. Submit manufacturer's certificate stating proper amount of materials was ordered and shipped to Project.
      b. Submit sealer manufacturer's certificate indicating review of project conditions and intent to issue warranty.
      c. Submittal of certificate is required prior to application of materials.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Concrete Stain and related materials:
   1. Base:
      a. LM Scofield.
   2. Optional:
      a. QC Construction Products.
      b. InCrete Systems.
      c. Triple S Chemical Products.
      d. Symons Corporation.
      e. Kemiko Concrete Floor Stain.

B. Floor Polish:
   1. Base:
      a. Lithochrome Colorwax.

C. Other manufacturers desiring approval comply with Section 01 61 00

### 2.2 MATERIALS

A. Colored Chemical Stain:
   1. Acidic water-based solution of metallic salts.
   2. Base Product: Scofield, Lithochrome Chemstain.
   3. Color: To be selected by Architect.

B. Clear Sealer:
   1. Base Product: Cementone Clear Sealer or CureSeal by Scofield.
   2. Color: Clear.

C. Floor Polish:
   1. Compatible, commercial floor polish.
   2. Base Product: Johnson Wax.

D. Protective Wet Cure Paper: Reinforced 2 ply laminated Kraft paper.
   1. Base Product: Transguard 4000 or approved.

E. Joint Sealant:
   1. Traffic bearing urethane sealant specified in Section 07 92 13 / Exterior Sealants.
   2. Color: Match stained concrete.
   3. Install as specified in Section 07 92 13 / Exterior Sealants.

F. Provide additional materials, equipment, and personnel required to achieve specified finish.

## PART 3 - EXECUTION

### 3.1 CONCRETE CURING

A. Apply materials in compliance with manufacturer's printed instructions.

B. Provide mechanical ventilation during and after application to dissipate fumes if natural ventilation is insufficient.

C. Identify areas of concrete on Project which are scheduled to receive Concrete Stain.

D. Do not use liquid curing materials on concrete which is scheduled to be stained.

E. Cure concrete flatwork, scheduled to be stained, with new and unwrinkled, non-staining, high-quality curing paper:
   1. Avoid overlapping curing paper when possible, since the color may appear different under the overlapped sections.
   2. Cure surfaces by same method.
      a. Chemically stain when areas of concrete are same age.

3.2 INSPECTION

A. Examine conditions and proceed with work.

B. Repair damage and defects in concrete surface as specified in Section 03 35 00 and obtain acceptance by Architect.

C. Verify that surfaces are clean, dry, dust free, and free of efflorescence, oil or other matter detrimental to stain application.

D. Ensure concrete has cured for time period required by manufacturer of product to be applied before application of products.
   1. Minimum cure time: 14 days.
   2. Exception: On Interior applications where certain colors are specified, concrete must be cured to meet moisture vapor emission requirements.

3.3 PREPARATION

A. General:
   1. Prepare surfaces in accordance with manufacturer's directions.
   2. Provide protection as necessary to protect adjacent materials and surfaces from dirt, dust, and other surface or physical damage.
   3. Prevent migration of airborne materials by use of tarpaulins, windbreaks, and similar containment devices.
   4. Maintain control of concrete chips, dust and debris.
      a. Collect water to prevent damage to adjacent surfaces.
   5. Provide protection as necessary to protect adjacent materials and surfaces from dirt, dust, spillage, overspray and other surface or physical damage.

B. Mechanical Preparation:
   1. Remove loose particles and foreign matter by method, which will not affect stain application.
   2. Concrete previously coated with liquid curing materials, paints, coatings, adhesives, waxes, or water repellants, or surfaces that cannot be successfully cleaned by other methods must be abrasive blasted, or other methods approved by manufacturer.
      a. Sand remaining on the surface should be removed by sweeping or by pressure washing before the concrete is chemically stained.
      b. Where abrasive blasting is required, control dust so as not to affect occupied areas.
   3. Ensure concrete is cured and remove residue and effects of curing compounds which would inhibit stain penetration of the bonding of fill materials.

C. Cleaning:
   1. Soil, form oil, plaster stains, oil, and grease must be completely removed.
   2. Acid washing shall not be used as a cleaning procedure.
   3. Horizontal or vertical concrete:
      a. Pressure wash equip with fan tip and minimum pressure of 2000 PSI 14 MPa.
      b. Hot water may facilitate cleaning of existing concrete.
      c. Utilize non-marking hoses.
      d. Rinse surface after cleaning until the rinse water is completely clean.

3.4 APPLICATION - STAIN

A. Stain Color Separation Lines:
   1. Where one stain color is separated from another stain color in field of area to be stained, saw cut structural slab to a depth of 1/4 IN 6 MM to establish a uniform straight line to terminate each application of stain color.
   2. Clean floor of dust and debris caused by saw cutting operations.

B. Protect adjacent surfaces not indicated to receive stain and to separate different stain colors during application.

C. Apply concrete stain in accordance with manufacturer's installation instructions to match approved mock-ups.

D. Apply stain in number of coats indicated to match the mock-up.
   1. Minimum 2 coats.
   2. Apply un-diluted, and at a rate of approximately 75-100 Gal 285-380 L per application, or as per manufactures recommendations.
   3. Apply additional coats for older, harder concrete substrates as required to match mock-up.

E. Review each successive stain application with Architect prior to proceeding with next step.

F. Avoid application during extreme weather conditions.
   1. More material or additional applications to produce desired results in hot, dry, and windy weather.
   2. Rain will wash chemical stain from the surface prematurely and runoff may stain adjacent areas or damage landscaping.

3.5 APPLICATION - SEALER AND JOINT SEALANTS

A. Sealer:
   1. Seal concrete after chemically stained, rinsed, and allowed to dry completely.
   2. Apply 2 coats of sealer in accordance with manufacturer's recommendations.
   3. Apply coats to prevent milky appearance.
   4. Maintain uncovered for minimum 24 HRS.

B. Joint Sealants:
   1. Apply joint sealants.
   2. Install utilizing proper sealant design as described in Section 07 92 16.

3.6 APPLICATION - FLOOR POLISH

A. Floor Polish:
   1. Provide at interior floor surfaces only.
   2. Once sealants and protective coatings have cured, and stain system has been visually approved by Architect, apply recommended floor polish to protect finish from remaining construction activities.
   3. Cover with protection as described in Cleaning and Protection.
   4. Prior to Occupancy, remove protection and re-apply floor polish where needed.

3.7 CLEANING AND PROTECTION

A. Clean up and remove debris daily.

B. Remove spillage, over spray, or drift from adjacent surfaces immediately in accordance with manufacturer's instructions.

C. Protect finished concrete surfaces from damage by construction equipment, operations and from adverse weather conditions.
   1. Areas subject only to foot traffic:
      a. Lay down Protective Wet Cure Paper, lapped and sealed at joints and edges.
   2. Areas subject to rolling trucks, dollies and other equipment:
      a. In addition to above, such areas shall be further protected by continuous Masonite board runways.
      b. Coordinate designation of such areas.
      c. Enforce policy that other trades utilize only the designated protected areas for construction and move-in traffic.

D. Remove protective covering paper when directed.

END OF SECTION

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# SECTION 09 91 13
# EXTERIOR PAINTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Exterior Painting, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Definitions:
1. "Paint" and "painting" refer to applied coatings.
2. Mechanical work and equipment: Work included in Mechanical Specification Divisions.
3. Electrical work and equipment: Work included in Electrical Specification Divisions.

B. Work Included:
1. Exterior surfaces scheduled to be painted, unless indicated to be painted under other sections.
2. Exposed exterior and on-site concrete masonry unit surfaces, including areaway walls, backside faces of parapets, screen walls, and retaining walls.
3. Mechanical and electrical work:
   a. Exterior equipment and items not completely factory finished.

C. Surfaces not to be painted:
1. Colored, split-face, patterned, ground-face, glazed, and other concrete masonry units with integral architectural finish.
2. Anodized aluminum, stainless steel, chromium plate, glass, copper, bronze or similar materials.
3. Moving parts of valves, operating units, mechanical and electrical parts, such as valve and damper operators, sending devices, motor and fan shafts.
4. Code labels, such as UL, FM that are Mylar or flat, non-embossed, plates.
   a. Embossed plates and labels stamped into frames will be painted, label and information on label to be readily visible and convenient for identification by authority having jurisdiction.
5. Equipment identification or rating plates.
6. Items having complete factory finish with exception of:
   a. Exterior mechanical equipment.
   b. Exterior electrical equipment.

### 1.3 SUBMITTALS

A. Product Data:
1. Manufacturer's data for each paint type to be applied indicating conformance to specifications.

B. Samples:

1. Manufacturer’s full palate of colors for selection by Architect.
2. Provide three 8 1/2 IN x 11 IN samples of each color and finish selected.
3. MPI Gloss samples.

C. Contract Closeout Information:
1. Maintenance data:
a. See Section 01 78 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide paint as product of one manufacturer as far as possible.

B. Paint, stain, and coating systems listed are Sherwin Williams unless noted otherwise.
1. Use comparable performance and aesthetic requirements for Paints by Optional manufacturers.

C. Paints:
1. Base:
a. Sherwin-Williams.
2. Optional:
a. Benjamin Moore.
b. PPG Paints.

D. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Paints and Stain Systems:
1. Paint, stain, and coating systems listed are Sherwin-Williams unless noted otherwise.
2. Colors:
a. As selected by Architect from manufacturer’s full palate and as indicated in Section 23 05 53.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine surfaces for defects and correct to prevent unsatisfactory results.

B. Verify compatibility of intermediate and topcoat finishes applied over surfaces primed by others.

C. Commencement of work constitutes acceptance of surfaces and responsibility for performance.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Clean substrates of substances that could affect appearance or impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
2. Remove mildew and neutralize surface.

C. Prior to painting, test surfaces with moisture meter.
1. Paint when moisture is within paint manufacturer's acceptable limits.

D. Wood:
1. Immediately before applying finish:
a. Sand surfaces with 180 grit or finer sandpaper, as necessary to accomplish the following:
1) Smooth surface texture.
2) Prepare grain to receive finish.
b. Remove dust.
2. Opaque Finishes:
a. After priming coat has dried, seal knots, pitch and resinous sapwood.
3. Stained and Clear Finishes:
a. Treat wood with compatible wash-coat prior to stain application.
b. Putty nail holes and minor defects, to match wood color.

E. Ferrous Metal and Hollow Metal:
1. Follow requirements of SSPC SP1 and SP3.
a. Except where higher prep levels are indicated.
2. Wire brush, or grind as necessary to remove shoulders at edge of sound paint to prevent telegraphing.
3. Touch up damaged shop coats.
4. For surfaces with touched up shop coat, omit first coat.
5. Hollow metal frame joints at intersections of Rabbets, Stops, and Soffit Joints:
a. Neatly fill corner seam with painter's caulk (in field) prior to painting.

F. Galvanized Metal and Non-anodized Aluminum:
1. Follow requirements of SSPC SP1.
2. Treat surfaces with galvanized surface cleaner as recommended by primer and topcoat manufacturer.

G. Gypsum Wallboard:
1. Repair minor irregularities left by finishers.
2. Exercise care to avoid raising nap of paper.
3. Apply prime coat.
4. Notify gypsum wallboard finisher to repair and refinish areas which indicate defects after application of primer.
5. Re-prime refinished areas.

H. Concrete and Masonry:
1. Repair minor defects.
2. Remove oil from concrete by washing with xylol.
3. Eliminate efflorescence before painting.

I. Block Filler:
1. Apply masonry to fill pinholes and minor surface defects, and to prime surface for topcoat.
2. Apply by brush, roller or sprayer.
a. Where spray-applied: Back-roll with roller or squeegee.
3. Minimum Nominal Thickness: 10 MIL 0.25 MM DFT.

a. Comply with manufacturer’s recommended coverage rates for conditions encountered.
4. Provide complete cover with recommended coating system.

J. Obtain architect's approval of finish for surfaces to receive high build glazed coatings.

3.3 APPLICATION

A. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items, or provide ample in place protection.

B. Touch up abraded areas of shop prime coats, suction or hot spots in plaster, gypsum wallboard, concrete block, and concrete before painting.

C. Provide coverage to hide.
1. Evenly spread and smoothly flow on for full, smooth cover.
2. Apply additional coats where undercoats show until paint film is of uniform finish and color.

D. Back prime wood trim with penetrating sealer.

E. Apply additional coats in accordance with manufacturer’s instructions.

F. Finish closets and semi-exposed surfaces to match nearest adjoining surfaces.
1. Include surfaces behind grills.

G. Upon completion of painting, replace removed items and remove protection.

H. Finish colors not indicated shall be selected by Architect from paint manufacturer’s standard colors.

3.4 PROTECTION AND CLEANUP

A. Provide WET PAINT signs.

B. Protect adjacent work from damage by painting and finishing work.

C. Remove temporary protective wrappings, after completion of operations.

D. Clean, repair or replace, and repaint damaged work.

3.5 EXTERIOR PAINT SYSTEMS

A. Concrete, Concrete Block and GFRC:
1. Latex, Gloss Level 4, Satin:
a. Sherwin-Williams:
1) Prime coat: Loxon Concrete and Masonry Primer.
2) Topcoat: Duration Exterior Acrylic Latex, Satin.
2. Elastomeric, smooth:
a. Sherwin-Williams:
1) Prime coat: Loxon Concrete and Masonry Primer.
2) Intermediate coat: ConFlex XL Elastomeric High Build Coating, Smooth.
3) Topcoat: ConFlex XL Elastomeric High Build Coating, Smooth.
3. Elastomeric, textured:
a. Sherwin-Williams:

1) Prime coat: Loxon Concrete and Masonry Primer.
2) Intermediate coat: ConFlex XL Elastomeric High Build Coating, Smooth.
3) Topcoat: ConFlex XL Texture Elastomeric High Build Coating, Medium.

4. Waterproof:
a. Sherwin-Williams:
1) Prime coat: Loxon Block Surfacer, as needed, or Loxon Conditioner, as needed.
2) Intermediate coat: Loxon XP Waterproofing System.
3) Topcoat: Loxon XP Waterproofing System.

B. Plaster:
1. Elastomeric, smooth:
a. Sherwin-Williams:
1) Prime coat: Loxon Concrete and Masonry Primer.
2) Intermediate coat; ConFlex XL Elastomeric High Build Coating, Smooth.
3) Topcoat: ConFlex XL Elastomeric High Build Coating, Smooth.

2. Elastomeric, textured:
a. Sherwin-Williams:
1) Prime coat: Loxon Concrete and Masonry Primer.
2) Intermediate coat: ConFlex XL Elastomeric High Build Coating, Smooth.
3) Topcoat: ConFlex XL Textured Elastomeric High Build Coating, Medium.

C. Direct-Applied Exterior Finish System (DEFS) Soffits:
1. Latex, Gloss Level 4, Satin:
a. Sherwin-Williams:
1) Prime coat: Loxon Concrete and Masonry Primer.
2) Intermediate coat: Duration Exterior Acrylic Latex, Satin.
3) Topcoat: Duration Exterior Acrylic Latex, Satin.

D. Metal Doors, Frames and Miscellaneous Metals - Ferrous, Primed, Zinc-coated, and Aluminum:
1. Water based urethane, Gloss Level 4, Satin:
a. Sherwin-Williams:
1) Prime coat: Pro Industrial Pro-Cryl Universal Acrylic Primer.
2) Intermediate coat: Waterbased Acrolon 100 Urethane, Satin.
3) Topcoat: Acrolon 100 Urethane, Satin.

E. Metal Stairs, Handrails, and Guardrails - Ferrous, Primed, Zinc-coated, and Aluminum:
1. Water based urethane, Gloss Level 6, Gloss:
a. Sherwin-Williams:
1) Prime coat: Pro Industrial Pro-Cryl Universal Acrylic Primer.
2) Intermediate coat: Waterbased Acrolon 100 Urethane, Gloss.
3) Topcoat: Waterbased Acrolon 100 Urethane, Gloss.

END OF SECTION

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# SECTION 09 96 23
# GRAFFITI-RESISTANT COATINGS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Graffiti – Moisture Protection Surface Sealer, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

C. Intended for concrete surfaces.

### 1.2 QUALITY ASSURANCE

A. ASTM D2369 Standard Test Method for Volatile Content of Coatings.

B. Applicator must be licensed by manufacturer, or approved in writing.

C. Mockup:
1. Minimum 4 FT x 4 FT area on each surface type.
2. Coordinate location with Architect.
3. Apply in accordance with Manufacturer’s recommendations and instructions.
4. Allow protective treatment cure before testing inspection.
5. Keep test panels available for comparison throughout protective treatment project.
6. Accepted test area may be included in work.

### 1.3 SUBMITTALS

A. Product Data:
1. Documentation that products submitted meet requirements of standards referenced.
2. Manufacturer's installation instructions.
3. For each type of material and accessory.

B. Contract Closeout Information:
1. Maintenance data.
   a. See Section 01 78 23.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Graffiti - Moisture Protection Surface Sealer:
1. Base:
   a. PROSOCO, Inc.
2. Optional:
   a. L&M Construction Chemicals.
   b. Hydrozo.
   c. Chemprobe.

B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Graffiti - Moisture Protection Surface Sealer:
1. Penetrating, clear, solvent-based silicone elastomer.
2. UV stable.
3. Total solids: 9 PCT minimum.
4. VOC Content: Comply with USEPA AIM VOC regulations (40 CFR 59.403).
5. Base Product: Sure Klean Blok-Guard & Graffiti Control by PROSOCO.

B. Graffiti Protection Removable Shield:
1. Clear, water-based sacrificial coating.
2. Prime as indicated for application.
3. Base product: Prosoco Sacrificial Coating SC-1.
4. Sacrificial Graffiti sealers shall have VOC content no greater than 50 g/L.
5. Non- Sacrificial Graffiti sealers shall have VOC content no greater than 100 g/L.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify suitability of substrate to accept installation.
1. Bring holes, voids, and cracks to Architect’s attention.

B. Application constitutes acceptance of substrate and responsibility for performance.

3.2 PREPARATION

A. Verify concrete is clean, dry, and absorbent, and free of fins, ridges, and voids.

B. Assure curing agents are compatible with sealer or completely removed.

C. Concrete must be cured for minimum of 28 days, with moisture content not exceeding 8 PCT.

D. Remove surface contamination by cleaning or, if necessary, by abrasive blasting.

E. Repair, holes, voids, and cracks.

F. Apply test patch.
1. If test patch indicates lack of adhesion, re-prepare surface.

3.3 APPLICATION

A. Apply in accordance with Manufacturer’s recommendations and instructions.

B. Do not apply to surfaces scheduled to receive cementitious coatings or toppings, such as concrete, terrazzo, polyester or epoxy coatings.

C. Spray Application:
1. Apply sealer wet-on-wet and saturate from bottom up, creating a 6 IN to 8 IN rundown below spray contact point.
2. Allow first application to penetrate 2 - 3 minutes.
3. Resaturate surface with sealer.

4. Spray in overlapping X-pattern to fluted surfaces to ensure coverage of recessed surfaces.
5. Reduce rundown to 4 IN to 6 IN below contact point when applying to burnished, ground face or similar smooth surfaces.

D. Brush or Roller Application:
1. Apply sufficient material to thoroughly saturate surface.
2. Avoid excessive overlapping.
3. Brush out non-penetrating heavy runs and drops.
4. Dense Surfaces:
   a. Apply a single coat to wet surface without creating drips, puddles or rundown.
   b. Do not over apply.
5. Porous Surfaces:
   a. Apply 2 coats.
   b. Apply second coat within 2 HRS of first coat, or when first coat is dry to touch.

E. Protect treated surfaces from rain for 4-6 HRS.

3.4 PATCHING AND CLEANING

A. Recoat areas which fail to match adjacent work.

B. Remove debris resulting from these operations.

END OF SECTION

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# SECTION 10 13 00
# DIRECTORIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Directories and Bulletin Boards, as indicated, in accordance with provisions of Contract Documents.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Installer Qualifications:
1. Experienced installer who is an authorized representative of the manufacturer for installation and maintenance of units required for this Project.

B. Source limitations:
1. Obtain through one source from a single manufacturer.

### 1.3 SUBMITTALS

A. Shop Drawings:
1. Include dimensional plans, elevations and details, large-scale sections of typical members, and other components. Show anchors, grounds, reinforcement and layout, and indicate finishes.
2. Include setting drawings, templates, and directions for installing anchor bolts and other anchorages to be installed as a unit of Work in other Sections.

A. Product Data:
1. Provide copies of manufacturer’s specifications and installation instructions for each type of material and accessory required.
2. Where fire resistance classification is indicated, submit copies of nationally recognized testing laboratory listings of products proposed for use.
3. Include data required to show specification compliance.

B. Samples:
1. Manufacturer's color charts showing the full range of colors and textures for board and sheet finishes.
2. Aluminum trim and accessories: 4 IN 100 MM long sections of extrusions and not less than 50 MM 2 IN squares of sheet or plate for each exposed metal surface showing available metal finishes.
3. Message strips: Samples of message strips in color selected with sample of typography indicated.

### 1.4 WARRANTY

A. Manufacturer shall warrant workmanship and materials for a period of two (2) years.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Illuminated Directories:
   1. Base:
      a. Nelson-Harkins Industries.
   2. Optional:
      a. Aarco Products, Inc.
      b. Andco Industries Corporation.
      c. Apco Graphics.
      d. ASI Sign System, Inc.
      e. Poblocki & Sons.
      f. The Tablet & Ticket Co.
      g. Vomar Products, Inc.

B. Non-illuminated Directories:
   1. Base:
      a. Nelson-Harkins Industries.
   2. Optional:
      a. Aarco Products, Inc.
      b. Apco Graphics.
      c. Andco Industries Corporation.
      d. ASI Sign Systems.
      e. Claridge Products and Equipment, Inc.
      f. Poblocki & Sons.
      g. The Tablet & Ticket Co.
      h. Vomar Products, Inc.

C. Bulletin Boards:
   1. Base:
      a. Claridge Products and Equipment, Inc.
   2. Optional:
      a. Andco Industries Corporation.
      b. Nelson-Harkins Industries.
      c. Poblocki & Sons.

2.2 PERFORMANCE REQUIREMENTS

2.3 MATERIALS

A. Aluminum Extrusions:
   1. Manufacturer's standard extruded aluminum sections with not less than the strength and durability properties specified in ASTM B221 for 6063-T5 alloy.

B. Plastic Sheet:
   1. Uncoated acrylic sheet: ASTM-D4802; Category A-1 (cell-cast sheet); Finish 1 (smooth or polished); Type UVA (UV absorbing); monolithic sheet; thickness indicated; transparent or opaque as indicated; clear or color as indicated or selected.

C. Tackboards:
   1. Natural-cork tackboards: Single-layer, 6.4 MM 1/4 IN thick, seamless, compressed fine-grain, bulletin board quality, natural cork sheet; face sanded for natural finish; complying with MS MIL-C-15116, Type II.

D. Non-Illuminated Directories:
   1. Fully recessed, non-illuminated directory.

2. Cabinet with an operable transparent cover.
3. Retainer frame with header panel and letter board or removable message strips.
4. Graphics for message strips, header panels, and other designs shall be in the letter style, size, spacing, and arrangement indicated.
5. Cabinet housing: Provide perimeter cabinet frame fabricated from aluminum extrusions of the profile indicated, mitered and welded with an aluminum-sheet rear cover panel.
   a. Structural reinforcement to prevent racking and misalignment.
   b. Provide mullions between individual units as indicated.
6. Frameless cover design:
   a. 1/4 IN 6 MM thick acrylic cover with acrylic returns to engage the perimeter frame.
7. Acrylic engraved-type message strips:
   a. 2-ply, 2-color, laminated, acrylic sheet engraving strips of size indicated.
8. Screen-printed message strips:
   a. Opaque acrylic plastic sheet of size indicated, with letters and other graphics applied by silk-screen-printing process.
   b. Message content:
      1) Provide message strips with wording and other designations that conform to list indicated and include blank strips as needed to fill out directory spaces.
   c. Message-strip color: Black.
   d. Letter size: 3/16 IN 5 MM.
   e. Letter style: Helvetica Medium.
   f. Letter color: Black.
   g. Letter case: All capitals.
9. Header panel:
   a. Opaque acrylic sheet header panel with letters and other graphics applied by silk-screen printing process.
10. Tackboard insert panels:
   a. Tackboard of material indicated with mullion trim matching the frame where tackboard surface adjoins other directory panels.

E. Bulletin Boards:
1. Provide surface-mounted, top-illuminated bulletin boards consisting of a cabinet housing with an operable transparent cover, containing a top-illumination system, and with tackable surface of material indicated.
2. Provide graphics for header panels and other designs in the letter style, size, spacing, and arrangement indicated.
3. Perimeter frame and cover design:
   a. Match perimeter frame and cover design of directories.
4. Perimeter frame and cover design: Extruded aluminum perimeter cabinet frame of profile indicated.
5. Header panel:
   a. Opaque acrylic sheet header panel with letters and other graphics applied by silk-screen printing process.
6. Illumination system:

a. Concealed top-lighting system consisting of fluorescent-strip fixtures including lamps and internal wiring with single concealed electrical connection to the building system.
b. Coordinate electrical characteristics with the power supply provided.
c. Ballasts: Low-temperature, high-power-factor, low-energy, fluorescent lamp ballasts that comply with Certified Ballast Manufacturers Association standards and carry its label.

F. Fasteners:
1. Provide screws, bolts, and other exposed fastening devices of the same material as the items being fastened.
2. Provide types, gages, and lengths to suit installation conditions.
3. Use theft-proof fasteners where exposed to view.

G. Hardware:
1. Hinges: Concealed pivot hinges.
2. Locks: Furnish each cover with manufacturer's standard lock.
a. Key locks alike.
b. Furnish 2 keys per lock.

H. Finishes:
1. Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations relative to applying and designating finishes.
2. Where colors for message strips, header panels, or other items are not indicated, provide colors as selected by Architect from manufacturer's full range of colors.
3. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
4. Class II, Clear Anodic Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine wall surfaces for compliance with requirements and other conditions affecting installation.

B. Correct unsatisfactory conditions.

3.2 INSTALLATION

A. Install units plumb and level, in locations and mounted as indicated.

B. Securely attach units to supporting structure with concealed fasteners, according to manufacturer's written installation instructions.

3.3 CLEANING AND PROTECTING

A. At completion of installation, clean surfaces according to manufacturer's written instructions.

B. Protect installed units from damage until acceptance at the time of project completion.

END OF SECTION

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# SECTION 10 14 00
# SIGNAGE

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services required for fabrication and installation of Signs as indicated in the drawings.

B. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. 2010 ADA Standards for Accessible Design.

B. American National Standards Institute, ICC/ANSI A117.1.

### 1.3 SUBMITTALS

A. See Section 01 33 00 for requirements.

B. Product Data:
   1. For each type of material and accessory.

C. Samples:
   1. Color and font samples for approval.

### 1.4 WARRANTY

A. Manufacturer shall warrant workmanship and materials for a period of two years.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Signs:
   1. Base:
      a. Poblocki Sign Company.
   2. Optional:
      a. Mohawk Sign Systems.
      b. ASI Sign Systems.
      c. Best Manufacturing Sign Systems.
      d. Innerface Architectural Signage.
      e. InPro Corporation.

B. Other manufacturers desiring approval comply with Section 01 61 00.

### 2.2 MATERIALS

A. Signs:
   1. Three-ply plastic laminate, 1-1/2 IN 38 MM wide x length required for script.
   2. Nominal letter height: 3/4 IN 19 MM.
   3. Letters and numbers: Raised 1/32 IN 0.8 MM.
   4. Uppercase.
   5. Letter style: Sans serif.
   6. Color: As selected.
      a. Characters: Dark.

b. Background: Light.
7. Finish: Non-glare.
8. Bevel edges.
9. Letters shall conform to following proportional standard:
a. The font width of uppercase letter “O” shall be 55 PCT minimum and 110 PCT maximum height of uppercase letter “I”.
b. Stroke thickness of uppercase letter "I" shall be 10 PCT minimum and 30 PCT maximum height of character.
10. Tactile lettering shall conform to following standards:
a. Character height measured vertically from the baseline of character shall be 5/8 IN minimum and 2 IN 50 MM maximum based on height of uppercase letter “I”.
b. Stroke thickness of uppercase letter "I" shall be 15 PCT maximum height of character.
c. The font width of uppercase letter “O” shall be 55 PCT minimum and 110 PCT maximum height of uppercase letter “I”.
d. Maintain minimum 1/8 IN 3 MM font separation between characters.
11. Braille characters shall conform to the following standard:
a. Braille characters shall be separated from adjacent raised characters or symbols 1/2 IN.
b. Grade 2 Braille translation to be provided by identification device manufacturer.

B. Directional and identification signs for communications systems: International symbols.

C. Adhesive: 3M double-coated urethane foam tape.
1. 4032 for smooth surfaces.
2. 4016 for rough surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location:
1. Single doors: Install on wall adjacent to latch side of door.
2. Double doors: Install on nearest adjacent wall.

B. Mount 5 FT above finish floor to centerline of sign.

C. Mount using adhesive tape.

3.2 SCHEDULE

A. Provide signs as follows:
1. "Stair" at each floor, each stair.
1. "Stair Egress" within stairwells.
2. "Mechanical Room" at each mechanical space door.
3. "Men" at each men's toilet.
4. "Women" at each women's toilet.
5. "Restroom" (or gender neutral identification) at each appropriately designed location.
6. "Family Restroom", at each location.
7. "Lactation Room" (with plumbing where applicable).
8. "Janitor", "Storage", "Housekeeping" (with plumbing where applicable).

9. "Evacuation Plan" with updatable insert where required.
10. "In Case of Fire…" signs located where appropriate.
11. "Fire Pump Room" at appropriate location.
12. "Electrical" at each electrical closet.
13. "Exit", "To Exit", "Not an Exit", etc., tactile signs where required.
14. Flag mounted Fire Extinguisher pictographic signs where required.
15. Accessibility directional (indicating route to nearest accessible element).
16. "Area of Refuge" where applicable.
17. Premises Identification address numbers (exterior: if applicable). 6” minimum.
18. Occupant load (Maximum Occupancy) for appropriate locations.

B. Provide signs at elevator call stations directing use of stairs: See ASME-A17.1, Appendix H.

C. Provide stair identification sign in enclosed stairs connecting three or more stories.
   1. See both IBC and NFPA for features of sign.

D. Provide international accessibility symbols at:
   1. Accessible entrance.
   2. Accessible exit.
   3. Accessible toilets.
   4. At inaccessible elements, provide directional signage to indicate route to nearest accessible element.

E. Provide directional and identification signs for:
   1. Assistance listening systems.

END OF SECTION

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# SECTION 10 14 16
# PLAQUES
# (FIBERGLASS EMBEDDED SOLID POLYMER INTERPRETIVE SIGNS)

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, tools, equipment, and services required for fabrication and installation of Plaques as indicated in the drawings.

B. Completely coordinate with work of other trades.

C. Content, appearance, and mounting of interpretive signs for viewing platform and kiosk(s) shall be a collaborative effort between Owner and Manufacturer.

### 1.2 COORDINATION

A. City of West Sacramento and Manufacturer shall coordinate terms of producing interpretive content, artwork, size, material and mounting of signage.

B. 20 hours for coordination.

### 1.3 SUBMITTALS

A. Shop Drawings:
   1. Submit full size drawing for approval prior to casting plaque.

B. Product Data.

C. Samples:
   1. Items, finishes, colors or other items as requested by Architect.

D. Contract Closeout Information:
   1. Maintenance data.
      a. See Section 01 78 23.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Plaques:
   1. Base:
      a. Pannier Graphics
   2. Optional:
      a. These manufacturers may use acceptable similar materials including high pressure plastic laminate or phenolic resin panels intended for exterior use.
      b. Site Essentials.
      c. Pulse Designs
      d. Wild Exhibit Signs and Displays

      e. A.R.K. Ramos.

B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Fiberglass Embedded solid polymer

B. Sizes: to be determined.
   1. Kiosk #1
   2. Kiosk #2
   3. Viewing Platform.

C. Mountings at kiosk shall be to post structure of kiosk.

D. Mountings at viewing platform shall covered bolting to metal deck.

E. Metal surfaces shall be PVFD coated with color to be determined by Owner.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify suitability of substrate to receive items.

B. Do not install until deficiencies are corrected.

C. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. Install according to manufacturer's instructions and recommendations.

END OF SECTION

# SECTION 31 00 00

# EARTHWORK

## PART 1 GENERAL

### 1.1 SCOPE

The work specified herein provides direction for slope grading and placement of embankment material to construct access pathways and ramps, parking embankments, and backfill for existing tree stumps holes. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans.

### 1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D1556 | (2015) Density and Unit Weight of Soil in Place by the Sand-Cone Method |
| ASTM D2216 | (2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass |
| ASTM D2487 | (2011) Soils for Engineering Purposes (Unified Soil Classification System) |
| ASTM D3740 | (2012a) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction |
| ASTM D4253 | (2016) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table |
| ASTM D4254 | (2016) Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density |
| ASTM D4318 | (2017) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D4643 | (2017) Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method |
| ASTM D6913 | (2009) Particle-Size Distribution of Soils using Sieve Analysis |

| | |
|---|---|
| ASTM D6938 | (2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
| ASTM D698 | (2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.)) |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2014) Safety and Health Requirements Manual |
| ER 1110-1-261 | (1999) Quality Assurance of Laboratory Testing Procedures |

## 1.3 DEFINITIONS

### 1.3.1 Suitable Materials

Suitable materials shall consist of materials classified in accordance with ASTM D2487 as SP, SW, SM, SC, SP-SM, SP-SC, SW-SM, SW-SC, GP, GW, GM, GP-GM, GP-GC, GW-GM, and GW-GC with a maximum particle size of 2 inches in greatest dimension, and meeting the additional requirements of paragraph 2.2, types of embankment materials. Suitable materials shall meet the requirements of Part 2 of this specification. Suitable materials, as defined herein, shall have no visible organics, roots greater than 1/2 inch in diameter, limbs, or wood fragments. Materials containing roots, debris, rubble, other deleterious items, perishable material, and trash shall not be used in the embankment.

### 1.3.2 Unsuitable Materials

Unsuitable materials include all other materials that are not defined as suitable materials in paragraph 1.3.1 herein. Materials are not classified as unsuitable based solely on moisture content. Unsuitable materials may be respread in borrow sites if the material is found suitable for borrow site restoration otherwise all unsuitable materials shall be disposed of in accordance with Section 02 41 00 DEMOLITION AND DECONSTRUCTION.

### 1.3.3 Unsuitable Debris

Material containing roots greater than 1/2-inch in diameter, debris, rubble, trash, or other deleterious items shall be classified as unsuitable debris.

### 1.3.4 Embankment Backfill Materials

The term "embankment backfill material" is defined as earthen material suitable to construct portions of the embankment, access ramps, tree stump hole backfill, or other earthen structures and backfill related to grading within the limits of the project. The terms "fill" "backfill" and "ramp fill" are used interchangeably with "embankment" material.

#### 1.3.4.3 Stump Hole Backfill

Embankment material used to fill in the stump holes created by tree removal.

1.3.4.5 Ramp Backfill Fill

Ramp backfill is embankment backfill material placed at ramps and roads as shown on the Plans.

1.3.4.6 Granular Sand Backfill

Granular sand backfill material used to fill areas that will serve as a drainage layer.

1.3.4.7 Cohesionless Soils

For the purpose of determining applicable compaction criteria in accordance with paragraph 3.7.2, cohesionless soils include all soils classified in accordance with ASTM D2487 as GW, GP, SW and SP. Soils classified as GM, SM, GW-GM, GP-GM, SW-SM, and SP-SM shall be identified as cohesionless only when a well-defined maximum dry density cannot be obtained.

1.3.5 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698 abbreviated as a percent of laboratory maximum density.

1.3.6 Offsite soil

Offsite soil is soil for which the source is outside the limit of construction identified on the plans and includes any contractor provided borrow site(s).

1.3.7 Relative Density

Relative density is expressed as a percentage of the maximum index density in accordance with ASTM D4253 and ASTM D4254.

1.3.8 Suitable Seedbed

A suitable seedbed is defined as a vegetation- and thatch-free soil surface that has been cultivated and prepared to provide a uniform (i.e., non-undulating) surface, and a soil surface texture that has been lightly disced to a depth of 3 inches for scarification of the soil surface (in Mixed Riparian Woodland Establishment Areas and Grassland Temporary Impact Seeding Areas) or lightly scarified by raking (in Riparian Understory Temporary Impact Areas).

1.4 QUALIFICATIONS

The earthwork contractor performing construction and reconstruction shall have experience in similar size and scope completed in the last five (5) years. The project experience must have been performed by the entity proposing to perform the work as defined below. An individual's experience from former companies shall qualify as contractor experience provided that the individual is the Contractor's designated Project Manager or Site Superintendent. Qualifying experience in earthwork construction and reconstruction shall consist of the following: 'Satisfactorily performed the work and completed the construction of at least three earthwork projects. The projects must have included a minimum embankment quantity of 5,000 cubic

yards and included construction restrictions imposed by seasonal construction limitations..

Refer to the proposal forms for additional information.

## 1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Excavation Plan;

Survey Data;

Equipment Data;

Material Distribution and Stockpile Plan;

Sheeting and Shoring Plan;

Dewatering Plan

Haul Road Plan

Plan of Operations

Flood Stage Contingency Plan

Temporary Facilities Plan

SD-03 Product Data

Offsite import material test results

Onsite material test results

Embankment and Backfill Materials; (proctor, type)

SD-09 Contractor's Field Reports

Quality Control Testing;

Construction Verification Survey Report;

## 1.6 GENERAL CONDITIONS

### 1.6.1 Lines and Grades

Unless otherwise noted on the Plans or directed by the Agency, the embankment shall be constructed to the lines, grades, and cross sections indicated on the Plans and in a manner consistent with the schedule of improvements defined. The Agency reserves the right to increase or decrease the foundation widths and embankment slopes or to make such other changes in the embankment or backfill sections as may be deemed necessary to produce a safe structure. Changes in quantities resulting from such revisions will

not constitute justification for change in contract unit prices, except as provided for in the General Specifications.

1.6.2 Conduct of the Work

The Contractor shall maintain and protect the embankment and backfill in a satisfactory condition at all times until final completion and acceptance of all work under the Contract. If the hauling equipment causes horizontal shear planes or slicken slides, rutting, quaking, heaving, cracking, or excessive deformation of the embankment or backfill, the Contractor shall limit the type, load, and/or travel speed of the hauling equipment on the embankment or backfill. The Contractor may be required to remove, at his own expense, any embankment material placed outside of prescribed slope lines. Any approved embankment or backfill material, rendered unsuitable due to the negligence of the Contractor, after being placed in the embankment or backfill before final acceptance of the work shall be replaced with suitable material by the Contractor in a satisfactory manner and no additional payment will be made. The Contractor shall excavate and remove from the embankment or backfill any material which is unsatisfactory and shall also dispose of such material and refill the excavated area as directed, unless directed otherwise by the Agency, all at no cost to the Agency.

1.6.3 Grading and Excavation Plan

Submit a written grading and excavation plan to the Agency a minimum of twenty (20) days prior to the beginning of any grading or excavation. Review of the detailed plan shall be obtained from the Agency prior to starting the work. If necessary, the plan shall be modified as required to meet field conditions, and the modifications shall be reviewed prior to use. As a minimum, the plan shall contain the following:

a. Proposed methods for preventing interference with, or damage to, existing underground or overhead utility lines, trees designated to remain, and other man-made facilities or natural features designated to remain within or adjacent to the construction right-of-way.

b. The proposed methods for controlling surface and ground water in or around the required grading or excavations.

c. Stockpiling and blending plan for embankment material showing locations, stockpile heights, slopes, limits, and drainage around the stockpile areas.

d. A complete listing of equipment used for grading, excavation, and transportation of the excavated material.

e. The Contractor's proposed sequence of work for grading and excavating with plan and cross-sectional views showing starting and final work locations and clearing and grubbing limits.

f. The Contractor's proposed site haul road pattern and plan for implementing dust control measures.

g. Documentation and video of Pre-Construction Condition of Roadway Gravel, Paving, and Slope Area that will remain.

h. The Contractor's plan for implementing the measures prescribed by the project SWPPP.

1.6.4 Survey Data

Copies of survey data in the form of cross sections of the existing conditions prior to construction shall be submitted. The Contractor shall submit written certification that the data is accurate, and surveying was performed by a surveyor authorized to practice land surveying in the State of California. Submit all data within 24 hours of performing field surveys per Section 5-9 of the General Specifications.

1.6.5 Equipment Data

Equipment data used for hauling, embankment placement, compaction, and sprinkling equipment shall be submitted and include weights, size, and contact pressures.

1.6.6 Material Distribution and Stockpile Plan

Earth material distribution and stockpile plan that describes where material will be obtained, placed, stockpiled, and blended for usage or for temporary disposal. This information shall be provided within ten (10) days after the notice to proceed.

1.6.7 Sheeting and Shoring Plan

Submit drawings and calculations, certified by a registered civil engineer authorized to practice in the State of California, describing the methods for shoring and sheeting of excavations if required. Drawings shall include material sizes and types, arrangement of members, and the sequence and method of installation and removal. Calculations shall include data and references used.

The Contractor shall provide a Professional Geotechnical Engineer licensed in the State of California to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the Excavation Plan, Sheeting and Shoring Plan, and Dewatering Plan as construction progresses to reflect changing conditions and shall submit an updated plan as necessary. A written report shall be submitted, at least monthly, informing the Agency and Construction Manager of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the Agency and Construction Manager at any time throughout the contract duration.

1.6.8 Dewatering Plan

If dewatering is required surface and groundwater control shall be accomplished in coordination with the required excavation and embankment construction activities. Seepage of water from adjacent bodies of water should be anticipated. Such seepage shall be intercepted at perimeter of the excavation area and rerouted around or away from the excavated area(s).

Excavations at depth should anticipate encountering saturated soil conditions from perched groundwater and shall be moisture conditioned as needed to meet specifications for use. Surface and/or groundwater control may necessitate the use of temporary diversion ditches, cofferdams and/or dewatering by the use of pumping or other means. If needed, a dewatering plan, reviewed by a Geotechnical or a Civil Engineer licensed in the State of California, shall be submitted for review and should incorporate the method(s) of dewatering, care of surface water and for controlling the surface and groundwater levels, and shall be the responsibility of the Contractor and which shall comply with all Federal, State and local regulations. The dewatering plan should include plan layout, equipment type, horse power of equipment, expected operational time, and noise generation.

### 1.6.9 Haul Road Plan

Haul roads and ramps, if needed, shall be located, and constructed within the construction limits shown on the Plans. Prior to the commencement of construction, the Contractor shall submit for review a site plan detailing the location of all site access, haul roads and ramps within the construction limits. Haul roads and ramps shall be constructed to maintain the intended traffic, be free draining, and be maintained in good condition throughout the contract period. Haul roads and ramps which cross any creek or drainage channel shall be constructed and maintained by the Contractor to not flood either upstream areas by restricting stream flows or flood downstream areas by the release of any stored water in the event that the crossing fails for any cause. Haul roads and ramps constructed during the contract duration shall be removed after work is completed (unless designated by the Agency to remain) and the impacted area restored to its preconstruction conditions. All haul roads within the right-of-way that will remain as public thoroughfares after construction shall be cleaned daily and maintained in the preconstruction condition. All haul roads within the RD900 easement shall be restored to preconstruction condition at the conclusion of construction at no additional cost to the Agency; this includes the import and placement of aggregate, grading and surfacing necessary to restore to pre project condition. All costs associated with these haul roads and ramps shall be considered as an obligation of the Contractor.

### 1.6.10 Plan of Operations

Twenty (20) days prior to commencement of haul road construction or placing embankment and backfill, whichever is earlier, the Contractor shall submit for review a Plan of Operations for accomplishing all embankment and backfill construction and for the location and construction of haul roads. The plan shall be reviewed by the Agency prior to the start of Work. This plan shall include, but not be limited to, the Contractor's proposed sequence of construction for embankment and backfill items, and methods and types of equipment to be utilized for all embankment and backfill operations, including transporting, placing, and compaction. This plan shall also include the names and addresses of the commercial testing labs which will perform the soil testing and inspection and describe how all required soils testing will be performed and reported.

### 1.6.11 Flood Stage Contingency Plan

In the event the water surface elevation of the Sacramento River is forecasted by the State-Federal Flood Forecast Center to increase

significantly for any reason, the Agency reserves the right to require the Contractor to stop excavation activities within the Bees Lakes project area and remove equipment, temporary facilities, and material from the Bees Lakes project area.

At least 15 days prior to any excavation within the Bees Lakes project area the Contractor shall submit a contingency plan outlining the contingency operations if river elevations above the flood stage (as defined by the Agency) are forecasted. The contingency plan shall include the proposed measure to fill in any excavations within proximity of the Chicory Loop roadway embankment and the removal of equipment, temporary facilities, and material from the Bees Lakes project area.

1.6.12 Temporary Facilities Plan

The contractor shall provide any temporary staging, access, ramps, administrative or testing facilities, traffic control, storage/stockpile areas or similar temporary facilities in accordance with 01 50 02.00 41 TEMPORARY CONSTRUCTION FACILITIES. Prior to commencing construction, the Contractor shall submit for review a plan, detailing the locations of all temporary facilities within the Project area. Temporary access and ramps shall meet the requirements of section 2.2.4 of this specification and shall be removed once construction use of access or ramp has been completed and restored to preconstruction or design grade conditions. Cuts into the new or existing embankment are prohibited.

1.6.13 Onsite Excavated Material Test Results

The Contractor shall ensure that the onsite excavated material meets the requirements described in Sections 2 and 3.9 of this specification and shall submit test results meeting the requirements described in section 3.9 of this specification.

1.6.14 Embankment Materials

The Contractor shall ensure that all embankment material used meet the definition of Suitable Materials as outlined in Section 1.3.1 of this specification. The Contractor shall ensure through testing that the soil type classifications outlined in Section 2.2 of this specification are met for any material placed. The Contractor shall ensure that placed embankment meets the moisture and compaction requirements described in Sections 3.6 and 3.7, respectively, of this specification and is conducted at the frequency described on Section 3.9 of this specification. The Contractor shall satisfy the reporting requirements described in Section 3.9 of this specification. All testing outlined and referenced in this section is a minimum and does not relieve the Contractor from the responsibility of performing additional testing if required to ensure compliance with the specifications.

1.6.15 Quality Control Testing

The Contractor shall submit all quality control test results. Testing laboratories shall meet the requirement of ASTM D3740 and ER 1110-1-261. Supervision of tests and report preparation shall be by a professional civil or geotechnical engineer licensed in the State of California. All reports shall bear said professional engineer's signature and stamp. Distribution of the copies to the Agency shall be within 24 hours after sampling or

initiating the test, except for test requirements that exceed 24 hours. For tests exceeding 24 hours, distribution shall be with 24 hours after completion of the test. Also refer to 01 45 01.10 QUALITY CONTROL SYSTEM (QCS).

All test reports shall be provided electronically and hard copy.

1.6.16 Construction Verification Survey Report

The Contractor shall complete post-construction verification surveys and submit a "Construction Verification Survey Report" which will include the description of equipment used, a description of methodology used, copies of the field notes, and the final data submitted. This report shall contain the certificate below, and be stamped and signed by the Professional Land Surveyor (or Civil Engineer, if legally allowed to practice surveying in the State of California) responsible for the survey work performed.

**Surveyor's Elevation Certificate:**

| | |
|---|---|
| I, the undersigned, do hereby state that I am licensed to perform surveying in the State of California, and I do hereby certify that the pre-construction and post-construction surveys for measuring the embankment(s) and related berm(s) were performed by me or by qualified staff under my supervision. I further certify that the technologies and methods used for these surveys are in compliance with the specifications for this project and that the data from said surveys comply with tolerances specified for this project. | |
| _____<br>Surveyor's Name | _____<br>Date |
| CA PLS/CE No.:_____ | |

### 1.6.17 Slides and Foundation Failures

The Contractor shall repair any slide that occurs in any part of the embankment prescribed in this section prior to final acceptance of the work. When the slide is caused through the fault of the Contractor, the repair shall be made at no cost to the Agency. The Contractor shall submit a plan detailing how the repair will be completed. The plan shall be reviewed by the Agency prior to the start of repair work. When the slide is not the fault of the Contractor, an extension of the unit prices for excavation and embankment shall be made to cover the cost of the repairs.

### 1.6.18 Drainage Requirements

The Contractor shall not block or restrict the flow in a natural drain, existing culvert, ditch or channel at any time without obtaining prior written acceptance from the Agency. This acceptance shall not relieve the Contractor from responsibility for any damage caused by his operation. The Contractor shall monitor the channel flow and provide sufficient free discharge areas so that conditions are not worsened upstream or downstream by possible floods during construction. Surface water shall be directed away from excavations and construction sites so as to prevent erosion and undermining of foundations. Diversion ditches, dikes, and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained. If private property is to be used for drainage, the Contractor shall submit written evidence that the right has been obtained from the property owner for drainage on his property.

### 1.6.19 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Utility lines damaged during construction shall be immediately reported to the Agency. The contractor shall coordinate with utility owners and relocations by others.

### 1.6.20 Protection of Existing Man-Made Facilities and Natural Features

Embankment excavation shall be conducted in such a manner as to avoid damage to trees left standing and trees outside the excavation areas shown in the plans, existing buildings, man-made facilities and natural features, with due regard to the safety of employees and others.

## PART 2 PRODUCTS

## 2.1 MATERIALS

### 2.1.1 Embankment Materials

The embankments shall be constructed of suitable earth materials as defined in 1.2 DEFINITIONS and obtained from project excavations, or approved contractor supplied sources. Embankment materials shall have no visible concentrations of organics, roots greater than 1/2 inch in diameter, limbs, or wood fragments. Materials containing roots, debris, rubble, other deleterious items, perishable material, and trash shall not be used in the embankment. Materials may be blended as needed to obtain a material suitable

for construction meeting the embankment requirements outlined in these Specifications. Blended materials shall be tested for suitability at the source site or at onsite stockpile areas prior to placement. Soil classification tests shall be completed for all blended material in accordance with ASTM D2487. The reuse of project excavations is to be maximized to the greatest extent possible and the Contractor shall blend, if required, all reused materials to meet outlined specifications. Material not meeting the specified requirements shall be hauled off site and disposed of in a legal manner.

Soils classified as organic clay or organic silt (OH or OL) are unsuitable and shall not be blended for use in the embankment material. These materials shall be hauled off-site and disposed of in a legal manner. Unsuitable debris as defined in paragraph 1.3 DEFINITIONS shall be disposed of off-site in a legal manner.

## 2.2 EMBANKMENT BACKFILLS

Table 2.2 Embankment Backfill Criteria

| Summary of the Type Categories and Associated Embankment Criteria | | | | |
|---|---|---|---|---|
| Embankment Type | Description and Classification Requirement | Liquid Limit | Plasticity Index | % Finer Than #200 Sieve |
| Embankment Backfill | Embankment (Parking and Trails) Excavation and trench Backfill.<br><br>GP, GM,GP-GM, GW-GM, GP-GC, GW-GC, SP, SW, SP-SM, SW-SM | <45 | <8 | <12%(Avg 10 consecutive tests)<br><br><50%(Any individual test) |

### 2.2.1 Embankment Backfill Material Requirements

Embankment backfill material may be obtained from the slope grading of the existing fill as shown on the plans or other approved excavations and shall be suitable for use as general site embankment beyond the limits of the embankment. Miscellaneous earthwork and stump hole backfill shall consist of suitable material with a maximum particle size less than 2 inches.

| GRADATION | | ASTM TEST PROCEDURE |
|---|---|---|
| Sieve Size | Percent Passing | |
| 3-inch | 100 | D6913 |
| No. 200 | <=12 (Avg 10 consecutive tests)<br><=50% (Any individual test) | D6913 |
| Liquid Limit <45 | | D4318 |
| Plasticity Index: <8 | | D4318 |

## 2.2 GRANULAR SAND BACKFILLS

Table 2.2 Granular Sand Backfill Criteria

| Summary of the Type Categories and Associated Embankment Criteria | | | | |
|---|---|---|---|---|
| Embankment Type | Description and Classification Requirement | Liquid Limit | Plasticity Index | % Finer Than #200 Sieve |
| Granular Sand Backfill | Extension of drainage layer<br><br>SP, SW, SP-SM, SW-SM | <45 | <8 | <5%(Avg 10 consecutive tests)<br><br><10%(Any individual test) |

### 2.2.1 Granular Sand Backfill Material Requirements

Granular Sand Backfill material may be obtained from the slope grading of the existing fill as shown on the plans or other approved excavations and shall be suitable for use as granular Sand Backfill.

| GRADATION | | ASTM TEST PROCEDURE |
|---|---|---|
| Sieve Size | Percent Passing | |
| 3-inch | 100 | D6913 |
| No. 4 | 90-100 | D6913 |
| No. 200 | <=5 (Avg 10 consecutive tests) <=10% (Any individual test) | D6913 |
| Liquid Limit <45 | | D4318 |
| Plasticity Index: <8 | | D4318 |

PART 3 EXECUTION

3.1 TOLERANCES

All embankments (prior to placement of surfacing) and backfills shall be constructed to the grades, lines, and cross-sections shown on the Plans and/or as determined by Contractors Agency-reviewed pre-construction surveys. The side slopes shall have a tolerance of 0 to plus 0.4 feet for final dressing (measured perpendicular to the slope). The top of multipurpose trail and parking area shall have a tolerance of 0 to plus 0.1 feet above and 0 feet below. These tolerances will be allowed provided that any excess material is so distributed that the multipurpose trail, parking area and slopes of the embankment drain and that there are no abrupt humps or depressions in any surfaces.

A tolerance of 0.2 feet above or below the prescribed grade will be allowed for finished surfaces outside the multipurpose trail, parking area, and slopes provided that the surface drains away from the embankment in the direction as indicated on the Plans with no abrupt humps or depressions.

3.2 PREPARATION OF FOUNDATION, PARTIAL EMBANKMENT SURFACES AND ABUTMENTS

3.2.1 Foundation Preparation

After excavation or stripping (as described in Section 31 11 00 CLEARING AND GRUBBING) of the embankment and foundation area to the extent indicated or otherwise required, the sides of stump holes, test pits, irrigation ditches/swales, utility excavation trenches and other similar cavities or depressions shall be broken down so as to flatten out the slopes, and the sides of the cut or hole shall be scarified to provide bond between the foundation material and the embankment. Unless otherwise directed, each depression shall be filled with the same material type that is to be placed immediately above the foundation. The embankment shall be benched or keyed,

placed in layers, moisture conditioned, and compacted in accordance with the applicable provisions of these Specifications for the specific material type. Materials which cannot be compacted by roller equipment because of inadequate clearances shall be compacted with power tampers in accordance with Paragraph 3.7 COMPACTION for the specific material type.

After filling of depressions and immediately prior to placement of compacted embankment in any section of the embankment, the foundation of such section shall be loosened thoroughly by scarifying, plowing, discing or harrowing to a minimum depth of 6 inches, and the moisture content shall be adjusted to the amount specified in Paragraph 3.6 MOISTURE CONTROL for the appropriate type of material. After removal of roots or other debris turned up in the process of loosening, the entire surface of the foundation area shall be compacted to the minimum specified percentage of the maximum dry density. Immediately prior to placement of compacted embankment on or against the surfaces of any partially filled section, all soft or loose material, all material containing cracks or gullies, and all material that does not conform with the specified zoning of the embankment shall be removed. The remaining surface of the partially filled section shall be loosened by scarifying, plowing, discing or harrowing to a minimum depth of 6 inches, and the moisture content shall be adjusted as specified in Paragraph 3.6 MOISTURE CONTROL for the appropriate type of material. The surface of the partially filled section upon which embankment is to be placed, shall then be compacted as hereinafter specified for the appropriate type of embankment. No separate payment will be made for loosening and rolling the foundation area or the surfaces of partially filled sections.

### 3.2.2 Benching

Benching into the existing embankment or existing side slopes is required. The horizontal and vertical cuts into the existing surface resulting from the benching operation shall be as shown in plans.

### 3.2.3 Shoring and Sheeting

In addition to EM 385-1-1 and other requirements set forth in this contract, the Contractor shall include provisions in the shoring and sheeting plan that will accomplish the following:

a. Prevent undermining of embankments, roads, or structures.

b. Prevent slippage or movement in banks or slopes adjacent to the excavation.

### 3.2.4 Dewatering

Dewatering shall be performed in compliance with Division IV, Section 23 "Dewatering" of the City of West Sacramento Standard Construction Specifications. Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation, accept with written approval, of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation

reaches the water level in order to maintain the integrity of the in situ material.

Contractor shall lower ground water tables within excavations to a minimum of three (3) feet below excavations or as otherwise required to establish a firm, stable foundation.

The Contractor shall operate dewatering system continuously until construction work below existing water levels is complete.

## 3.3 EXCAVATION

Excavation shall consist of slope grading, the removal of tree stumps, trenching for utility installation, excavation as necessary to install foundations for the abutments and viewing platforms, to key and bench embankments, and removal of objectionable and unsuitable materials.

### 3.3.1 Utilities

For new utility placement excavate to the dimensions indicated or to safe limits if dimensions are not provided. Grade the bottom of trenches to provide uniform support for each section of pipe or structure after bedding material placement, as shown on the Plans. Subgrade shall be compacted in accordance with these Specifications per the material type and location. Pipes shall be uniformly supported for the entire length.

Pipe bed shall be uniform and cleared of any loose material prior to placement of pipe.

## 3.4 PLACEMENT AND SPREADING

### 3.4.1 General

No embankment shall be placed on any part of the embankment foundation until such areas have been inspected by the Agency.

#### 3.4.1.1 Gradation and Distribution

The gradation and distribution of materials shall be such that the embankment will be free from lenses, pockets, streaks, and layers of material differing substantially in texture or gradation from surrounding material of the same class. Special care shall be taken to break down large lumps of high plasticity clay and blend with surrounding soil. If lenses, pockets, or layers of materials differing substantially in texture or gradation from surrounding material or large lumps of high plasticity clay occur in the spread material, the layer shall be removed, blended and tested for suitability prior to replacement. Blending of materials shall occur in an approved stockpile area.

During the placing and spreading process, the Contractor shall maintain at all times a force of workers adequate to remove all particles with a greatest dimension of 2-inches, oversize roots, debris, rubble, trash, deleterious items, concentrations of organic material, and oversize stone from all embankment materials. All stones and rock fragments larger than 3 inches in any dimension shall be removed from the embankment unless otherwise noted in this Specification.

3.4.1.2 Foundations and Partial Embankment Fills

The foundations and all partial embankments receiving embankment shall be kept thoroughly drained. Placement operations will be such as to avoid mixing of materials from adjacent sections as much as practicable.

3.4.1.3 Equipment Traffic

Equipment traffic on any embankment zone shall be routed to minimize rutting of placed embankment and to distribute the compactive effort as much as practicable. Ruts formed in the surface of any layer of spread material shall be filled before that material is compacted. The surface shall be loosened by scarifying or other approved methods before material for the succeeding layer is placed and compacted.

3.4.2 Placement of Embankment and stump hole Backfill

No embankment or backfill shall be placed on or against concrete within 7 days after concrete placement or having less than 70 percent of the design strength, without prior review by the Agency. Crawler-type tractors, vibratory equipment and other similar compaction equipment shall not be used within 4 feet of any completed or partially completed structure. Compaction within 4 feet of completed or partially completed structures shall be accomplished by the use of mechanical hand tampers, vibrating plates, or other approved methods and equipment. The Contractor shall ensure that compaction operations do not damage the structure or any existing utilities. Any damage caused by the Contractor's operation shall be repaired at the Contractor's expense.

3.4.3 Embankment Placement

Place embankment material and spread in layers not more than 8 inches in uncompacted thickness, except that within four (4) feet of structures, the uncompacted layer thickness is reduced to four (4) inches, unless otherwise noted. Finish slopes by pulling the slopes to the lines, grades and tolerances identified in the plans and specifications with suitable equipment and seed embankment material and disturbed areas in accordance to section 3.4.4.

3.4.4 Seeding of Disturbed and Graded Areas

Seed graded and disturbed areas in accordance with the requirements of 32 92 00 SEEDING.

3.4.4.1 Seedbed Preparation of Disturbed Areas

Remove nonnative vegetation within the Riparian Woodland Establishment Areas, and temporary impact areas to be seeded, as directed by the Agency. Remove trimmings, trash, and debris found within the Project site and recycle or otherwise dispose of materials in accordance with State and local regulations.

Provide a dozer or tractor capable of pulling tillage equipment (e.g., double-row hydraulic offset disc, ring roller, drill seeder) and leveling equipment (e.g., float, box scraper) needed to prepare a Suitable Seedbed, as defined in this Section, in Mixed Riparian Woodland Establishment Areas and Grassland Temporary Impact Seeding Areas which will have been disturbed

by construction activities prior to planting. Contractor shall lightly disc soil surfaces in preparation for seeding. Use appropriate equipment and confine equipment access to planting areas and staging areas/access routes only so as to not damage roots, trunks, or branches of planted and existing vegetation.

#### 3.4.4.1 Staging Areas

Provide a dozer and a standard 3-shank tool bar, or equivalent with Agency approval. Contractor shall be solely responsible for locating and avoiding underground and above ground utilities. Rip soil surfaces in staging areas used for equipment or materials staging that will be planted or seeded, in preparation for planting to alleviate soil compaction. Cross-rip each site (north to south and east to west or similar to approximate 90 degree angles) using 3 shanks spaced approximately 24 inches apart with a single pass to a minimum depth of 18 inches.

## 3.5 MOISTURE CONTROL

### 3.5.1 General

The materials in each layer of the embankment shall have a moisture content within the limits specified below. Material that is not within the specified moisture content limits after compaction shall be reworked to obtain the specified moisture content, regardless of density.

#### 3.5.1.1 Insufficient Moisture for Suitable Bond

If the top or contact surfaces of partially filled sections do not meet the specified moisture content, the Contractor shall loosen the dried materials by scarifying or discing to a minimum depth of six inches, shall dampen the loosened material and shall compact this layer in accordance with the applicable requirements of Paragraph 3.7 COMPACTION.

#### 3.5.1.2 Excessive Moisture for Suitable Bond

If the top or contact surfaces of partially filled sections do not meet the specified moisture content, the wet material shall be removed or scarified and permitted to dry, assisted by discing or harrowing, if necessary, to a minimum depth of six inches. The material shall be dried to an acceptable moisture content, and shall be compacted in accordance with the applicable requirements of Paragraph 3.7 COMPACTION.

#### 3.5.1.3 Drying Wet Material

Material that is too wet shall be substantially dried in the stockpile area or borrow area prior to bringing to the embankment. Drying shall be assisted by discing or harrowing, if necessary, until the moisture content is reduced to an amount that will require minimal processing once the material is placed.

#### 3.5.1.4 Increasing Moisture in Dry Material

The moisture content of material that is too dry shall be adjusted in the stockpile area or the borrow area prior to placement as embankment. The Contractor shall add water to the embankment material and by discing, harrowing, or other approved methods, work the moisture into the material

until a uniform distribution of moisture is obtained that will require minimal processing once the material is placed. Water applied on a layer of embankment shall be accurately controlled in amount so that free water will not appear on the surface during or subsequent to compaction. Should too much water be added to any part of the embankment, the compaction on that section of the embankment shall be delayed until the moisture content of the materials is reduced to an amount within the specified limits.

3.5.2 Moisture Content Requirements

3.5.2.1 Cohesionless Soils

For soil classified as cohesionless soil defined in Section 1.3.4.7, the moisture content after compaction shall be within the limits of 3 percentage points above optimum to 3 percentage points below optimum moisture content as determined by ASTM D698 for subgrade to receive embankment material. In addition, moisture conditioning shall be accomplished in a manner that does not cause significant pumping or rutting due to excessive moisture that inhibits adequate compaction. For materials where a well-defined maximum dry density cannot be obtained, refer to Section 3.7.2.

3.6 COMPACTION

3.6.1 Compaction Equipment

Compaction equipment shall conform to the following requirements and shall be used as prescribed in subsequent paragraphs.

3.6.1.1 Tamping Rollers

Tamping rollers shall be as follows:

a. Towed -Tamping rollers shall consist of a heavy duty double drum unit, with a drum diameter not less than 60 inches, and an individual drum length of not less than 60 inches. The drums shall be capable of being ballasted with water or a combination of sand and water. Each drum shall have staggered feet uniformly spaced over the cylindrical surface such as to provide approximately three tamping feet for each 2 square feet of drum surface. The tamping feet shall be 7 to 9 inches in clear projection from the cylindrical surface of the roller and shall have a face area of not less than 5 square inches nor more than 7 square inches. The roller shall be equipped with cleaning fingers, so designed and attached as to prevent the accumulation of material between the tamping feet, and these cleaning fingers shall be maintained at their full length throughout the periods of use of the roller. The ground pressure of the roller shall not be less than 3500 pounds per linear foot of weighted drum width, and shall not be more than 2000 pounds per linear foot of empty drum width. The two drums comprising one roller unit shall be yoked such that they will oscillate when traversing uneven surfaces. The design and operation of the tamping roller shall be subject to the review by the Agency who shall have the right at any time during the prosecution of the work to direct such repairs to the tamping feet, minor alterations in the roller and variations in the weight as may be found necessary to secure optimum compaction of the earth embankment materials. The Contractor may be required to add

ballast to the roller to the maximum capacity specified by the manufacturer of the roller. The roller shall be drawn by a crawler-type or a rubber-tired tractor at a speed not to exceed 5 miles per hour. The use of the rubber-tired tractor shall be discontinued if the tires leave ruts that prevent uniform compaction by the tamping roller. If tamping rollers are used in tandem, not more than two rollers in tandem will be permitted and in such case, one trip of the tandem rollers over any surface will be considered as two passes. When tamping rollers are used in tandem, the tamper foot spacing shall be offset so that the circumferential rows on the rear drums are in line with the mid-point of the circumferential rows on the forward drums.

b. Self-propelled - Self-propelled tamping rollers may be used in lieu of tractor drawn tamping rollers provided the foot pressure on the tamping feet of the self-propelled roller are approximately the same as the foot pressure on the towed roller. For self-propelled rollers steered with rubber-tired wheels, the tire pressure shall not exceed 40 psi. Self-propelled rollers shall be operated at speeds not exceeding 5 miles per hour. The Agency has the authority to limit or eliminate the use of self-propelled rollers if they are found to cause shearing or laminations of the compacted embankment.

3.6.1.2 Vibratory Rollers

Vibratory rollers for compacting pervious sand and gravel fills, or filter and transition drainage layers, shall be equipped with a smooth steel compaction drum and shall be operated at a frequency of vibration during compaction operations between 1100 and 1500 vpm. Vibratory rollers may be either towed or self-propelled and shall have an unsprung drum weight that is a minimum of 60 percent of the rollers' static weight. Towed rollers shall have at least 90 percent of their weight transmitted to the ground through the compaction drum when the roller is standing in a level position hitched to the towing vehicle. Rollers for compacting rock fill, sand and gravel fills, or filter and drainage layers shall have a minimum static weight of 20,000 pounds, a minimum dynamic force of 40,000 pounds when operating at 1400 vpm, and an applied force not less than 9,000 pounds per foot of compaction drum length. Rollers for compacting sand and gravel fills or filter and drainage layers shall have a minimum static weight of 8,000 pounds, a minimum dynamic force of 16,000 pounds when operating at 1400 vpm, and an applied force not less than 5,000 pounds nor greater than 9,000 pounds per foot of compaction drum length. The level of amplitude and vibration frequency during compaction will be maintained uniform throughout the fill zone within which it is operating. Rollers shall be operated at speeds not to exceed 5 mph. The equipment manufacturer shall furnish sufficient data, Plans, and computation for verification of the above specifications, and the character and efficiency of this equipment shall be subject to review.

3.6.1.3 Rubber-Tired Rollers

Rubber-tired rollers shall have a minimum of four wheels equipped with pneumatic tires. The tires shall be of such size and ply as to be capable of being operated at tire pressures between 80 and 100 psi at a 25,000 pound wheel load. The roller wheels shall be located abreast and so designed that each wheel will carry approximately equal load in traversing uneven ground. The spacing of the wheels shall be such that the distance between the

nearest edges of adjacent tires will not be greater than 50 percent of the rated tire width of a single tire at the operating pressure for an 25,000 pound wheel load. The roller shall be provided with a body suitable for ballast loading such that the load per wheel may be varied, as directed by the Agency, from 18,000 to 25,000 pounds. The roller shall be towed at a speed not to exceed 5 miles per hour. The character and efficiency of this equipment shall be subject to review by the Agency.

3.6.1.4 Hand Operated Compactors

Compaction of material in areas where it is impracticable to use a roller or tractor compaction shall be performed by the use of approved hand operated power compactors.

a. Power Tampers: Power tampers shall be hand operated equipment capable of compacting material in confined areas. The compactors shall be either an internal combustion or pneumatic activated tamper. Tampers shall have sufficient weight and striking power to produce the specified compaction. The character and efficiency of this equipment shall be subject to the review by the Agency.

b. Vibratory Plate Compactor: Vibratory compactors operated by hand in confined areas shall utilize the oscillating cam principal and shall deliver a centrifugal force not less than 2000 lbf at a rate of approximately 2000 impulses per minute (33.5Hz minimum). The character and efficiency of this equipment shall be subject to the review by the Agency.

3.6.1.5 Crawler-Type Tractors

Crawler-type tractors used for spreading or compaction shall weigh not less than 20,000 pounds, shall exert a ground pressure of not less than 6 psi, and shall be operated at a speed not to exceed 3.5 miles per hour.

3.6.1.6 Sprinkling Equipment

Sprinkling equipment shall consist of tank trucks, pressure distributors or other equipment designed to apply water uniformly and in controlled quantities to variable width of surface.

3.6.1.7 Miscellaneous Equipment

Scarifiers, discs, spring-tooth or spike-tooth harrows, spreaders, hydro seeding equipment and other equipment shall be suitable for use in embankment construction. Equipment used for processing embankment material shall be capable of penetrating the full loose lift thickness of the specific material type.

3.6.2 Compaction of Embankment

After a layer of material has been dumped and spread, it shall be harrowed to break up the embankment materials to eliminate all clods and to obtain uniform moisture distribution. Harrowing shall be performed with a heavy disc plow, or other approved harrow, to the full depth of the layer. If one pass of the harrow does not accomplish the breaking up of the materials, additional passes of the harrow shall be required, but in no case will more

than three passes of the harrow on any one layer be required for this purpose.

| LOCATION | PERCENT OF THE MAXIMUM DENSITY |
|---|---|
| Subgrade to Receive Embankment Material | 95 percent |
| Embankment Material Placed within 12 inches of Pavement | 100 percent |
| Embankment Material Placed for trail grading, ramps, Under structures and trenches. | 97 percent |
| Random, Non-Structural Embankment within the Project | 80 percent |

Embankment compaction for cohesionless soils as defined in Section 1.3.4.7 shall comply with the test methods provided above provided a well-defined maximum dry density can be obtained.

If a well-defined maximum dry density cannot be obtained, cohesionless soils shall be placed in maximum eight-inch lifts and moisture conditioned according to section 3.6 Moisture control except that moisture content shall be between 4.0 to 6.0% as determined by ASTM D2216 or ASTM D4643. Each eight inch lift shall be compacted as follows:

| LOCATION | COMPACTION REQUIREMENT |
|---|---|
| Subgrade to Receive Embankment Material | Minimum 6 passes with a roller specified in Section 3.6.1.2 or 3.6.1.3, and compaction shall continue until the dry density of successive compaction roller passes does not increase > 0.5 pcf when tested with a nuclear density gauge in accordance with ASTM D6938. |
| Embankment Material Placed within 12 inches of Pavement | Minimum 8 passes with a roller specified in Section 3.6.1.2 or 3.6.1.3, and compaction shall continue until the dry density of successive compaction roller passes does not increase > 0.5 pcf when tested with a nuclear density gauge in accordance with ASTM D6938. |
| Embankment Material Placed for trail grading, ramps, under structures and trenches. | Minimum 6 passes with a roller specified in Section 3.6.1.2 or 3.6.1.3, and compaction shall continue until the dry density of successive compaction roller passes does not increase > 0.5 pcf when tested with a nuclear density gauge in accordance with ASTM D6938. |

| LOCATION | COMPACTION REQUIREMENT |
|---|---|
| Non-Structural Embankment within the Project | Minimum 3 passes with a roller specified in Section 3.7.1.2 or 3.7.1.3, and compaction shall continue until the dry density of successive compaction roller passes does not increase > 0.5 pcf when tested with a nuclear density gauge in accordance with ASTM D6938. |

A pass with a roller is defined as one equipment width for the entire length of the lift placed in one direction. Contractor shall overlap each pass by a minimum of 3 feet.

In areas which are not accessible by roller, the embankment shall be compacted with an approved hand operated compactor to a density equal to that obtained in other areas which are accessible to rollers.

Dumping, spreading, sprinkling, and compacting may be performed at the same time at different points along a section when there is sufficient area to permit these operations to proceed simultaneously. Compaction equipment shall be operated such that the strip being traversed by the roller shall overlap the rolled adjacent strip by not less than 3 feet.

## 3.7 STOCKPILES

Weeds growing on stockpiled material shall be controlled by discing of the stockpiles or with a non-residual herbicide. Herbicides and methods of application shall be reviewed by the Agency prior to weed control.

## 3.8 FIELD QUALITY CONTROL

### 3.8.1 General

As a part of the Contractor Quality Control (CQC) system required by Section 01 45 01.10 QUALITY CONTROL SYSTEM (QCS), the Contractor shall establish and maintain field quality control for foundation preparation, embankment and backfill operations to assure compliance with contract requirements and maintain detailed records of field quality control for all operations. Approximately 20 percent of tested locations will be selected for quality assurance by the Agency.

### 3.8.2 Embankment

The Contractor shall perform sufficient testing to ensure that the embankment is being constructed as specified. The testing program specified below shall be considered the minimum acceptable frequency of testing. This does not relieve the Contractor from the responsibility of performing additional testing if required to ensure compliance with these Specifications.

a. Embankment Material Testing

(1) Soil classification tests shall be performed in accordance with ASTM D2487 for each 500 cubic yard of placed material and by

each different classification of material. As prescribed in ASTM D2487, grain size analyses in accordance with ASTM D6913 and Atterberg limits in accordance with ASTM D4318 shall be performed on each soil sample. The Contractor shall submit additional tests on materials that were blended in order to meet specifications.

(2) Moisture Density and Relative Compaction Relationships. The moisture-density relations for cohesive soils shall be determined in accordance with ASTM D698, Method A (a minimum of five (5), five-point compaction tests). The moisture-density curves will be compiled to form a family of curves which will be utilized to estimate optimum properties (maximum dry density and optimum moisture content) to be used with field density and associated testing described in 3.8.2a(3) below. Relative density for cohesionless soils shall be determined in accordance with ASTM D4253 and ASTM D4254.

| **TEST METHOD** | **FREQUENCY** |
|---|---|
| Moisture Density | Minimum of five (5) test per 500 CY of material or representative samples of each type of embankment material used. |
| Relationship (ASTM D698) | One test for every 100 cubic yards embankment placed with a minimum of one test per shift. |
| Soil Gradation (ASTM D6913), (ASTM D4318),and Soil Classification (ASTM D2487) | One test for each moisture density Atterberg Limit and relative compaction relationship. |

(3) Water (Moisture) Content Tests. Determination of water content shall be performed in accordance with ASTM D2216. ASTM D4643 may be used when rapid moisture content results are needed. If ASTM D4643 test method is used, a correlation between this method and D2216 test method shall be established and reviewed by the Agency. One water content test will be performed for each in-place density test at the location of the in-place density test. Backfill and embankments not meeting the required specifications for water content shall be retested after corrective measures have been applied.

(4) In-place Density Testing. The minimum in-place density testing is shown in the table below. The horizontal locations of tests shall be randomly staggered in the embankment. At each field density test location, soil samples shall be obtained for two-point compaction test, moisture content, grain size analysis, and Atterberg limits test. For two-point compaction tests, one moisture content shall be at the in-situ moisture content and one moisture content shall be between 3 and 5% below optimum. Embankment not meeting the required specifications for in-place density shall be retested after additional compaction has been completed.

| TEST METHOD | FREQUENCY |
|---|---|
| Nuclear Method (ASTM D6938) or Sand Cone (ASTM D1556) | One (1) In-Place Density Test for every 200 cubic yards of completed embankment unless otherwise specified. Additionally, at least one (1) test for each lift of embankment placed and material type. |
| Sand Cone (ASTM D1556) | One test for every ten (10) nuclear method tests and a minimum of one (1) test per shift and material type. |
| Two-Point Compaction Tests | At the location of each In-Place Density Test. |
| Soil Gradation and Atterberg Limit Tests | One (1) test for every 200 cubic yards of compacted embankment.<br><br>Minimum of one (1) test per shift and material type. |

When the nuclear method is used for in-place density testing, according to ASTM D6938, the first test and every tenth test thereafter for each material type shall include a sand cone correlation test in accordance with ASTM D1556.

Sand cone tests shall be performed adjacent to the location of the nuclear test, shall include a nominal 6 inch diameter sand cone, and shall include a minimum wet soil weight of 6 pounds extracted from the hole. Nuclear density testing equipment shall not be used during rain. The density correlations shall be submitted with test results within 24 hours after completing the test. Each transmittal including density test data shall include a summary of all density correlations for the job neatly prepared on a summary sheet including at a minimum:

(i) Meter serial number and operators initials.
(ii) Standard count for each test.
(iii) Material type.
(iv) Probe depth.
(v) Moisture content by each test method and the deviation.
(vi) Wet density by each test method and the deviation.
(vii) Density sand calibration

If soil appears to contain organics based on color or smell, the Agency will require the Contractor to test the material in accordance with ASTM D2487 to classify organic clay or organic silt (OH or OL).

Placement, moisture conditioning and compaction of cohesionless material for which a well-defined maximum density cannot be determined shall be in accordance with Section 3.6.2 of these Specifications. Lift thickness, compaction equipment type and compactor roller passes shall be observed and documented on a full

time basis. In-place nuclear density and moisture content tests and test frequency shall be in accordance with 3.9.2.a(3).

3.8.3 Reporting

On a daily basis, the Contractor shall furnish the inspection records and all material testing results, the quantity of embankment placed, as well as the records of corrective action taken, in accordance with Section 01 45 04.00 CONTRACTOR QUALITY CONTROL.

-- End of Section --

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# SECTION 31 11 00

# CLEARING, GRUBBING, AND DISCING

## PART 1 GENERAL

### 1.1 SCOPE

The work covered by this section consists of furnishing all labor, equipment, and materials necessary to perform the clearing grubbing, and discing, asphalt and concrete roadway removal, the removal or disposal of all cleared and grubbed materials, the removal and disposal of all asphalt and concrete, and the filling of all grubbing holes, as specified herein, as shown on the Plans, or as otherwise directed by the Agency.

### 1.2 DEFINITIONS

#### 1.2.1 Clearing

Clearing shall consist of the removal and disposal of large obstructions: trees, heavy vegetation, fencing, poles, septic tanks and lines, structures, utilities, old piling and similar debris that fall within the identified limits of construction shown on the plans; excluding restricted habitat areas. Refer to specification 02 41 00 DEMOLITION AND DECONSTRUCTION for removal and disposal procedures.

#### 1.2.2 Grubbing

Grubbing shall consist of the removal of all stumps, roots greater than 0.5 inches in diameter, buried logs, and other objectionable material as defined in these Specifications that fall within the identified limits of construction shown on the Plans; excluding restricted habitat areas or features otherwise shown as protected on the plans.

#### 1.2.3 Discing

Discing shall consist of the removal and stockpile/disposal of crops, weeds, grass, and other small vegetative and organic materials to the ground surface and of the Discing of the surface soil to the depth specified herein and to the construction limit shown on the Plans.

Discing shall be performed where the plans identify the footprint of construction for the placement of Embankment Fill.

### 1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Clearing, Grubbing and Discing Work Plan

Pre-Construction Surveys

SD-06 Test Reports

Post-Construction Surveys

1.4 ORDER OF WORK

a. Work shall be carried out within the project limit of construction identified in the Plans. Clearing and grubbing within temporary construction access areas is not required unless it is necessary to allow for access.

b. All clearing and grubbing work shall be completed at least 100 feet in advance of embankment construction. In locations where work on drainage structures is performed prior to embankment or ramp construction, all clearing and grubbing shall be completed in advance for at least 100 feet in both directions from the structure, measured along the trail or ramp center line.

c. All Discing work shall be performed where the identified footprint is to have embankment fill placed upon. See specification 31 00 00 EARTHWORK for suitable and unsuitable materials.

d. All holes caused by clearing and grubbing operations shall be excavated in conformance with Section 31 00 00 EARTHWORK. The excavations shall then be backfilled with the soil type to be placed above the material removed in conformance with Section 31 00 00 EARTHWORK. The backfill shall be keyed into adjacent ground and placed in layers to the level of adjacent Discing operations.

PART 2 PRODUCTS

2.1 WORK PLAN

A Clearing, Grubbing and Discing Work Plan shall be submitted to the Agency within 15 calendar days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is reviewed. The Contractor shall allow 10 calendar days in the schedule for the Agency's review. No adjustment for time or money will be made if re-submittal of the Clearing, Grubbing and Discing Work Plan is required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

a. Schedule of activities.

b. Method of clearing, grubbing, and Discing, and equipment to be used.

c. Method of removing asphalt and concrete removal and equipment to be used.

d. Disposal or recycle site for asphalt and concrete roadway material to be removed.

2.2 PRE-CONSTRUCTION SURVEYS

Surveys shall be performed immediately prior to clearing and grubbing to determine the acreage cleared and grubbed. The Contractor shall provide plan layout sheets on 100 foot intervals minimum and at break points for all cleared and grubbed areas.

## 2.3 POST-CONSTRUCTION SURVEYS

Surveys shall be performed immediately after stripping. The Contractor shall provide plan layout sheets on 100 foot intervals minimum and at break points for all stripped areas.

# PART 3 EXECUTION

## 3.1 CLEARING

### 3.1.1 General

The clearing operations must consist of the complete removal of obstruction above the ground surfaces as indicated on the Plans, except that only trees specifically designated on the Plans to be removed will be removed. All other trees must be protected even if within the designated limits of construction. I

### 3.1.2 Limits of Clearing

All stumps, down timber, snags, brush, vegetation, rock, stone, concrete rubble, abandoned structures, trash and similar materials and items must be cleared within the limits of construction.

#### 3.1.2.1 Vegetation

Vegetation to be removed must consist of all woody plants and other vegetation taller than 12-inches above the ground surface, except for trees that are not designated on the Plans to be removed. Vegetation shorter than 12-inches can be left in place and disced in place.

#### 3.1.2.2 Tree Removal

Only trees identified for removal on the Plans will be removed. Tree removal shall consist of removing the canopy, tree trunk, (and roots when located in the existing Chicory Loop Embankment). When tree root removal is required, all tree roots greater than 0.5 inches in diameter shall be excavated and removed and disposed of offsite at a location approved by the Agency. Roots larger than 0.5 inches in diameter can be expected to be located below ground in a similar proximity as the size of the canopy of the given tree. Any voids created as a result of the excavation of trees shall be backfilled and compacted with suitable material per specification 31 00 00 EARTHWORK. Tree removals must be completed outside of the nesting season.

##### 3.1.2.2.1 Additional Tree Removal

Additional trees not identified to be removed in the Plans that the contractor intends to remove to allow for construction requires Agency approval prior to removal. Submit a RFI with the list of additional trees to be removed and the justification for its removal.

### 3.1.4 Debris Removal

Remove and dispose of any debris within the construction limit shown on the Plans, or as designated for removal on the Plans or as directed by the Agency.

## 3.2 GRUBBING

### 3.2.1 General

Grubbing shall consist of the grinding of all stumps, removal of buried logs, and other objectionable material as defined in these Specifications and to the limits of construction shown on the Plans, excluding restricted habitat areas or vegetation to be protected in place. When holes are caused by grubbing operations, they must be backfilled with suitable material in accordance with 31 00 00 EARTHWORK.

## 3.3 DISCING

### 3.3.1 General

After inspection and review of cleared and grubbed areas, Discing may proceed.

### 3.3.2 Description of Work

Disced surfaces of excavations and fill foundations of heavy growth of crops, grass weeds and other vegetation to the limits and depth as specified below. Greater depths of discing may be necessary as specified below and as determined by the Agency. Discing is not needed for the for areas not receiving embankment fill placement.

a. The area identified on the Plans as the footprint associated with receiving embankment fill placement (trails, ramps, and stump hole backfill shall be disced to break down crops, weeds, grass, and other vegetative materials. Discing shall be to a minimum depth of 0.5 feet (measured perpendicular to the fill slope). Deeper discing may be required in areas where concentrations of organic soils or tree roots are encountered. Compact disced subgrade in accordance with 31 00 00 Earthwork.

## 3.4 DISPOSAL REQUIREMENTS

### 3.4.1 Cleared and Grubbed Material

Except as hereinafter specified, all logs, limbs, slash, and other debris products of the clearing and grubbing operations shall be disposed of offsite at an approved waste facility or as directed by the Agency. Refer to specification 02 41 00 DEMOLITION AND DECONSTRUCTION for additional direction on cleared and grubbed material disposal.

## 3.5 FIELD QUALITY CONTROL

### 3.5.1 Discing

The Contractor shall establish and maintain quality control for Discing operations to assure compliance with contract requirements and maintain

records of the quality control for all construction. The Contractor shall complete a post-discing verification which will include the description of equipment used, a description of methodology used, copies of the field notes, and the final data submitted. This report shall contain the certificate below, and be stamped and signed by the Professional Land Surveyor (or Civil Engineer, if legally allowed to practice surveying in the State of California) responsible for the survey work performed and shall be furnished to the Agency in accordance with Section 01 45 00.10 10 QUALITY CONTROL SYSTEM (QCS).

-- End of Section --

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# SECTION 31 25 00
# FLOATING ISLANDS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Floating islands and floating streambed, island anchors.

B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards—none.

B. Quality Control:
1. Testing agency:
   a. Contractor to employ and pay for services of a testing agency to:
      1) Perform materials evaluation.
      2) Design concrete mixes.
2. Do not begin assembling floating islands or floating streambed until product submittal has been approved by Engineer.
   a. Approval of floating islands, floating streambed, island anchors, and related submittals by Engineer does not relieve Contractor of his responsibility to provide products that meet the requirements of this Specification.
3. Adjustments to the design shall not be made without engineer approval.

C. Qualifications:
1. Floating islands and streambed shall be as manufactured by Floating Islands West, or approved equivalient.

### 1.3 DEFINITIONS

A. Floating Islands: UV-resistant, durable floating fiber matrix made from recycled plastic that floats on water with sufficient thickness and porosity to support terrestrial and marsh plants growing on top of the matrix and allowing roots to penetrate through matrix and enter water column below island.

B. Floating Streambed:Floating Island as described above with a dedicated stream channel, airlift pump, and connection apparatus to secure airlift pump at head of artificial stream channel.

C. Island anchors: Cable attachments with a helical ground anchors embedded in solid soil beneath ponds to secure the floating islands and floating streambed.

D. Binding cables: Stainless steel cables used to add tension to island modules to hold them together.

E. Binding cable sleeves: PVC pipes within the floating islands and streambed through which binding cables are installed.

F. Binding plate: square galvanized steel plate located on the perimeter of the floating island and floating streambed used for tensioning binding cables

G. Cable crimps: tube of metal designed to deform onto cable, or pair of cables to bind cables and prevent movement or slipping via friction

H. Anchor plate: galvanized steel plate located on the ends of the floating islands and floating streambed used for attaching island anchors

I. Anchor cables:

J. Helical anchors:

K. Streambed plate: fiberglass plate located beneath the streambed portion of the floating streambed.

L. Anchor shackle: U-shaped piece of metal secured with a clevis pin or bolt across the opening, or a hinged metal loop secured with a quick-release locking pin mechanism

M. Inoculates: specific cultured microbes that provide remediation and plant growth benefits

N. Indicated: Indicated by Contract Documents.

O. Required: Required by Contract Documents.

P. Submitted: Submitted to Engineer.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Floating island and floating streambed schematics.
   a. Floating island and floating streambed design submittal to include the following information:
      1) Overall dimensions.
      2) All component materials.
      3) All component dimensions.
      4) Assembly instructions and diagrams
3. Product technical data including:
   a. Manufacturer's installation instructions.
   b. Manufacturers and types:
      1) Floating islands.
      2) Floating streambed.
      3) Airlift Pump
4. Certifications:
   a. Statement from manufacturer that floating islands and floating streambed are constructed of 100% recycled PET woven fiber coated with UV-resistant polyurea.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:

1. Floating islands and floating streambed:
   a. Follow manufacturer’s instructions

2. Island anchors:
   a. Follow manufacturer's instructions

B. Delivery:
1. Floating islands and floating streambed:
   a. Ship to jobsite in an enclosed box truck.
   b. Ship to jobsite with part labels to match assembly instructions.
2. Island anchors:
   a. Follow manufacturer's instructions

C. Handling:
a. Follow manufacturer's instructions

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
1. Floating islands:
   a. As manufactured by Floating Islands West.
2. Floating streambed:
   a. As manufactured by Floating Islands West.
3. Island anchors:
   a. Pier Tech Systems or approved equivalent
4. Inoculates:
   a. As provided by Intrinsyx Environmental, or approved equivalent.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Floating islands and floating streambed matrix.
1. 100% recycled PET woven fiber coated with UV-resistant polyurea

B. Inoculates
1. Petroleum-degrading willow endophytes in culture of 1-2 species.
2. Nitrogen-fixing willow or poplar endophytes in culture of 1-5 species.

C. Island anchors:
1. As provided by PierTech Systems ground piles to 35 ft depth, or approved equivalent

D. Binding cables
1. Tensioning cables shall be 5/16" 316 stainless steel for tension cables not connected to ground anchors
2. Tensioning cables shall be 3/8" 316 stainless steel for tension cables not connected to ground anchors

E. Binding cable sleeves:
1. ¾" schedule 40 PVC pipe

F. Binding plates:
1. 3/8" galvanized steel

G. Cable crimps:

1.

H. Anchor plates:
1. 3/8” galvanized steel

I. Anchor cables:
1. 3/8” 316 stainless steel

J. Anchor shackle:
1. 3/8” stainless steel bolting

K. Helical anchors:
1. Pier tech ground piles to 35 ft or approved equivalent

L.

M.

PART 3 - EXECUTION

3.1 ASSEMBLING FLOATING ISLANDS

A. Formwork:
1. Contractor is responsible for assembly of floating islands and floating streambed.
2. Construct floating islands to match shapes and sizes indicated on drawings.
   a. Allowable tolerances:
3. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs or elevated floor slabs to drains.
   a. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.
   b. Do not place floor drains through beams.
4. Openings:
   a. Provide openings in formwork to accommodate work of other trades.
   b. Accurately place and securely support items built into forms.
5. Chamfer strips: Place 3/4 IN chamfer strips in forms to produce 3/4 IN wide beveled edges on permanently exposed corners of members.
6. Clean and adjust forms prior to concrete placement.
7. Tighten forms to prevent mortar leakage.
8. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.

B. Reinforcement:
1. Position, support and secure reinforcement against displacement.
2. Locate and support with chairs, runners, bolsters, spacers and hangers, as required.
3. Set wire ties so ends do not touch forms and are directed into concrete, not toward exposed concrete surfaces.
4. Lap splice lengths: ACI 318 Class B top bar tension splices unless indicated otherwise on the Drawings.
5. Extend reinforcement to within 2 IN of concrete perimeter edges.
   a. If perimeter edge is earth formed, extend reinforcement to within 3 IN of the edge.

6. Minimum concrete protective covering for reinforcement: As shown on Drawings.
7. Do not weld reinforcing bars.
8. Welded wire reinforcement:
   a. Install welded wire reinforcement in maximum practical sizes.
   b. Splice sides and ends with a splice lap length measured between outermost cross wires of each fabric sheet not less than:
      1) One spacing of cross wires plus 2 IN.
      2) 1.5 x development length.
      3) 6 IN.
   c. Development length: ACI 318 basic development length for the specified fabric yield strength.

C. Construction, Expansion, and Contraction Joints:

1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
   a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph below, submit proposed construction joint location in conformance with this Specification Section.
2. Unplanned construction joints will not be allowed.
3. Locate wall vertical construction joints at [30] [50] FT maximum.
4. Locate construction joints in floor slabs and foundation base slabs so that concrete placements are approximately square and do not exceed [2500] [4000] SQFT.
5. Locate construction joints in columns and walls:
   a. At the underside of beams, girders, haunches, drop panels, column capitals, and at floor panels.
   b. Haunches, drop panels, and column capitals are considered part of the supported floor or roof and shall be placed monolithically therewith.
   c. Column based need not be placed monolithically with the floor below.
6. Install construction joints perpendicular to main reinforcement with all reinforcement continued across construction joints.
7. At least [48] [72] HRS shall elapse between placing of adjoining concrete construction.
8. Thoroughly clean and remove all laitance and loose and foreign particles from construction joints.
9. Before new concrete is placed, dampen concrete surfaces.

D. Embedments:

1. Set and build in anchorage devices and other embedded items required for other work that is attached to, or supported by concrete.
2. See Specification Section 03 15 19 - Anchorage to Concrete.
3. Use setting diagrams, templates and instructions for locating and setting.

E. Placing Concrete:

1. Place concrete in compliance with ACI 304R and ACI 304.2R.
2. Place in a continuous operation within planned joints or sections.

3. Begin placement when work of other trades affecting concrete is completed.
4. Place concrete by methods which prevent aggregate segregation.
5. Do not allow concrete to free fall more than 4 FT.
6. Where free fall of concrete will exceed 4 FT, place concrete by means of tremie pipe or chute.

F. Consolidation: Consolidate all concrete using mechanical vibrators supplemented with hand rodding and tamping, so that concrete is worked around reinforcement and embedded items into all parts of forms.

G. Protection:

1. Protect concrete from physical damage or reduced strength due to weather extremes.
2. In cold weather comply with ACI 306.1 except as modified herein.
   a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice or snow.
   b. Do not place heated concrete that is warmer than 80 DEGF.
   c. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50 DEGF for seven days or 70 DEGF for 3 days.
   d. Do not allow concrete to cool suddenly.
3. In hot weather comply with ACI 305.1 except as modified herein.
   a. At air temperature of 90 DEGF and above, keep concrete as cool as possible during placement and curing.
   b. Do not allow concrete temperature to exceed 90 DEGF at placement.
   c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
   d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 LBS/SF/HR as determined from ACI 305.1, Figure 2.1.5.

H. Curing:

1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.
2. Cure concrete by use of moisture retaining cover, burlap kept continuously wet or by membrane curing compound.
3. Provide protection as required to prevent damage to concrete and to prevent moisture loss from concrete during curing period.
4. Provide curing for minimum of [seven] [14] days.
5. Form materials left in place may be considered as curing materials for surfaces in contact with the form materials except in periods of hot weather.
6. In hot weather follow curing procedures outlined in ACI 305.1.
7. In cold weather follow curing procedures outlined in ACI 306.1.
8. Curing vertical surfaces with a curing compound:
   a. Cover vertical surfaces with a minimum of two coats of the curing compound.

b. Allow the preceding coat to completely dry prior to applying the next coat.
c. Apply the first coat of curing compound immediately after form removal.
d. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
e. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.

I. Form Removal:
1. Remove forms after concrete has hardened sufficiently to resist damage from removal operations or lack of support.
2. Where no reshoring is planned, leave forms and shoring used to support concrete until it has reached its specified 28-day compressive strength.

3.2 INSTALLING FLOATING ISLANDS

A. Deploying floating islands:
1. .

B. Anchoring floating islands:
a. .
2. .

C. Planting floating islands: See specification SECTION 32 93 00 EXTERIOR PLANTS.

D. Installing inoculates in floating islands:

3.3 ASSEMBLING FLOATING STREAMBED

A. Preparation:

3.4 DEPLOYING FLOATING STREAMBED

A. Tests During Construction:
1.

3.5 ACCEPTANCE OF FLOATING ISLANDS AND FLOATING STREAMBED:

A. Floating islands and floating streambed will be accepted if all of the following requirements are met:
1. Binding cables have been tensioned to poundage indicated in the contract documents.
2. Island and streambed modules have been assembled to tolerances indicated in the contract documents.
3. Island anchors have been installed to resistance indicated in the contract documents.
4. Floating island and floating streambed have been inoculated with products indicated in the contract documents.
5.

B. If tests fail, perform additional tests and/or corrective measures as directed by Engineer.
1. Perform additional tests and/or corrective measures at no additional cost to Owner.

END OF SECTION

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SECTION 31 63 29

DRILLED CONCRETE PIERS AND SHAFTS
**11/19**

PART 1 GENERAL

[1.1 UNIT PRICES

a. Requirements for price breakdown of drilled concrete piers or shafts are specified in Section 01 20 00 PRICE AND PAYMENT PROCEDURES. Requirements for construction scheduling related to drilled concrete piers or shaft work are specified in Section 01 32 17.00 20 NETWORK ANALYSIS SCHEDULES (NAS).

b. Requirements for price breakdown of drilled concrete piers or shaft work are specified in Section 01 20 00 PRICE AND PAYMENT PROCEDURES.

[1.1.1 Basis of Bids

Base the bid on the number and total length of drilled concrete [piers] [and] [shafts], established by top and bottom elevations and diameters, as indicated and specified. Adjustment of the contract will be made [in accordance with the CONTRACT CLAUSES], if the total length of drilled concrete [piers] [or] [shafts] installed and approved is greater or less than the total length shown. The Contractor will not receive payment for rejected concrete [piers] [or] [shafts] or for those not conforming to specifications.

][1.1.2 Tests

1.1.2.1 Load Test

The Contract includes [_____] load tests rated at [_____] kips per drilled concrete [pier] [or] [shaft]. The Contracting Officer reserves the right to increase or decrease the number of load tests. Adjustments in the contract price will be made for each such increase or decrease by the amount bid for "Additional Drilled Concrete [Pier] [or] [Shaft] Test" or "Omitted Drilled Concrete [Pier] [or] [Shaft] Load Test".

1.1.2.2 Penetration Test

The Contract includes [_____] penetration tests. The Contracting Officer reserves the right to increase or decrease the number of penetration tests. Adjustments in the contract price will be made for each such increase or decrease by the amount bid for "Additional Penetration Test" or "Omitted Penetration Test".

1.1.2.3 Proof Test Hole

The Contract includes [_____] proof test holes. The Contracting Officer reserves the right to increase or decrease the number of proof test holes. Adjustments in the contract price will be made for each such increase or decrease by the amount bid for "Additional Proof Test Hole" or "Omitted Proof Test Hole".

][1.1.3 Separate Unit Prices

1.1.3.1 Additional Concrete [Pier][ or][ Shaft] Lengths

Additional [pier] [shaft] lengths will be paid for at the contract unit price for "Additional [Pier] [Shaft] Length" for each diameter of [pier] [shaft] installed as approved.

1.1.3.2 Omitted [Pier] [and] [Shaft] Lengths

The contract price will be reduced by the amount bid for "Omitted [Pier] [Shaft] Length" for each diameter of [pier] [shaft] omitted as directed.

1.1.3.3 Casings Permanently Left in Place

Steel casings permanently left in place due to contract conditions:

a. Total pounds of steel beyond casings indicated will be paid for at the contract unit price per pound for "Additional Steel Casing."

b. Omitted Casing Steel: The contract price will be reduced by the amount bid for "Omitted Casing Steel" omitted as directed.

1.1.3.4 Reinforcing Steel for Additional [Piers] [Shafts]

Reinforcing steel for additional [pier] [shaft] lengths will be paid for at the contract unit price for "Additional [Pier] [Shaft] Reinforcing Steel" installed as approved.

1.1.3.5 Reinforcing Steel for [Piers] [Shafts] Omitted

The contract price will be reduced by the amount bid for "Omitted [Pier] [Shaft] Reinforcing Steel" omitted as directed.

1.1.3.6 Removal of Rock

Removal of rock within the limit of [piers] [shafts] will be paid for at the contract unit price for "Removal of Rock" per linear foot, for each diameter of [pier] [shaft] installed. Rock excavation is defined as any hard dense material that cannot be removed with [pier] [shaft] drilling equipment having the specified capacity and could only be removed by hand, air tools, blasting, or other specialized methods.

1.1.3.7 Removal of Obstructions Other Than Rock

Removal of obstructions other than rock within the limits of the [piers] [shafts] which cannot be removed using standard drilling equipment with the specified capacity will be paid for at the contract unit price per linear foot for "Removal of Obstructions" for each diameter of [pier] [shaft] installed.

][1.1.4 Basis of Payment

1.1.4.1 Unit Price

The Contracting Officer has the right to increase or decrease the linear footage of drilled [piers] [shafts] to be furnished and installed by changing the [pier] [shaft] elevations, by requiring the installation of additional [piers] [shafts], or omission of [piers] [shafts] from the requirements shown and specified. Whether or not such changes are made, the Contractor will be paid at the contract unit price per linear foot

(including drilled pier and/or shaft) multiplied by the total linear feet of acceptable [piers] [shafts] actually installed provided, however, that in the event the Contracting Officer requires an increase or decrease in the linear footage of [piers] [shafts] furnished and installed, the contract unit price will be adjusted in accordance with the CONTRACT CLAUSES.

1.1.4.2 Full Compensation

Payment in accordance with the above paragraph Unit Price constitutes full compensation for furnishing, delivering, handling, and/or installing (as applicable) all material, labor and equipment necessary to meet contract requirements applicable to the [piers] [shafts]. The Contractor will not be allowed payment for rejected [piers] [shafts].

1.1.4.3 Load Tests

The Contract includes [_____] [_____] -kips [pier] [shaft] load tests. The Contracting Officer reserves the right to increase or decrease the number of load tests. Adjustments in the contract price will be made for such increases or decreases by the amounts bid for "Additional [Pier] [Shaft] Load Test" or "Omitted [Pier] [Shaft] Load Test."

1.1.4.4 Penetration Tests

The Contract includes [_____] penetration tests. The Contracting Officer reserves the right to increase or decrease the number of penetration tests. Adjustments in the contract price will be made for such increases or decreases by the amounts bid for "Additional Penetration Test" or "Omitted Penetration Test."

1.1.4.5 Proof Test Holes

The Contract includes [_____] proof test holes. The Contracting Officer reserves the right to increase or decrease the number of proof test holes. Adjustments in the contract price will be made for such increases or decreases by the amounts bid for "Additional Proof Test Hole" or "Omitted Proof Test Hole."

]]1.2 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 117 | (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary |
| ACI 301 | (2016) Specifications for Structural Concrete |
| ACI 304R | (2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete |
| ACI 305R | (2020) Guide to Hot Weather Concreting |

| | |
|---|---|
| ACI 306.1 | (1990; R 2002) Standard Specification for Cold Weather Concreting |
| ACI 318 | (2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14) |
| ACI 336.1 | (2001) Specification for the Construction of Drilled Piers |
| ACI SP-66 | (2004) ACI Detailing Manual |

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

| | |
|---|---|
| ASCE 7-16 | (2017; Errata 2018; Supp 1 2018) Minimum Design Loads and Associated Criteria for Buildings and Other Structures |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.1/A5.1M | (2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding |
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |
| AWS D1.4/D1.4M | (2011) Structural Welding Code - Reinforcing Steel |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A615/A615M | (2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A1064/A1064M | (2022) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |
| ASTM C31/C31M | (2022) Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| ASTM C39/C39M | (2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| ASTM C94/C94M | (2022a) Standard Specification for Ready-Mixed Concrete |
| ASTM C143/C143M | (2020) Standard Test Method for Slump of Hydraulic-Cement Concrete |
| ASTM C150/C150M | (2022) Standard Specification for Portland Cement |
| ASTM C172 | (2010) Standard Practice for Sampling |

Freshly Mixed Concrete

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

| | |
|---|---|
| CRSI 10MSP | (2018) Manual of Standard Practice |

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

| | |
|---|---|
| FHWA NHI-10-016 | (2010) Drilled Shafts: Construction Procedures and LRFD Design Methods |

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

| | |
|---|---|
| 29 CFR 1926.651 | Specific Excavation Requirements |

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Installation Plan

SD-02 Shop Drawings

Drilled Shaft Diameters[; G[, [____]]]

Depth of Test Holes[; G[, [____]]]

Top and Bottom of Shaft Elevations[; G[, [____]]]

Steel Reinforcement[; G[, [____]]]

Anchor Bolt Locations[; G[, [____]]]

Accessories[; G[, [____]]]

SD-05 Design Data

Drilled Shaft Foundation Design Analysis[; G[, [____]]]

Mix Design Data[; G[, [____]]]

SD-06 Test Reports

Soils Report[; G[, [_]]]

Ground Water Conditions

Load Test[; G[, [____]]]

Penetration Test[; G[, [____]]]

Slump

Concrete[; G[, [____]]]

Compressive Strength[; G[, [____]]]

SD-07 Certificates

Bill of Lading for Ready-Mix Concrete Deliveries

Steel Reinforcement[; G[, [____]]]

Welding Certificates[; G[, [____]]]

Excavation and Drilling Equipment

Qualifications of Excavator[; G[, [____]]]

Qualifications of Engineer[; G[, [____]]]

## 1.4 QUALITY CONTROL

### 1.4.1 General

Install drilled shaft foundations in accordance with applicable requirements as described by ACI 336.1, and FHWA NHI-10-016.

### 1.4.2 Sequencing and Scheduling

Submit a detailed installation plan describing the schedule for drilling and/or excavation, installation of steel reinforcement and concrete placement with anticipated site conditions so that each excavated shaft is poured the same day that the drilling is performed.

### 1.4.3 Inspection Criteria

Design inspection activities to minimize delays while insuring the intent of the Industry Standard Specifications.

### 1.4.4 Qualification of Excavation Contractor

An experienced excavator with five (5) years experience and licensed in the State of [_____], specialized in excavating and installing work similar in material, design, and extent to that indicated for this Project. Submit certificates substantiating the Qualifications of Excavator.

### 1.4.5 Qualification of Professional Engineer

Provide engineering services by an authorized engineer currently licensed in the State of [_____]; having a minimum of four (4) years experience as an engineer knowledgeable in drilled shaft foundation design analysis, protocols and procedures for the ACI 336.1, FHWA NHI-10-016, ASCE 7-16, and the [_____] Building Code. Submit certificates substantiating the Qualifications of Engineer.

### 1.4.6 Welding Qualifications

Provide and maintain qualified procedures and personnel according to AWS D1.1/D1.1M, AWS D1.4/D1.4M, and AWS A5.1/A5.1M. Submit Welding Certificates to the Contracting Officer.

1.4.7 Pre-Construction Conference

After submittals are received and approved but before drilled shaft excavation and foundation work, including associated work, is performed, the Contracting Officer will hold a pre-construction conference to review the following:

a. The drawings, specifications and the geotechnical report.

b. Finalize construction schedule and verify availability of materials, Excavator's personnel, equipment, and facilities needed to make progress and avoid delays.

c. Methods and procedures related to drilled shaft foundation installation, including engineer's written instructions.

d. Support conditions for compliance with requirements, including alignment between foundation system and erection of structural members.

e. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.

f. Temporary protection requirements for foundation assembly during and after installation.

1.5 PROJECT CONDITIONS

1.5.1 Existing Conditions

Locate existing underground utilities before excavating drilled shaft foundations. If existing utilities are to remain in place, provide protection during drilled shaft operations.

1.5.2 Interruption of Existing Utilities

Do not interrupt any utility to occupied facilities unless directed in writing by the Contracting Officer.

1.5.3 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit work to proceed without water entering into the area of excavation.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

Submit design data for the following:

a. Drilled shaft foundation design analysis to include, but not limited to the following:

(1) Applicable Building code criteria for the excavation's geographic area

(2) Dead and Live Loads

(3) Compressive and Lateral Loads

(4) Collateral Loads

(5) Foundation Loads

(6) Bearing strata

(7) Casing description

b. Mix design data in accordance with paragraph READY-MIX CONCRETE accompanied by the Bill of Lading for Ready Mix Concrete deliveries.

2.1.1 Assembly

Installation drawings are to include, but not limited to, the following items indicating a completely dimensioned layout and location of drilled shafts and concrete placement for foundation system. Submit detailed shop drawings for the following:

a. Drilled shaft diameters

b. Depth of test holes

c. Top and bottom of shaft elevations

d. Steel reinforcement

e. Anchor bolt locations

f. Accessories

2.2 EQUIPMENT

2.2.1 Drilling and Excavation Equipment

Provide drilling and excavation equipment having adequate capacity, including but not limited to, power, torque and down thrust to excavate a hole of diameter and depth indicated. Also provide excavation and over-reaming tools of adequate design, size and strength to perform the work indicated.

Provide special drilling equipment including, but not limited to, rock core barrels, rock tools, air tools and other equipment as necessary to construct the shaft excavation to the size and depth indicated when materials encountered can not be drilled using earth augers and/or over-reaming tools.

Submit certificates substantiating appropriate selection of excavation and drilling equipment.

2.3 MATERIALS

2.3.1 Steel Reinforcement

2.3.1.1 Deformed Steel Bars

Steel bars conforming to ASTM A615/A615M, Grade 60 ksi and ACI 318.

2.3.1.2 Plain Steel Wire

Steel wire conforming to ASTM A1064/A1064M.

2.3.2 Ready-Mix Concrete

Ready-Mix concrete and mix design conforming to ACI 117, ACI 301, and ACI 304R, minimum compressive strength 5,500 psi at 28 days. Slump results between 5 to 6 inches, according to ASTM C143/C143M.

Portland cements conforming to ASTM C150/C150M, Type II. Provide one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

Potable water conforming to ASTM C94/C94M.

Measure, batch, mix and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

PART 3 EXECUTION

3.1 PREPARATION

Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled shaft foundation operations.

Provide Fall Protection as required by Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and 29 CFR 1926.651.

3.2 INSTALLATION

3.2.1 Construction Criteria

Provide equipment for checking the dimensions and alignment of each shaft excavation. Determine dimensions and alignment jointly with the contractor and engineer. Measure final shaft depths with appropriate weighted tape measure or other approved method after cleaning.

Provide and install monolithically cast-in-place concrete drilled shaft foundation to the sizes indicated.

Provide and install straight cylindrical shaft foundation of the type indicated.

Tolerances:

a. Maximum variation of the center of any shaft foundation from the required location: 3 inches, measured at the ground surface.

b. Bottom Diameter: Minus zero, plus 6 inches, measured in any direction.

c. Maximum variation from plumb: 1:40.

d. Maximum bottom level: Plus or minus 2 inches.

3.2.2 Excavation

Accomplish excavation of shaft foundations by standard excavation methods including, but not limited to, conventional augers fitted with soil and/or rock teeth, or under-reaming tools attached to drilling equipment of

adequate size, power, torque and down thrust necessary for the work.

Perform excavation through whatever materials that are encountered to the dimensions, depths and applicable ACI 336.1 tolerances.

Protect excavated walls with temporary watertight steel casings of sufficient length to prevent water intrusion, cave-ins, displacement of surrounding earth, and injury to personnel and damage to construction operations.

Excavate shafts for drilled foundations to indicated elevations. Remove loose debris, materials and/or muck to make bottom surfaces level within ACI 336.1 tolerances.

Remove water from excavated shaft prior to concrete placement.

### 3.2.3 Steel Reinforcement

Comply with recommendations in the CRSI "Manual of Standard Practice" CRSI 10MSP for fabricating, placing and supporting reinforcement. Shop fabricate steel reinforcement in accordance with ACI SP-66.

When practicable, deliver the reinforcement cage assembly to the jobsite as a complete unit ready for installation. Should it be necessary to make any additional connections and/or splices, provide as indicated on the approved shop drawings, at-grade level prior to lowering the complete assembly into the hole.

Clean reinforcement of loose rust, mill scale, earth and other foreign materials. Do not tack weld crossing reinforcing bars. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Lower reinforcement steel into the hole in such a manner as to prevent damage to the walls of the excavation. Place, tie and/or clip cage symmetrically about the axis of the shaft. Use centering devices securely attached to the cage to clear the shaft walls and maintain the cage in place throughout the concrete placement operations.

Cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between reinforcing and embedded items, notify the Contracting Officer in order to reconcile conflicts before concrete placement. Position and support anchors and embedded items with appropriate accessories.

Use templates to set anchor bolts, leveling plates and other accessories required for structure erection. Provide blocking and/or holding devices to maintain required anchoring positions during final concrete placement.

### 3.2.4 Concrete Placement

Keep all equipment, including but not limited to, mixers, pumps, hoses, tools and screeds clean and free of set concrete throughout the placement operation.

Convey concrete from the mixer to place of deposit by best industry methods that prevents segregation and loss of material. Size and design the equipment for conveying concrete to ensure uniform, continuous placement of concrete.

Place concrete in accordance with ACI 318.

Place concrete in a continuous operation and without segregation into dry excavations whenever possible after inspection and written approval by the Contracting Officer. Use all practicable means to obtain a dry excavation before and during concrete placement.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. When hot weather conditions exist that would impair quality and strength of placed concrete, comply with ACI 305R. Comply with ACI 306.1 for cold-weather protection.

A minimum of 50 percent of the base for each shaft is to be less than 1/2 inch of sediment at the time of concrete placement. Maximum depth of sediment or debris at any place on the base of the shaft is not to exceed 1-1/2 inches. Shaft cleanliness is to be determined by the engineer by visual inspection.

## 3.3 FIELD QUALITY CONTROL

### 3.3.1 Test Reports

As a minimum, submit the following test reports and data.

a. Soils Report

b. Ground Water conditions

c. Load Test

d. Penetration Test

e. Slump

f. Concrete

g. Compressive Strength

Sample and test concrete for quality control during placement.[ Quality control testing is provided by the contract.]

Sample freshly placed concrete for testing in accordance with ASTM C172.

Make concrete test specimens for compressive strength at 7 and 28 days for each design mix conforming to ASTM C31/C31M. Compression test concrete in accordance with ASTM C39/C39M.

Test Slump at plant for each design mix in accordance with ASTM C143/C143M.

-- End of Section --

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# SECTION 32 11 23

# AGGREGATE SURFACING/BASE COURSE

## PART 1 GENERAL

### 1.1 SCOPE

The work specified herein consists of the construction of an aggregate surfacing and aggregate base course. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans. Sources of all materials shall be selected well in advance of the time that materials will be required in the work.

### 1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C117 | (2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C127 | (2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate |
| ASTM C128 | (2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate |
| ASTM C131 | (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM D1557 | (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |
| ASTM D2487 | (2011) Soils for Engineering Purposes (Unified Soil Classification System) |
| ASTM D6938 | (2015) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |

| | |
|---|---|
| ASTM D75/D75M | (2014) Standard Practice for Sampling Aggregates |
| ASTM E11 | (2015) Wire Cloth and Sieves for Testing Purposes |

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

| | |
|---|---|
| CDT Std Specs | (2006) Standard Specifications |

## 1.3 DEFINITIONS

For the purposes of this specification, the following definitions apply.

### 1.3.1 Aggregate Surfacing/Base Course

Aggregate surfacing/base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

### 1.3.2 Cement Treated Aggregate Base

Cement treated aggregate base shall be as described in Section 27, "Cement Treated Bases" of CDT Std Specs.

### 1.3.3 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as percent of laboratory maximum dry density.

## 1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

List of proposed equipment to be used in performance of construction work, including descriptive data.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work.

SD-06 Test Reports

Source of Material Compliance Test Data

Gradation, Atterberg limits tests, and moisture-density relationship from the material source.

Laboratory Moisture-Density Relationship

Laboratory moisture-density relationship tests taken from material placed in the field for QC testing purposes.

Moisture-Density Determinations

Field Density Tests

Certified copies of test results for review not less than 15 days before material is required for the work.
Calibration curves and related test results prior to using the device or equipment being calibrated.
Copies of field test results within 24 hours after the tests are performed.

## 1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01 45 04.00 41 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. For all testing required by this section, appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials and conditions being certified by the tests. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Agency may specify the time and location of the tests. Copies of test results shall be furnished to the Agency within 24 hours of completion of the tests. Certified copies of test results shall be submitted not less than 15 days after completion of initial test requests.

### 1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Agency.

### 1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

#### 1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C117 and ASTM C136. Sieves shall conform to ASTM E11.

#### 1.5.2.2 Field Density Tests

Determine the in-place density in accordance with ASTM D6938.

#### 1.5.2.3 Wear Test

Wear tests shall be made on ABC coarse material in conformance with ASTM C131.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

a. Sieve Analysis.

b. Moisture-density relationship.

c. Wear.

1.5.3.2 In Place Tests

Each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

a. Density tests shall be performed on every lift of material placed and at a frequency of one tests for every 500 square yards, or portion thereof, of completed area.

b. Sieve Analysis shall be performed on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.

c. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square yards of base course,or portion thereof, of completed area. Measurements shall be made in 3 inch diameter test holes penetrating the base course. At least one test per completed area shall be performed.

d. One laboratory moisture-density relationship per every 4 field density tests shall be performed of completed area.

1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted course(s). The source of material compliance test data shall also be submitted.

1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

## 1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work shall be subject to review before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

# PART 2 PRODUCTS

## 2.1 AGGREGATES

The aggregate surfacing/base course (ABC) shall consist of clean, sound, durable particles of crushed stone, crushed gravel, angular sand, South River Road Structural Section or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the No. 4 sieve shall be known as coarse aggregate; that portion passing the No. 4 sieve shall be known as fine aggregate.

### 2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Recycled Asphaltic Concrete: Recycled asphaltic Concrete shall consist of material salvaged from the demolition of South River Road or other project areas.

#### 2.1.1.1 Aggregate Surfacing/Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest mid sectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

### 2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Surfacing/Base Course

ABC fine aggregate shall consist of screenings, angular sand, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E11.

TABLE I. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

| Sieve Designation | Operating Range | Contract Compliance |
|---|---|---|
| 1 inch | 100 | 100 |
| 3/4 inch | 90-100 | 87-100 |
| No. 4 | 35-60 | 30-65 |
| No. 30 | 10-30 | 5-35 |
| No. 200 | 2-9 | 0-12 |

NOTE 1: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C127 and ASTM C128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Agency.

NOTE 2: The Contract compliance range consists of the material gradation tested after placement and including any deviation resulting from crushed particle occurring as the result of compaction.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control.

3.2 OPERATION OF AGGREGATE SOURCES

The aggregate sources shall be operated to produce the quantity and quality of materials meeting these specifications requirements in the specified time limit. Aggregate shall be from commercial sources.

## 3.3 SALVAGE AND STOCKPILING MATERIAL

Salvaged material from the excavation of existing roadway surfaces shall be utilized as Aggregate Surfacing for the landside O&M Corridor road and meet the gradation requirements of ¾" Caltrans Class 3 Aggregate Base.

Aggregates shall be stockpiled on the cleared and leveled areas to prevent segregation. If material along the reach of South River Road materially varies, stockpile each material separately.

## 3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the base course, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the base course(s), the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the base course(s). Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the base course is placed.

## 3.5 INSTALLATION

### 3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant at source. The Contractor shall make adjustments in placement methods or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification.

### 3.5.2 Placing

The mixed material shall be placed on the prepared subgrade in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall be thicker than 6 inches or thinner than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

### 3.5.3 Grade Control

The finished and completed base course shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required base course thickness so that the finished base course and the subsequent surface course will meet the designated grades.

### 3.5.4 Compaction

Each layer of the base course shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 95 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

### 3.5.5 Thickness

Compacted thickness of the base course shall be as indicated. No individual layer shall be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. The total compacted thickness of the base course(s) shall be within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements plus 1/2 inches. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/4 inch of the thickness indicated. The total thickness of the base course shall be measured at intervals in such a manner as to ensure one measurement for each 160 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

### 3.5.6 Cement Treated Base Course

The placement and spreading of cement shall be in accordance with Section 27-1.06 of CALTRANS resulting in a maximum compacted thickness of 6 inches and minimum compacted thickness of 3 inches. Compaction of the cement treated base course shall be in accordance with Section 27-1.07 of CALTRANS except the finish surface shall meet the requirements of paragraph "Finishing" and "Smoothness" of this specification. Curing shall be in accordance with Section 27-1.10 of CALTRANS.

### 3.5.7 Finishing

The surface of the top layer of base course shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, then the top layer shall be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

### 3.5.8 Smoothness

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 20 foot intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

## 3.6 TRAFFIC

Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

## 3.7 MAINTENANCE

The base course shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any base course that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the requirements of this specification. Any area of base course that is damaged shall be reworked or replaced as necessary to comply with this specification.

## 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

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# SECTION 32 12 16

# HOT-MIX ASPHALT (HMA) FOR ROADS

## PART 1 GENERAL

### 1.1 UNIT PRICES

#### 1.1.1 Method of Measurement

The amount paid for will be the number of short tons of hot-mix asphalt mixture used in the accepted work. Weigh hot-mix asphalt mixture after mixing, and no separate payment will be made for weight of asphalt cement material incorporated herein.

#### 1.1.2 Basis of Payment

Payment will constitute full compensation for furnishing all materials, equipment, plant, and tools; and for all labor and other incidentals necessary to complete work required by this section of the specification.

### 1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C136/C136M | (2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C566 | (2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying |
| ASTM D1461 | (2011) Moisture or Volatile Distillates in Bituminous Paving Mixtures |
| ASTM D2172/D2172M | (2011) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures |
| ASTM D2950/D2950M | (2014) Density of Bituminous Concrete in Place by Nuclear Methods |
| ASTM D3665 | (2012) Random Sampling of Construction Materials |
| ASTM D3666 | (2013) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials |
| ASTM D4125/D4125M | (2010) Asphalt Content of Bituminous Mixtures by the Nuclear Method |

| | |
|---|---|
| ASTM D5444 | (2015) Mechanical Size Analysis of Extracted Aggregate |
| ASTM D6307 | (2010) Asphalt Content of Hot Mix Asphalt by Ignition Method |
| ASTM D6925 | (2014) Standard Test Method for Preparation and Determination of the Relative Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor |
| ASTM D6926 | (2010) Standard Practice for Preparation of Bituminous Specimens Using Marshall Apparatus |
| ASTM D6927 | (2015) Standard Test Method for Marshall Stability and Flow of Bituminous Mixtures |

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

| | |
|---|---|
| CTM 526 | (2002) Operation of California Profilograph and Evaluation of Profiles |

## 1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design;

Quality Control;

Material Acceptance;

Percent Payment;

SD-04 Samples

Asphalt Cement Binder

Aggregates

SD-06 Test Reports

Aggregates;

QC Monitoring

SD-07 Certificates

Asphalt Cement Binder;

Testing Laboratory

## 1.4 ENVIRONMENTAL REQUIREMENTS

Do not place the hot-mix asphalt upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3. The temperature requirements may be waived by the Contracting Officer, if requested; however, meet all other requirements, including compaction.

| Table 3. Surface Temperature Limitations of Underlying Course | |
|---|---|
| Mat Thickness, inches | Degrees F |
| 3 or greater | 40 |
| Less than 3 | 45 |

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections indicated. Construct each course to the depth, section, or elevation required by the drawings and roll, finish, and approve it before the placement of the next course.

### 2.1.1 Mix Design

Hot Mix Asphalt shall conform to Section 39 of the State Standard Specifications and shall be Type A Hot Mix Asphalt using PG 64-10 asphalt binder unless otherwise required by the Engineer. Aggregate used in HMA Type A must comply with the 3/4-inch HMA Type A and B gradation.

# PART 3 EXECUTION

## 3.1 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, clean the underlying course of dust and debris. Apply a prime coat and tack coat in accordance with the contract specifications.

## 3.2 TESTING LABORATORY

Submit certification of compliance and Plant Scale Calibration Certification. Use a laboratory to develop the JMF that meets the requirements of ASTM D3666. The Agency will inspect the laboratory equipment and test procedures prior to the start of hot mix operations for conformance to ASTM D3666. The laboratory shall maintain the Corps certification for the duration of the project. A statement signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The statement shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

## 3.3 TRANSPORTING AND PLACING

### 3.3.1 Transporting

Transport the hot-mix asphalt from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F. To deliver mix to the paver, use a material transfer vehicle operated to produce continuous forward motion of the paver.

### 3.3.2 Placing

Place and compact the mix at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it will have the required thickness and conform to the grade and contour indicated. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 10 feet. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 10 feet from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

## 3.4 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. Compact the surface as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be in accordance with Caltrans Standard Specification, Section 39 Asphalt Concrete. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to

grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

## 3.5 JOINTS

The formation of joints shall be performed ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

### 3.5.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. Remove the cutback material from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

### 3.5.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, shall be cut back a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

## 3.6 QUALITY CONTROL

### 3.6.1 General Quality Control Requirements

Develop and submit an approved Quality Control Plan. Submit aggregate and QC test results. Do not produce hot-mix asphalt for payment until the quality control plan has been approved addressing all elements which affect the quality of the pavement including, but not limited to:

a. Mix Design

b. Aggregate Grading

c. Quality of Materials

d. Stockpile Management

e. Proportioning

f. Mixing and Transportation

g. Mixture Volumetrics

h. Moisture Content of Mixtures

i. Placing and Finishing

j. Joints

k. Compaction

l. Surface Smoothness

3.6.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site and meeting the pertinent requirements in ASTM D3666. Laboratory facilities shall be kept clean and all equipment maintained in proper working condition. The Agency shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Agency will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.6.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability (NA for Superpave), flow (NA for Superpave), in-place density, grade and smoothness. Develop a Quality Control Testing Plan as part of the Quality Control Program.

3.6.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE) by one of the following methods: the extraction method in accordance with ASTM D2172/D2172M, Method A or B, the ignition method in accordance with ASTM D6307, or the nuclear method in accordance with ASTM D4125/D4125M. Calibrate the ignition oven or the nuclear gauge for the specific mix being used. For the extraction method, determine the weight of ash, as described in ASTM D2172/D2172M, as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.6.3.2 Gradation

Determine aggregate gradations a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D5444. When asphalt content is determined by the ignition oven or nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, test aggregates in accordance with ASTM C136/C136M using actual batch weights to determine the combined aggregate gradation of the mixture.

3.6.3.3 Temperatures

Check temperatures at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.6.3.4 Aggregate Moisture

Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C566.

3.6.3.5 Moisture Content of Mixture

Determine the moisture content of the mixture at least once per lot in accordance with ASTM D1461 or an approved alternate procedure.

3.6.3.6 Laboratory Air Voids, Marshall Stability and Flow

Take mixture samples at least four times per lot compacted into specimens, using 50 blows per side with the hand-held Marshall hammer as described in ASTM D6926. When the Superpave gyratory compactor is used, mixes will be compacted to 50 gyrations in accordance with ASTM D6925. Hot-mix provided under the DOT Superpave option shall be compacted in accordance with the DOT requirements. After compaction, determine the laboratory air voids of each specimen. Stability and flow shall be determined for the Marshall-compacted specimens, in accordance with ASTM D6927.

3.6.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D2950/D2950M.

3.6.3.8 Grade and Smoothness

Conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraphs MATERIAL ACCEPTANCE.

3.6.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.6.3.10 QC Monitoring

Submit all QC test results to the Agency on a daily basis as the tests are performed. The Agency reserves the right to monitor any of the Contractor's

quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

### 3.6.4 Sampling

When directed by the Agency, sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

## 3.7 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Forward test results and payment calculations daily to the Agency. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 2000 short tons. Where appropriate, adjustment in payment for individual lots of hot-mix asphalt will be made based on in-place density, laboratory air voids, grade and smoothness in accordance with the following paragraphs. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

### 3.7.1 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Agency desires, will be taken from a loaded truck delivering mixture to each sublot, or other appropriate location for each sublot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each sublot sample in accordance with ASTM D6926. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

### 3.7.2 Additional Sampling and Testing

The Agency reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Contractor. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

### 3.7.3 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 0.05 foot from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of

abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. The grade will be determined by running lines of levels at intervals of 25 feet, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, test the final wearing surface of the pavement for conformance with the specified plan grade. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

### 3.7.4 Surface Smoothness

Use one of the following methods to test and evaluate surface smoothness of the pavement. Perform all testing in the presence of the Agency. Keep detailed notes of the results of the testing and furnish a copy to the Agency immediately after each day's testing. [Use the profilograph method for all longitudinal testing, except where the runs would be less than 200 feet in length and the ends where the straightedge will be used.] Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Agency.

#### 3.7.4.1 Smoothness Requirements

##### 3.7.4.1.1 Straightedge Testing

The finished surfaces of the pavements shall have no abrupt change of 1/4 inch or more, and all pavements shall be within the tolerances of 1/4 inch in both the longitudinal and transverse directions, when tested with an approved 12 feet straightedge.

##### 3.7.4.1.2 Profilograph Testing

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and each 0.1 mile segment of each pavement lot shall have a Profile Index not greater than 9 inches/mile when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 200 feet, that direction shall be tested by the straightedge method and shall meet requirements specified above.

#### 3.7.4.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. Test each lot of the pavement in both a longitudinal and a transverse direction on parallel lines. Set the transverse lines 15 feet or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lanes less than 20 feet wide and at the third points for lanes 20 feet or wider. Also test other areas having obvious deviations. Longitudinal testing lines shall be continuous across all joints.

3.7.4.2.1 Straightedge Testing

Hold the straightedge in contact with the surface and move it ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

3.7.4.2.2 Profilograph Testing

Perform profilograph testing using approved equipment and procedures described in CTM 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 mile segment of each pavement lot. Grade breaks on parking lots shall be accommodated by breaking the profile segment into shorter sections and repositioning the blanking band on each segment. The "blanking band" shall be 0.2 inches wide and the "bump template" shall span 1 inch with an offset of 0.3 inch. Compute the Profile Index for each pass of the profilograph in each 0.1 mile segment. The Profile Index for each segment shall be the average of the Profile Indices for each pass in each segment. The profilograph shall be operated by a DOT approved operator. Furnish a copy of the reduced tapes to the Agency at the end of each day's testing.

-- End of Section --

# SECTION 32 15 40

# STABILIZED DECOMPOSED GRANITE PAVING

## PART 1 GENERAL

### 1.1 SCOPE

The work specified herein consists of the construction of a stabilized decomposed granite paving. The work shall be performed in accordance with this specification and shall conform to the lines, grades, notes and typical sections shown in the plans. Sources of all materials shall be selected well in advance of the time that materials will be required in the work.

### 1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C33/C33M-16 | Concrete Aggregates |
| ASTM C117 | (2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing |
| ASTM C127 | (2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate |
| ASTM C128 | (2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate |
| ASTM C131 | (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| ASTM C136 | (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM D1557 | (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3) |
| ASTM D2487 | (2011) Soils for Engineering Purposes (Unified Soil Classification System) |

| | |
|---|---|
| ASTM D6938 | (2015) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) |
| ASTM D75/D75M | (2014) Standard Practice for Sampling Aggregates |

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

| | |
|---|---|
| CDT Std Specs | (2006) Standard Specifications |

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| M147-65-UL-04 | Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses. |

## 1.3 DEFINITIONS

For the purposes of this specification, the following definitions apply.

### 1.3.1 Degree of Compaction

Degree of compaction required is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as percent of laboratory maximum dry density.

## 1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

Manufacturer’s current catalog content and specifications for ¼” minus decomposed granite, stabilizer, and geotextile fabric.

Waybills and Delivery Tickets

Copies of waybills and delivery tickets during the progress of the work.

Special Warranty in accordance with section 1.9 Warranty

SD-05 Samples

Half a pound for each size and color range of decomposed granite. Mock-up sample of 10-foot wide by 6-foot long, full depth to match finish condition per section 1.8 Quality Assurance.

SD-06 Test Reports

Stabilized decomposed granite paving

Certified copies of field tests of compressive strengths of stabilized decomposed granite paving.

Submit manufacturer's written maintenance instructions.

## 1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01 45 04.00 41 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. For all testing required by this section, appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials and conditions being certified by the tests. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Agency may specify the time and location of the tests. Copies of test results shall be furnished to the Agency within 24 hours of completion of the tests. Certified copies of test results shall be submitted not less than 15 days after completion of initial test requests.

### 1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Agency.

### 1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

#### 1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C117 and ASTM C136. Sieves shall conform to ASTM E11.

#### 1.5.2.2 Field Density Tests

Determine the in-place density in accordance with ASTM D6938.

### 1.5.3 Testing Frequency

#### 1.5.3.1 In Place Tests

Each of the following tests shall be performed on the proposed material after construction in place to demonstrate that the proposed material meets all specified requirements in place.

a. Compaction testing to be provided by contractor, one test per 2,000 square feet of stabilized decomposed granite.

b. After water application, test with a minimum of one core sample per 1,000 square feet; repair sample area to match adjacent section.

c. The total thickness of the decomposed granite shall be measured at intervals in such a manner as to ensure one measurement for each 160 square yards of base decomposed granite. Measurements shall be made in 3-inch diameter test holes penetrating the decomposed granite.

## 1.6 WEATHER LIMITATIONS AND PROJECT CONDITIONS

Do not install stabilized decomposed granite during rain or while sub-base is wet from rain or below 40 degrees Fahrenheit and falling.

Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.

## 1.7 STORAGE

Protect from contamination with foreign materials. Isolate stockpiles to prevent mixing of different aggregate grades and types. Prevent contamination with organic materials.

## 1.8 QUALITY ASSURANCE

Installer Qualifications:
Installer to provide evidence to indicate successful experience in providing Stabilized Aggregate surface or ability to follow installation instructions.

Mock-ups:
Install 10-feet wide by 6-feet long mock-up of stabilized decomposed granite. Location to be agreed upon by owner’s representative.

## 1.9 WARRANTY

General Warranty

The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

Specialty Warranty

Submit a written warranty executed by the installer agreeing to repair or replace components of Stabilized Aggregate that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

Premature wear and tear, provided the material is maintained in accordance with manufacturer’s written maintenance instructions.

Failure of system to meet performance requirements.

Warranty Period

Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.

Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

## PART 2 PRODUCTS

### 2.1 DECOMPOSED GRANITE

Sand and crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation requirements:

Crushed Stone Sieve Analysis Percentage of Weight Passing a Square Mesh Sieve AASHTO T11-82 and T2782.

¼" Minus Crushed Aggregate Surface

Gradation:

| Sieve Designation | % Passing by Weight |
|---|---|
| 3/8 inch | 100 |
| No. 4 | 90-100 |
| No. 8 | 71-80 |
| No. 16 | 55-65 |
| No. 30 | 40-50 |
| No. 50 | 25-35 |
| No. 100 | 15-21 |
| No. 200 | 10-15 |

Color:

Desert Gold, or approved equal.

#### 2.1.1 Stabilizer Binder

Stabilizer Solutions, Inc. or approved equal.

Non-Toxic organic binder - colorless, odorless, naturally binding stabilizing powder that binds to decomposed granite or crushed 1/4" minus aggregate.

Product shall have 25 years of experience at same formulation.

#### 2.1.2 Weed Control Fabric

Roll Type Polypropylene or Polyester Mats: Woven, needle punched, or non-woven fabric treated for protection against deterioration due to ultraviolet radiation. Minimum 99 percent opaque to prevent photosynthesis and seed germination, fabric allows air, water, and nutrients to pass through to plant roots.

Minimum wight: 5 ounces per square yard.

Minimum thickness: 20 mils.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

Sub-grades shall have been rough-graded to within 1/10 foot of finish grades less depth of decomposed granite paving.

Verify that HMA, concrete paving, airline piping, and slope grading have been installed, accepted, and completed prior to commencement of work.

When the decomposed granite is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control.

### 3.2 PREPARATION OF UNDERLYING COURSE

Prior to constructing the decomposed granite, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the decomposed granite, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 31 00 00 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the decomposed granite. Stabilization shall be accomplished by mixing decomposed into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the decomposed granite is placed.

### 3.5 INSTALLATION

#### 3.5.1 Mixing the Materials

The decomposed granite and stabilizer shall be mixed thoroughly and continuously mixed with a pugmill or other approved mechanically mixing method on site. Drop spreading over preplaced aggregate, bucket mix or rototiller is not acceptable. Mix at a rate of 12-15 pounds of stabilizer per ton of aggregate screenings. Verify with manufacturer correct stabilizer rate for project and climate. The Contractor shall adjust placement methods or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to ensure a satisfactory placement of material meeting all requirements of this specification. Always blend stabilizer and aggregate DRY.

Adjust quantity of water added to the mixture to permit maximum compaction of the materials after it is placed on the sub-grade. Moisture shall permeate full depth. After water application, test with core samples per section 1.5 and repair sample area to match adjacent section.

### 3.5.2 Placing

The mixed material shall be placed on the prepared subgrade in layers of uniform thickness with an approved spreader in lifts not to exceed 3-inches. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the decomposed granite is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable decomposed granite surface. DO NOT place on filter fabric.

### 3.5.3 Watering

Water heavily for full-depth moisture penetration of profile. Water activates stabilizer. Apply 25 to 45 gallons of water per 1-ton to achieve saturation. Randomly test for depth using a probing device, which reaches full depth.

Contractor shall wait a minimum of 6 to 72 hours or until such time that the stabilized aggregate is able to accept compaction from a 1 to 5 ton roller without separation, plowing or any other physical compromise of the aggregate.

If surface aggregate drives significantly quicker than subsurface materials, lightly mist surface before compaction.

### 3.5.4 Compaction

Do not begin compaction for 6 to 72 hours after placement and watering. Each layer of the stabilized decomposed granite shall be compacted with a 1 to 5 ton double drum roller or other approved compaction equipment making a minimum of 4 passes.DO NOT use a vibratory plate compactor or vibration feature on roller.

Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. If pumping or pancaking of surface occurs, surface is still too wet to roll.

Compaction shall continue until each layer has a degree of compaction that is at least 85% percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory decomposed granite surface.

Lightly spray surface area following compaction. Do not disturb aggregate surface with spray action.

Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

### 3.5.5 Thickness

Compacted thickness of the base course shall be as indicated. No individual layer shall be thicker than 3-inches. The total compacted thickness of the decomposed granite shall be within 1/8-inch of the thickness indicated. Where the measured thickness is more than 1/8-inch deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed.

Where the measured thickness is more than 1/8-inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements plus 1/8-inches. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 1/8-inch of the thickness indicated.

### 3.5.6 Grade Control

The finished and completed decomposed granite surface shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required decomposed granite thickness so that the finished decomposed granite surface will meet the designated grades. Finished surface shall be uniform in texture and appearance and not vary more than 1/8” in 10-feet from true profile and cross section.

### 3.5.7 Finishing

The surface of the top layer of decomposed granite shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of decomposed granite to meet grade. If the elevation of the top layer of decomposed granite is 1/8 inch or more below grade, then the top layer shall be raked/scarified to a depth of at least 1-1/2 inches and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable decomposed granite surface. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be raked/scarified, reworked and recompacted or it shall be replaced as directed.

## 3.6 TRAFFIC

Completed portions of the decomposed granite may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

## 3.7 MAINTENANCE

The decomposed granite shall be maintained in a satisfactory condition until the full trail is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any area of decomposed granite that is damaged shall be reworked or replaced as necessary to comply with this specification.

## 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of as directed. No additional payments will be made for materials that must be replaced.

-- End of Section --

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# SECTION 32 17 24.00 10

# PAVEMENT MARKINGS

## PART 1 GENERAL

### 1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM E1710 | (2011) Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer |
| ASTM D7585 | (2010) Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments |

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

| | |
|---|---|
| CALTRANS | State of California Department of Transportation (CALTRANS) Standard Specifications |

CITY OF WEST SACRAMENTO

| | |
|---|---|
| City of West Sacramento | The City of West Sacramento Standard Construction Specifications |

### 1.2 SUBMITTALS

Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Sampling and Testing

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

For glass beads used in drop-on applications and in thermoplastic formulations, test results for each lot of beads specifying the EPA test methods used and tracing the lot to the specific test sample.

Submit retroreflectivity readings for traffic stripes and pavement markings at locations with deficient retroreflectivity determined by the Engineer.

SD-07 Certificates

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

Compliance

Certificate of compliance, including the product name, lot or batch number, and manufacture date.

## 1.3 QUALITY ASSURANCE

### 1.3.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

### 1.3.2 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.3.3 Maintenance of Traffic

1.3.3.1 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.3.4 Application

Before starting permanent application of two-component painted traffic stripes or markings, apply a test stripe of the paint on roofing felt or other suitable material in the presence of the Engineer. The test section must be at least 50 feet in length.

Test each lot of glass beads for arsenic and lead under EPA Test Method 3052 and 6010B or 6010C.

The Engineer will perform a nighttime, drive-through, visual inspection of the retroreflectivity of the traffic stripes and pavement markings and notify you of any locations with deficient retroreflectivity. Measure the retroreflectivity of the deficient areas using a retroreflectometer under ASTM E1710 and the sampling protocol specified in ASTM D7585.

1.4 DELIVERY, STORAGE, AND HANDLING

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 ENVIRONMENTAL REQUIREMENTS

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 50 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

Products shall adhere to the provisions in Section 20, "TRAFFIC STRIPING, SIGNING AND PAVEMENT MARKINGS", of the City of West Sacramento Division IV Standard Construction Specifications.

PART 3 EXECUTION

Work shall be performed as identified in this Section and in conformance with the provisions in Section 20, "TRAFFIC STRIPING, SIGNING AND PAVEMENT MARKINGS", of the City of West Sacramento Division IV Standard Construction Specifications and the CALTRANS Standard Specifications.

3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be marked before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

### 3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, apply a pretreatment with an aqueous solution, containing 3 percent phosphoric acid and 2 percent zinc chloride, to prepared pavement areas prior to painting.

### 3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Remove existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

## 3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

### 3.2.1 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 50 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

#### 3.2.1.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.

3.2.1.2 Primer

After surface preparation has been completed the asphalt concrete pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes.

a. Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch ( 265-400 square feet/gallon).

3.2.1.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch.

b. Sprayed Markings: All sprayed thermoplastic markings shall be applied at the specified width and the thicknesses designated in the contract plans. If the plans do not specify a thickness, centerline markings shall be applied at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch plus or minus 0.005 inch.

c. Reflective Glass Spheres: Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 pound/20 square feet of compound.

3.2.2 Preformed Tape

The pavement surface temperature shall be a minimum of 60 degrees F and the ambient temperature shall be a minimum of 60 degrees F and rising. The preformed markings shall be placed in accordance with the manufacturer's written instructions.

3.2.3 Raised Reflective Markers

Prefabricated markers shall be aligned carefully at the required spacing and permanently fixed in place by means of epoxy resin adhesives. To insure good bond, pavement in areas where markers will be set shall be thoroughly cleaned by sandblasting and use of compressed air prior to applying adhesive.

3.2.4 Reflective Media

Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint

applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

## 3.3 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph 3.1 SURFACE PREPARATION. Demonstrate removal of pavement marking in an area designated by the Agency. The demonstration area will become the standard for the remainder of the work.

### 3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

### 3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

-- End of Section --

# SECTION 32 33 00
# SITE FURNISHINGS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Furnish labor, materials, appurtenances, tools, equipment, and services for Site Furnishings, as indicated, and in accordance with Contract Documents.

B. Section Includes:
   1. Bicycle racks.
   2. Trash receptacles.
   3. Ash Urn receptacles.

C. Completely coordinate with work of other trades.

### 1.2 QUALITY ASSURANCE

A. Source Limitations:
   1. Obtain site furnishing through one source from single manufacturer when practicable.

### 1.3 SUBMITTALS

A. Product Data:
   1. For each type of product indicated.

B. Project Information:
   1. Site Furnishings Schedule: For site furnishings use same designations indicated on Drawings when preparing Schedule.

C. Contract Closeout Information:
   1. Maintenance data.
      a. See Section 01 78 23.

### 1.4 WARRANTY

A. Manufacturer's 1 year warranty covering repair or replacement resulting from defects in material or workmanship.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

A. Bicycle Racks:
   1. Base:
      a. Landscape Forms.
   2. Optional:
      a. Creative Pipe.
      b. Dero.
      c. Huntco Supply.

B. Trash Receptacles:
   1. Base:
      a. Landscape Forms.
   2. Optional:
      a. Creative Pipe.
      b. Huntco Supply.

C. Ash Urns:

1. Base:
   a. Landscape Forms.
2. Optional:
   a. Creative Pipe.
   b. Huntco Supply.

D. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

A. Anchors, Fasteners, Fittings, and Hardware:
1. Manufacturer's standard, corrosion-resistant, coated or corrosion resistant materials, commercial quality.
2. Angle Anchors:
   a. For inconspicuously bolting legs of site furnishings to on or below grade substrate.
   b. Provide one anchor per leg.

B. Grout:
1. Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107.
2. Grout shall be for exterior applications.

C. Erosion Resistant Anchoring Cement:
1. Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement.
   a. Formulation manufactured for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound.
   b. Resistant to erosion from water exposure without needing protection by sealer or waterproof coating.
2. Anchoring cement shall be for exterior applications.

2.3 BICYCLE RACKS

A. Base Product:
1. Inverted U Bicycle Rack:
   a. Model: SU15, as manufactured by Creative Pipe.
   b. Color: Black.
2. Fabrication: Ranges from 1.5 IN inside diameter and 1.9 IN outer diameter to 2.0 IN I.D., and 2.375 IN O.D., Schedule 40 Steel Pipe.
   a. Inverted U’s: 36 IN high x 18 IN wide, installed.
   b. Bicycle racks shall not be welded in sections.
      1) Only base plate shall be welded to steel pipe with two 1/8 IN vent holes. Provide one hole on inside of each upright where pipe is welded to baseplate.
   c. Finish: Coat bicycle rack after fabrication with Thermoplastic, polyethylene copolymer based powder coating.
      1) Thickness: 8-12 mils.
      2) Racks shall have welded, flanged base plates, minimum 6 IN diameter x 3/8 IN thick with minimum 7/16 IN diameter mounting holed on each base plate.

2.4 TRASH RECEPTACLES

A. Base Product:

1. Model: Pitch Trash Receptacle, as manufactured by Landscape Form.
2. Size: 25 IN square top; 18 IN square footprint.
3. Insert: 28 gallon.
4. Finish: Powder Coat.
5. Color: Silver.

2.5 ASH URNS

A. Base Product:
1. Model: Grenadier Free Standing Ash Urn.
2. Size: 10 x 10 x 35 IN height.
3. Capacity: 1-3/4 gallon.
4. Finish: Powder coat.
5. Color: Silver.

2.6 FABRICATION

A. Metal Components:
1. Form to required shapes and sizes with true, consistent curves, lines, and angles.
2. Separate dissimilar metal materials to prevent electrolytic action.

B. Welded Connections:
1. Weld connections continuously.
2. Weld solid members with full-length, full-penetration welds.
3. Weld hollow members with full-circumference welds.
4. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing.
5. Welded surfaces shall match contours of adjoining surfaces.

C. Pipes and Tubes:
1. Form simple and compound curves by bending members in jigs.
2. Produce uniform curvature for each repetitive configuration required.
3. Maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of railing components.

D. Exposed Surfaces:
1. Polished, sanded, or otherwise finished.
2. Surfaces shall be smooth, free of burrs, barbs, splinters, and sharpness.
3. Edges and ends shall be rolled, rounded, or capped.

E. Factory Assembly:
1. Assemble components in factory to greatest extent possible to minimize field assembly.
2. Clearly mark units required for assembly infield.

2.7 FINISHES - GENERAL

A. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work:
1. Variations in appearance of abutting or adjacent pieces are acceptable only if they are within range of approved samples.
2. Noticeable variations in same piece are not acceptable.

3. Variations in appearance of other components are acceptable if they are within the range of approved samples.
4. Assemble or install to minimize contrast.

2.8 ALUMINUM FINISHES

A. Powder Coat Paint Finish:
1. Manufacturer's standard, baked, polyester, powder coat.

2.9 STEEL AND GALVANIZED STEEL FINISHES

A. Powder Coat Paint Finish:
1. Manufacturer's standard, baked, polyester, powder coat finish.

B. PVC Finish:
1. Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC plastisol finish.
2. Flame retardant.

2.10 IRON FINISHES

A. Powder Coat Paint Finish:

B. Manufacturer's standard, baked, polyester, powder coat finish.

2.11 STAINLESS-STEEL FINISHES

A. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches.

B. Run grain with long dimension of each piece.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

3.3 CLEANING

A. After completing site furnishing installation, inspect components.

B. Remove spots, dirt, and debris.

C. Repair damaged finishes to match original finish or replace component.

END OF SECTION

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SECTION 32 80 00

IRRIGATION

## PART 1: GENERAL

### 1.01 SCOPE

A. GENERAL PROVISIONS: The General Specifications and Special Provisions apply to the work outlined in this Section.

B. REQUIRED WORK: Work shall be performed at the planting area locations shown on the Drawings. The work required under this Section shall include, but is not limited to, all labor, tools, materials, equipment, and incidentals required to install and maintain temporary irrigation systems to supply water to installed vegetation as prescribed in these Specifications, as shown on the Drawings and as directed by the City. No deviations from these specifications will be allowed without written approval from the City.

C. RELATED WORK: The work required under this Section is related to the following Sections of the Specifications.

Section 01 90 00, Mobilization and Demobilization
Section 32 92 00, Seeding
Section 32 93 00, Planting
Section 32 98 00, Maintenance

D. MINIMUM QUALIFICATIONS: The Contractor shall meet or exceed the minimum qualifications and conform to requirements specified in the Notice to Contractors, Special Provisions, and Bidder Experience Form.

E. PROJECT SCHEDULE: The Contractor's strict conformance to the Project Schedule is essential for the success of this Project. Contractor shall coordinate the sequencing of irrigation activities with the City. The schedule for irrigation activities shall be developed to meet the requirements specified in Special Provisions SP-X, “Time of Completion” and SP-X, “Project Schedule.”

F. INTENT: The intent of this Contract is to create a self-sustaining riparian woodland ecosystem with healthy plants by the end of the Maintenance Period. The establishment of plants will be supported by temporary drip irrigation systems with a contractor supplied water source. Watering applications shall be conducted to establish healthy plants that are not irrigation-dependent at the end of the Maintenance Period. Water applications shall be reduced in frequency and duration over the establishment period. The Contractor shall be responsible for the installation of complete and fully operational systems to meet the performance standards for plant survivorship as prescribed in Section 32 98 00, “Maintenance” Article 1.01 “Performance Standards.” Refer to Section 32 98 00, “Maintenance,” for additional requirements.

G. PERFORMANCE STANDARDS: The Contractor shall be responsible for installing and maintaining irrigation systems in good condition according to the Drawings and these Specifications and the City’s direction. No materials substitutions shall be allowed without approval from the City.

H. OPERATION: The installed irrigation systems shall be fully operational prior to plant installation and remain operational during the Construction Period and for the duration of the Maintenance Period, at a minimum. The City may direct the Contractor to leave the irrigation systems in place and operational beyond the Maintenance Period of this Contract. The Contractor shall irrigate the planting areas as indicated on the Drawings and as prescribed in Section 32 98 00, “Maintenance” Article 3.02 “Irrigation Application.” The irrigation start date shall be approved by the City before the start of any operations.

I. FEES: Unless otherwise noted in this Section, the Contractor shall pay all fees associated with the irrigation systems installation and operation incurred during the Construction Period and Maintenance Period. The Contractor shall be responsible for utility costs and operation costs for the irrigation systems.

## 1.02 DEFINITIONS

A. CONSTRUCTION PERIOD: The Construction Period refers to the time required to complete all work in association with site preparation, irrigation systems installation, and planting as described on the Drawings and in these Specifications.

B. MAINTENANCE PERIOD: The Maintenance Period shall be as defined in Section 32 98 00, “Maintenance” Article 1.02 “Maintenance Period.”

C. IRRIGATION SYSTEM FIELD ACCEPTANCE: The milestone at which the City inspects and accepts all work related to irrigation systems installation, as described on the Drawings and in these Specifications, as complete.

D. SATURATED WORK AREA: A saturated work area is defined as any area specified for work in the Drawings and these Specifications for which the soil moisture content creates conditions that performing work in the area would result in damage (e.g., soil compaction, soil displacement, and track rutting) to the desired condition for the area.

E. HEALTHY PLANT: A healthy plant shall be free of mechanical or insect damage or infestation, or disease; and exhibit good form, evidence of robust growth (foliage and wood), and a healthy root system (well rooted in its substrate, but not root bound). Plants must not be heat or water stressed.

F. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA A: See Section 32 92 00, “Seeding” Article 1.02 “Mixed Riparian Woodland Establishment Area A” for definition.

G. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA B: See Section 32 92 00, “Seeding” Article 1.02 “Mixed Riparian Woodland Establishment Area B” for definition.

## 1.03 REFERENCES

A. UNIFORM PLUMBING CODE: All work required in this Section shall be conducted in conformance to the Uniform Plumbing Code, latest edition.

B. AMERICAN WATER WORKS ASSOCIATION (AWWA): All work required in this Section shall be conducted in conformance to the AWWA Standards, latest edition (www.awwa.org).

1.04 SUBMITTALS

A. PRODUCTS: The Contractor shall submit catalog data sheets on all irrigation system materials and equipment to be installed under this Contract for approval by the City before ordering materials.

B. SUBMITTAL SUBSTITUTIONS: A request for substitution of products, materials, and/or approaches may be submitted by the Contractor for approval in accordance with Section 5-13, "Substitutions" of the General Specifications. All substitutions submitted for approval as "an equal" shall be submitted as a package and not as individual requests for substitution of products, materials, and/or approaches, and shall be fully supported by documented proof of equivalency to the products, materials, and/or approaches specified.

C. IRRIGATION LAYOUT PLAN: Contractor shall provide an irrigation layout plan, including water source details, for approval by the City prior to purchase and installation of irrigation system materials.

D. AS-BUILT DRAWINGS: Contractor shall prepare in accordance with Section 11-3, "Record Drawings" of the General Specifications and Section 32 98 00, "Maintenance."

1.05 DELIVERY, HANDLING, AND STORAGE

A. All materials and equipment delivered to the Project site shall be clearly marked to identify the item, material, class, and pipe wall thickness. All material shall be new, unblemished, and installed according to these Specifications. All pipe sizes prescribed in these Specifications are nominal inside diameter, unless otherwise noted.

B. Contractor shall handle all materials to ensure that irrigation supplies are not damaged during shipping, handling, or storage. All irrigation supplies, including pipe and tubing shall be stored in a manner to prevent vandalism and theft; or damage from sunlight, moisture, or contact with vehicles, equipment, or tools.

**PART 2: PRODUCTS**

2.01 MATERIALS

A. ISOLATION VALVES: Isolation valves shall be utility ball valves. All thermoplastic ball valves shall be Utility sealed unit type constructed from polyvinylchloride (PVC) Type I, ASTM D 1784 Cell Classification 12454 or CPVC Type IV, ASTM D 1784 Cell or equal.

B. MAIN LINE PIPE: All main line pipe shall be Schedule 40 PVC or equal pipe, manufactured in conformance to ASTM D2241 for rigid PVC compounds, installed on grade.

C. LATERAL LINE PIPE: Lateral line (non-pressurized) pipe shall be Schedule 40 PVC or equal, manufactured in conformance to ASTM D2241 for rigid PVC compounds, sized as required to provide sufficient flow to the drip emitters installed on grade.

D. PIPE FITTINGS: Unless otherwise specified, pipe fittings shall be Schedule 40, solvent-weld fittings that conform to ASTM D1785. For threaded joints, only factory-formed threads will be permitted on PVC pipe fittings.

E. PRIMER AND CEMENT: Solvent-weld joint primer of a different color (e.g., purple primer) than the pipes, and slow-set gray cement shall be used on main line pipe joints. Clear, quick-set cement shall be used on lateral line pipe joints.

F. FLEXIBLE TUBING: Flexible tubing shall be high quality, durable, flexible tubing, ¾–inch diameter. Flexible tubing shall have a group of inline drip emitters based on the spacing specified in the Drawings and these Specifications.

G. DRIP EMITTERS: Drip emitters shall be 0.6 GPH pre-punched, in-line style emitters. A group of three emitters at 1-foot spacing shall be assigned per woody plant.

H. DRIP TUBING FITTINGS: The Contractor shall provide the necessary fittings to secure the emitters to the flexible tubing to be used as part of the irrigation system.

I. FLUSH OUTS: Figure-8 hose-end clamps shall be used to close the end of ¾–inch diameter flexible tubing, to allow for easy opening and flushing of flexible tubing.

J. AIR VACUUM RELIEF VALVE: The air vacuum relief valve shall be Rain Bird Air/Vacuum Relief Valve Kit, or equivalent, to allow air to escape the pipeline during startup and to enter the lines at shutdown to prevent suction of dirt into the system.

K. PIPE ANCHORS: Pipe/tubing anchors shall be #3 rebar, bent in a U-shape and of sufficient length to secure piping during inundation. The anchors are intended to prevent pipe displacement caused by pipe buoyancy during flood events. Pipes shall be filled with water prior to inundation to partially counter buoyancy.

L. TUBING PINS: Tubing Pins shall be at least 10-gauge solid wire bent to form a U-shape, of sufficient length to stabilize tubing and hold the tubing in place during inundation.

## PART 3: EXECUTION

### 3.01 PREPARATION

A. LAWS, CODES, ORDINANCES, AND REGULATIONS: All local, municipal, and State laws, codes, ordinances, and regulations governing or relating to any part of this work are considered a part of these Specifications and shall be conformed to by the Contractor. These Specifications shall take precedence whenever they call for a higher quality or larger size than is required by the aforementioned codes, ordinances, and regulations. The Contractor shall be responsible for conformance to all applicable codes governing the materials and work at this Project site. Manufacturer's specifications shall govern should their directions and detailed drawings address information not included in these Specifications.

B. SYSTEM DESIGN: The irrigation system design shall be determined by the Contractor, and submitted for approval to the City, as described in this Section. Irrigation systems shall be designed to accommodate site conditions and water source and apply water according to the frequency and duration in Section 32 98 00, “Maintenance,” Article 3.02 “Frequency and Duration,” as needed to maintain healthy plants.

3.02 SITE CONDITIONS

A. SITE CONDITIONS: The Contractor shall verify site conditions and be familiar with existing grade conditions, locations of existing features to be preserved, and all existing vegetation to remain. Field adjustments may be necessary to avoid disturbances to existing vegetation to remain. Before ordering materials or proceeding with work, the Contractor shall verify all dimensions and quantities between these Specifications and field conditions; all discrepancies shall be reported immediately to the City.

B. COORDINATION: The Contractor shall be responsible for all coordination required for this Project including, but not limited to the following:

1. In consultation with the City, the Contractor shall coordinate all activities required by the Drawings and these Specifications to avoid conflicts with levees, levee maintenance, roads, utilities, existing habitat, work conducted by the City of West Sacramento or Reclamation District 900, and any existing features. Frequent coordination and communication with the City are of particular importance.

2. The Contractor shall be responsible for calling Underground Service Alert (USA) at 811 / 1-800-227-2600 to identify locations of underground utilities, where present.

3. The Contractor shall be responsible for coordinating and scheduling the placement of materials and equipment necessary to complete the work and for ensuring that subcontractors do the same as quickly and efficiently as possible and in conformance with the Project Schedule included in these Specifications.

4. The Contractor shall submit a plan for City approval that shows proposed equipment and materials storage and staging locations.

C. FIELD ADJUSTMENTS: Field adjustments necessary to accommodate or to minimize disturbances to existing facilities shall be conducted at the Contractor’s expense. Work shall be temporarily suspended in the area of the discrepancy until the City has provided a written resolution to the conflict. The Contractor shall assume full responsibility for proceeding with work without written approval.

D. MINOR REPAIRS: To maintain the irrigation systems in an operational condition, the City will have the right to make occasional, temporary or other minor repairs, as required. This right will not in any way relieve the Contractor of responsibilities described in these Specifications. The City will notify the Contractor, in writing, within 2 Working Days of the time of initiating the repairs.

E. ADJUSTMENTS: If irrigation system adjustments are determined necessary, the Contractor shall proceed only after receiving written approval from the City. If it is determined that the irrigation systems or any of its parts or equipment are improperly installed or for any reason

not adequately operational, corrections shall be made by the Contractor at the Contractor's expense to ensure that the systems conforms to these Specifications to the satisfaction of the City.

F. VANDALISM: Throughout the Contract Period, the Contactor shall carry insurance to cover vandalism and theft on the Project site. The Contractor shall be responsible for securing the Project site to minimize adverse effects from vandalism and theft according to the Special Provisions.

3.03 WATER SUPPLY

A. WATER SOURCE: No on-site water source is available for irrigation; the irrigation systems will be supplied by a mobile water source or by temporary water storage tank(s) placed within the woodland restoration area(s) at the contractor discretion, to be determined by the contractor. The Contractor shall provide and install all fittings required to connect the mobile water source or temporary storage tank water supply to and operate the systems. The main line connections will supply water from the water source to two systems, Irrigation System A (located in Mixed Riparian Woodland Establishment Area A) and Irrigation System B (located in Mixed Riparian Woodland Establishment Area B). The irrigation systems may consist of several subsystems as needed for proper delivery of irrigation water. Before ordering the irrigation materials, the Contractor shall field verify the proper flow rates, volume, and connection to the water source. Should the water volumes and flow rates not deliver the necessary water for irrigation, the Contractor will need to modify the system to supply the appropriate volumes.

3.04 ISOLATION VALVES

A. OFF SETS: Valves shall be offset 3 feet from the main line and a minimum of 3 feet from roadway edges and fences

B. PLACEMENT: Valves shall be grouped together wherever possible. All valves shall be set on-grade. Valve locations shall be clearly marked with a 4– by 4–inch by 4–foot long pressure-treated post set 18 inches into the ground and painted white; the post shall be placed within 24 inches of the valve. Soil shall be compacted around the post at the time of placement.

3.05 PIPE PLACEMENT

A. GENERAL: Main line and lateral line irrigation pipe shall be set above grade, unless vehicle or equipment access is required. Locations where pipe is buried to facilitate access shall be coordinated with the City. The Contractor shall identify any underground utilities within the Project boundaries and shall ensure that excavation operations do not damage or disrupt services. Any damage to existing utilities shall be repaired at the Contractor's expense.

B. EXISTING CONDITIONS: Work shall be performed to minimize impacts on existing trees and shrubs to remain on site, as well as all existing site conditions.

C. SOLVENT WELD JOINTS: Solvent weld joints shall be of commercial quality and made according to manufacturer's specifications for solvent weld piping. Pipes and fittings shall be completely cleaned to be free of dirt, dust, and moisture before installation and the application of primer and solvent cement. Main lines shall be allowed to set for at least 24 hours before the system is flushed or pressure is applied to the system. After cementing, the pipes and fittings should be held in position for at least 45 seconds to permit cement to set thoroughly before

moving. No primer is required for lateral line installation. Clear, quick–set cement shall be used on lateral line pipe joints. Lateral lines shall be allowed to set for at least 6 hours before the system is flushed or pressure is applied to the system.

D. THREADED JOINTS: Pipe joint compound shall be used on all metal threaded joints. For PVC–to–metal connections, the Contractor shall use a Schedule 80 PVC male adapter, working with the metal connections first. The threads of the male adapter shall be wrapped in Teflon tape, inserted into the female fitting, and lightly tightened with a wrench. Pipe joint compound shall not be allowed on PVC to metal connections. Threaded PVC adapters that can be welded for threaded PVC connections shall be used. Teflon tape shall be used on all threaded fittings.

E. PIPE ANCHORING: All pipe placed on grade shall be secured with pipe/tubing anchors, sandbags, or other means as determined by the Contractor and approved by the City.

3.06 MAIN LINE PIPE

A. GENERAL: The Contractor shall install PVC, pressurized pipe at the main line locations.

B. PLACEMENT: Main line pipe shall be installed according to Article 3.05 “Pipe Placement” of this Section. Before installation of the main line pipe, the Contractor shall stake the locations of the main line pipe for approval by the City.

C. ANCHORING: Main line pipe placed on grade shall be secured with pipe anchors set 10 feet on center. A sandbag shall be placed over each pipe anchor.

3.07 LATERAL LINE PIPE

A. GENERAL: The Contractor shall install lateral line pipe for the drip irrigation systems from the drip isolation valves to the flexible tubing that leads to the individual drip emitters.

B. PLACEMENT: Lateral line pipe shall be installed for approval by the City, and according to Article 3.05 “Pipe Placement” of this Section. Before installation of the lateral line pipe, the Contractor shall stake the locations of all lateral line pipe for approval by the City.

C. ANCHORING: Lateral line placed on grade shall be secured with pipe/tubing anchors set 10 feet on center. A sandbag shall be placed over each pipe anchor.

D. AIR VACUUM RELIEF VALVE: Contractor shall attach an air vacuum relief valve to lateral line pipe.

3.08 DRIP IRRIGATION SYSTEMS

A. GENERAL: The Contractor shall supply and install drip irrigation systems to adequately water the container plants at locations shown on the Drawings and as prescribed in these Specifications. The drip irrigation systems shall be operated manually.

B. INSTALLATION: The drip irrigation systems shall be installed before installation of any plants. Irrigation of all plants shall begin the same day as plant installation and shall meet the

requirements of this Section. At all times, irrigation system operation shall be as directed by the City.

C. PLACEMENT: All irrigation installation operations must be conducted in coordination with plant location field marking and planting hole excavation, according to Section 32 93 00, “Planting”. PVC piping and fittings shall connect drip tubing to lateral line pipe. Plant locations must be field marked and approved, and planting holes must be excavated before installation of flexible tubing, with 3 inline emitters at each woody plant location.

D. FLEXIBLE TUBING: Flexible tubing shall connect the drip system to lateral line pipe. The Contractor shall provide the required couplings and fittings for tubing to pipe connections. Flexible tubing shall be secured with tubing anchors. All tubing lengths shall receive at least two tubing anchors. Tubing anchors shall be set flush with the top of the flexible tubing without kinking or damaging the tubing.

E. FLUSH-OUTS: Flexible tubing shall be folded at the end of the planting row and secured with a flush-out. Contractor shall insert ¾–inch diameter flexible tubing into one side of a figure–8 hose–end clamp, fold over and insert back to close. Once irrigation system is in place, it shall be flushed for a minimum of ½-hour to ensure that debris, rocks, and dirt are removed from system. The Contractor shall ensure that all sites are being irrigated and that flow is continuous. The drip systems shall be capped while the system is still operating to ensure that no debris, rocks, or dirt enter the pipes.

F. DRIP EMITTER PLACEMENT: Drip emitters shall be set at field marked plant locations according to Section 32 93 00, “Planting.” For all woody plants, drip emitters shall be placed on a berm or within a watering basin adjacent to the root crown as shown on the Drawings. The center emitters shall be set next to the plant and the other 2 emitters shall be 1–foot apart from the center, for a total of 3 emitters.

G. DRIP EMITTER INSTALLATION: Drip emitters shall be 0.6 GPH pre-punched, in-line style emitters. A group of three emitters at 1-foot spacing shall be assigned per woody plant. After the flexible tubing with in-line emitters has been installed on each run, that line shall be rechecked under pressure for leaks around the emitters or fittings. Any leaks shall be repaired to ensure a fully operational system.

## 3.09 HAND WATERING

A. If at any time the irrigation systems are not fully operational, and when directed by the City, the Contractor shall be responsible for watering installed plants using hand watering techniques. Hand watering shall occur for plants that have not yet been installed, replants, late-planted plants, or certain species or individual plants that require irrigation after most other plants no longer require irrigation. Hand watering shall consist of the application of water in a manner that is sufficient to wet the soil and saturate the root zone as prescribed in Article 3.10 “Irrigation Application” without damaging the plant, the surrounding grade, or the planting berm. Water pressure shall be regulated to a level that applies sufficient water without causing damage to plants or erosion to the plant berm. Should watering be required in dry winter periods, it shall be conducted as directed by the City as part of the Maintenance Period according to Section 32 98 00, “Maintenance.”

## 3.10 IRRIGATION APPLICATION

A. APPLICATION: Throughout the Construction Period and Maintenance Period, the Contractor shall apply water to container plantings according to Section 32 98 00, “Maintenance” Article 3.02 “Application,” as needed to maintain plant health. Irrigation system shall be operated manually by the Contractor.

B. FREQUENCY AND DURATION: Throughout the Construction Period and Maintenance Period, the Contractor shall apply water according to the frequency and duration in Section 32 98 00, Maintenance, Article 3.02 “Frequency and Duration,” as needed to maintain plant health.

3.11 OBSERVATIONS AND TESTING

A. OBSERVATIONS: The Contractor’s installation operations shall be subject to observation and approval by the City. The Contractor shall notify the City 5 Business Days prior to the need for observations according to the requirements of this Section. The Contractor shall field mark the location of the system components, including, but not limited to, water source connections to the existing main line, main line pipe, sleeve pipe, lateral line pipe, all valves, and drip irrigation systems for approval by the City before installation. Additionally, the Contractor shall obtain all observations required by local agencies.

B. LOCAL AGENCY OBSERVATIONS: The Contractor shall be responsible for obtaining all inspections required by local agencies. The Contractor shall notify the City of the inspection at least 5 Business Days prior to any local agency inspection site visits.

C. TESTING: The Contractor shall operate the irrigation systems for approval by the City. The Contractor shall notify the City 5 Business Days in advance of testing. The irrigation systems shall be fully operational at the time of planting and before the start of the Maintenance Period. The Contractor shall perform tests as specified and repair all faulty joints or system problems. The Contractor shall provide a force pump and all other required test equipment. Use of cement or caulking to seal leaks will not be permitted at any time. Before testing, the lines shall be flushed to remove dirt and other debris that may have accumulated in the pipe. After the irrigation lines and valves installed on the main line have set for a minimum of 24 hours, the following tests shall be performed:

1. Main line: The Contractor shall fill all main lines with water and test at 80 psi constant pressure for 2 hours. The Contractor shall monitor the test pressure gauge and visually inspect all joints for signs of leakage in the presence of the City. If any defects are found, they must be repaired and the entire observation process must be repeated.

2. A pressure test of the lateral line pipes will not be required. Any apparent leaks between the valves and the drip emitters shall be repaired.

3. The drip irrigation systems shall be tested at operating pressures and observed for leakage by the City concurrently with final observation of the entire operating irrigation system. During the tests, each valve shall be operated for a sufficient period to allow the City to observe the specific valve location and to ensure that the drip emitter irrigation systems are operating adequately to meet minimum plant watering requirements during the dry season. If it is determined that the drip emitter irrigation systems, or any of its parts or equipment, are improperly installed then corrections shall be made by the Contractor at the Contractor’s expense to ensure that the systems conform to these Specifications.

## PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. IRRIGATION SYSTEM INSTALLATION: No measurement of the irrigation system installation shall occur.

B. WATERING/IRRIGATION APPLICATION: No measurement of watering operations will occur.

4.02 PAYMENT

A. IRRIGATION SYSTEMS INSTALLATION: Payment for irrigation systems installation as designed per the Drawings and these Specifications shall be made at the Contract lump sum price. This includes payment for all labor, materials, and equipment required to install and operate irrigation systems as specified herein.

B. WATERING/IRRIGATION APPLICATION: No separate payment will be made for watering during the Construction Period; it will be considered incidental to irrigation system installation.

4.03 PAYMENT ITEMS

A. IRRIGATION SYSTEMS INSTALLATION: Payment for irrigation systems as designed per the Drawings and these Specifications shall be made under the item “Irrigation Systems Installation” on the Bid Form.

*** END OF SECTION ***

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# SECTION 32 82 00
# POND AERATION

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
   1. Aerator installation
   2. Air line installation
   3. Pond Aerators
   4. Leviathan

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Procurement and Contracting Requirements.
   2. Division 01 - General Requirements.

### 1.2 QUALITY ASSURANCE

A. Referenced Standards: none.

B. Quality Control:
   1. Aerator testing:
      a. Contractor to test performance of:
         1) Aerator pump
         2) Air supply line manifold and valves
         3) Aerators
         4) Leviathan
   2. Trench construction:
      a. Contractor to perform compaction testing to meet compaction standards indicated in contract documents.

### 1.3 DEFINITIONS

A. Blowers: Air pumps installed in pump shed for supplying air to pond aerators and leviathan.

B. Air line: Piping to be installed to deliver air from aerator to aerators and leviathan.

C. Sleeves: Protective pipe housing for airlines at indicated locations.

D. Blower shed valves: air line valves required on PVC and metal piping within the blower shed.

E. Junction box: valve box housing air line manifold prior to ponds.

F. Manifold: Pipe manifold installed inside junction box used to split air flow to aerators and leviathan.

G. Manifold valves: Air line valves integral with the manifold.

H. Aerators: Air diffusers installed beneath floating islands as indicated.

I. Leviathan: Air lift pump installed integrally with floating streambed as indicated.

J. Indicated: Indicated by Contract Documents.

K. Required: Required by Contract Documents.

L. Submitted: Submitted to Engineer.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Shed wall penetration fittings and products.
1)
3. Product technical data including:
a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Manufacturers and types:
1) Blowers.
2) Air lines, including sleeves.
3) Junction box.
4) Manifold valves.
5) Aerators.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage of Material:
1. Theft of materials from the site is a concern. Store materials securely to eliminate potential for theft.
2. Blowers:
a. Do not store on site. Install immediately upon delivery.
b. After installation, keep shed locked outside of working hours.
3. Air lines:
a. Minimize storage on site. Store in a secured area. Cover with UV protective material. Do not store for more than 2 days on site.
4. Air line products:
a. Store per manufacturer recommendations.
5. Manifold valves:
a. Store per manufacturer recommendations.
6. Glue and adhesives
a. Store per manufacturer recommendations.
7. Aerators
a. Store per manufacturer recommendations.

B. Delivery:
1. Blowers:
a. Deliver to site immediately prior to installation.
2. Air line:
a. Deliver to site immediately prior to installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
1. Blowers:
a. Republic Manufacturing
2. Air lines:
a.

3. Blower shed air line valves.
   a. PVC valves
      1) Spears, Hayward, or equivalent
   b. Metal valves
      1) N/A
4. Manifold valves:
   a. Spears, Hayward, or equivalent
5. Junction box:
   a. Christy or equivalent
6. Air diffusers:
   a. Pro-Glass Airstones or equivalent

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Blowers: Two identical regenerative air blowers are required that include the following characteristics and options:
   1. Able to deliver 50 CFM at 100 in $H_2O$
   2. 230V 3Ph 2 hp motors
   3. Required soft-start option
   4. High pressure relief valve
   5. Outlet pressure valve
   6. Air filter kit
   7. Noise reduction kit
   8. Manufacturer recommended operational temperature range maximum 104F
   9. Recommended Republic 4RC510-H16, or equivalent if approved by overseeing engineer

B. Air lines
   1. PVC air lines:
      a. Includes air lines in blower shed and installed in trenches between shed and ponds.
      b. Schedule 40 PVC at indicated dimensions.
   2. Metal air lines:
      a. Includes air lines from blower to trench.
      b. Schedule 40 steel pipe at indicated dimensions.
   3. Weighted air lines:
      a. Includes 3/4” and 5/8” air lines in ponds.
      b. Easypro “Quick Sink” weighted PV airline or equivalent:
         1) ¾” diameter for two aerators at large pond;
         2) 5/8 diameter for two aerators at small pond.
   4. Leviathan air line:
      a. 2” PVC suction hose or equivalent flexible hose with 2.0-2.2” interior diameter and material density 1,100-1,500 $kg/m^3$
      b. Air hose fittings as described in plans. 2.0” Aluminum camlock fittings at airlift pump connection

C. Air line fittings
   1. PVC valves:
      a. 2” PVC ball valves with true union fittings
   2. Manifold valves:
      a. 2” Sch 40 PVC socket ball valve for airlift pump air hose
      b. 1” Sch 40 PVC socket gate valves for 3/4” weighted airlines at large pond

c. ¾" Sch 40 PVC socket ball valves for 5/8" weighted airlines at small pond

D. Adhesives
1. PVC compound as recommended by PVC pipe manufacturer.

E. Junction boxes
1. Concrete flush mount vault with iron or steel lid
a. 36-40" length X 22-24" width X 24" depth

PART 3 - EXECUTION

3.1 INSTALLING BLOWERS

A. Mounting:
1. Mount blowers according to manufacturer's recommendation on bench inside blower shed at indicated locations and orientations.

3.2 INSTALLING AIR LINES.

A. Install PVC pipe and valves inside blower shed as indicated in plans. Use thread tape and/or clear silicone sealant on all threaded fittings.

B. Install metal pipe and valves inside blower shed as indicated in plans. Use thread tape and/or clear silicone sealant on all threaded fittings.

C. Wall penetrations:
1. Install wall penetrations per manufacturer's recommendations.
2. All wall penetrations shall be tight fitting to walls and pipes allowing no visible daylight at or around penetrations. Hole through wall should be cut completely avoiding studs. Hole should be bracketed on both sides by pipe sleeve or pipe flange bolted to wall with flange manufacturer-recommended screws.

D. Trench installations:
1. Install pipes in trenches as indicated.
2. Use standard PVC glued fittings as necessary to couple PVC pipes together.
3. For threaded connections in trench near shed, use thread tape with silicone sealant on all connections.

E. Junction box:
1. Install flush mounted valve boxes of indicated dimensions and locations to provide access to buried air line manifolds.
2. All manifold pipes and valves shall fit within the junction box.

F. Install air lines downstream of junction box in trenches as indicated, in conduit of indicated dimensions.
1. Install weighted air lines as indicated to locate aerators beneath floating islands as indicated.
2. Install PVC leviathan air hose as indicated to connect leviathan to air supply.

3.3 FIELD QUALITY CONTROL

A. Tests During Construction:

1. Contractor shall perform system testing to ensure aerators function and all air lines are free of leaks and defects prior to backfilling air line trenches.
2. Contractor shall test thermostat on/off switched for blowers and shed interior circulation fan. Circulation fan shall turn on at 85 F, and off at 80 F. Blowers shall turn off at 105 F and re-start at 100F. Test each blower separately to ensure proper shut-down and automatic restart cycle. A thermometer and 110V space heater will be required to perform testing.

END OF SECTION

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SECTION 32 92 00

SEEDING

## PART 1: GENERAL

### 1.01 SCOPE

A. GENERAL PROVISIONS: The General Specifications and Special Provisions apply to the work prescribed in this Section.

B. REQUIRED WORK: Work shall be performed at the locations shown on the Drawings. Work under this Section shall include, but is not limited to, all labor, tools, materials, equipment, and incidentals required to complete the following activities as shown on the Drawings, contained in these Specifications, and directed by the City. No deviations from the Drawings or these Specifications shall be allowed without written approval from the City. The Contractor shall plan for appropriate crew sizes supplied with necessary equipment to complete the required work for seeding, as described in this Section.

C. RELATED WORK: The work required under this Section is related to the following Sections of the Specifications.

Section 01 90 00, Mobilization and Demobilization
Section 31 00 00, Earthwork
Section 32 80 00, Irrigation
Section 32 93 00, Planting
Section 32 98 00, Maintenance

D. MINIMUM QUALIFICATIONS: The Contractor shall meet or exceed the minimum qualifications and conform to requirements specified in the Notice to Contractors, Special Provisions, and Bidder Experience Qualifications statement.

E. PROJECT SCHEDULE: The Contractor's strict conformance to the Project schedule is essential for the success of this Project. Contractor shall conduct seeding as described on the Drawings and in the Special Provisions. The schedule for seeding activities shall be developed to meet the requirements specified in Special Provisions SP-4, “Time of Completion” and SP-6, “Project Schedule.” Contractor shall coordinate the sequencing of seeding activities with the City.

F. PERFORMANCE STANDARDS: The Contractor shall be responsible for installing seeding materials in good condition according to these Specifications and the City’s direction. No materials substitutions shall be allowed without prior approval from the City. The Contractor shall be responsible for providing evidence of successful germination of seeded areas before Seeding Field Acceptance is provided.

### 1.02 DEFINITIONS

A. MAINTENANCE PERIOD: The Maintenance Period shall be as defined in Section 32 98 00, “Maintenance” Article 1.02 “Maintenance Period.”

B. SEEDING FIELD ACCEPTANCE: The milestone at which the City inspects and accepts all work related to seeding, as described on the Drawings and in these Specifications, as complete.

C. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA A: The Mixed Riparian Woodland Establishment Area A is the woodland planting area on the downstream or southwestern edge of the Project site, as shown on the Drawings. The Mixed Riparian Woodland Establishment Area A shall receive ripping and discing as described in Section 31 00 00, "Earthwork;" pre-planting weed management, site preparation, and plant installation as described in Section 32 93 00, "Planting;" irrigation system installation as described in Section 32 80 00, "Irrigation;" seeding as described in Section 32 92 00, "Seeding," and maintenance as described in Section 32 98 00, "Maintenance."

D. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA B: The Mixed Riparian Woodland Establishment Area B is the woodland planting area on the upstream or northeastern edge of the Project site, as shown on the Drawings. The Mixed Riparian Woodland Establishment Area B shall receive receive ripping and discing as described in Section 31 00 00, "Earthwork;" pre-planting weed management, site preparation, and plant installation as described in Section 32 93 00, "Planting;" irrigation system installation as described in Section 32 80 00, "Irrigation;" seeding as described in Section 32 92 00, "Seeding;" and maintenance as described in Section 32 98 00, "Maintenance."

A. GRASSLAND TEMPORARY IMPACT SEEDING AREAS: The Grassland Seeding Areas occur in grassland areas temporarily disturbed by project construction activities, as shown on the Drawings. The Grassland Seeding Areas shall receive pre-planting weed management and site preparation as described in Section 31 00 00, "Earthwork" and Section 32 93 00, "Planting;" seeding as described in Section 32 92 00, "Seeding;" and maintenance as described in Section 32 98 00, "Maintenance."

B. RIPARIAN UNDERSTORY TEMPORARY IMPACT SEEDING AREAS: The Riparian Understory Temporary Impact Seeding Areas occur in areas of existing riparian forest that will have temporary disturbance and removal of understory vegetation occurring as part of project construction activities, as shown on the Drawings. Additionally, areas of bare ground 100 sf or larger in area resulting from targeted woody invasive plant removal events in riparian understory vegetation would also be reseeded. The Riparian Understory Temporary Impact Seeding Areas shall receive seeding as described in Section 32 92 00, "Seeding;" and maintenance as described in Section 32 98 00, "Maintenance."

G. SENSITIVE RESOURCE AREAS: See Section 01 90 00, "Mobilization and Demobilization" Article 1.02 "Sensitive Resource Area" for definition.

H. SEEDBED PREPARATION: Activities required to prepare an area for seeding. Seedbed preparation activities may include clearing weeds and debris and raking/harrowing or light discing. Seeding areas will have been prepared for seeding as described in Section 31 00 00 "Earthwork," however it may be necessary to conduct additional discing or soil surface scarification prior to seeding if there is a delay between earthwork completion and seeding.

I. SUITABLE SEEDBED: A suitable seedbed is defined as a vegetation- and thatch-free soil surface that has been cultivated and prepared to provide a uniform (i.e., non-undulating) surface, and a soil surface texture that has been lightly disced to a depth of 3 inches for scarification of the soil surface or lightly scarified by harrowing or raking.

J. SEED MIX TYPE 1: Seed Mix Type 1 is prescribed on the Drawings, to be broadcast seeded in the Mixed Riparian Woodland Establishment Areas. The mix contains species native to the California Central Valley and shall be applied according to the prescribed application rates of pounds per acre of Pure Live Seed (PLS).

K. SEED MIX TYPE 2: Seed Mix Type 2 is prescribed on the Drawings, to be hydroseeded in the Grassland Temporary Impact Seeding Areas. The mix contains species native to the California Central Valley and shall be applied according to the prescribed application rates of pounds per acre of Pure Live Seed (PLS).

L. SEED MIX TYPE 3: Seed Mix Type 3 is prescribed on the Drawings, to be broadcast seeded in the Riparian Understory Temporary Impact Areas. The mix contains species native to the California Central Valley and shall be applied according to the prescribed application rates of pounds per acre of Pure Live Seed (PLS).

M. SEEDING: Seeding is the installation of a specified seed mix by means described in this Section. Seeding shall occur in the areas identified as Mixed Riparian Woodland Establishment Areas A and Area B, Grassland Temporary Impact Seeding Areas, and Riparian Understory Temporary Impacts Seeding Areas on the Drawings.

N. PLANTING ROWS: Planting rows are linear planting areas within the mixed riparian woodland establishment areas where container plants will be installed and irrigation lines located.

O. SATURATED WORK AREA: See Section 32 80 00, “Irrigation” Article 1.02 “Saturated Work Area” for definition.

## 1.03 REFERENCES

A. SEED NAMES: All species contained in the seed mix shall be true to scientific names and varietals as indicated in:

1. Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken (eds.). 2012. *The Jepson Manual: Vascular Plants of California, Second Edition*. University of California Press. Berkeley, CA.

2. United States Department of Agriculture, Natural Resources Conservation Service. 2020.The Plants Database. Available: <http://plants.usda.gov>. National Plant Data Team, Greensboro, NC 27401-4901 USA.

## 1.04 SUBMITTALS

A. GENERAL: The Contractor shall be responsible for delivering submittals to the City for approval before ordering materials.

B. SEEDING MATERIALS: The City may at any time request, test, and analyze seeding material samples to ensure their conformance to these Specifications. The Contractor shall furnish, at no additional cost, certified seed mix labels from the supplier affixed to sealed seed mix bags for the City's approval prior to seeding. The contractor shall submit source and type of bulking agent to be used for the City’s approval. Seeding materials not meeting the City's approval shall immediately be removed from the Project site at the Contractor's expense. The Contractor

shall be solely responsible for any additional expenses required because of materials not meeting the requirements of these Specifications.

C. EQUIPMENT: Within 5 Business Days of the Notice to Proceed, the Contractor shall submit manufacturer specifications describing all equipment to be used under this Contract.

D. WEED MANAGEMENT PLAN: Within 30 Calendar Days of the Notice to Proceed, the Contractor shall provide the City with a Weed Management Plan, addressing all aspects of weed management (i.e., monitoring, assessment, eradication, and control) for the City's approval. The Weed Management Plan shall include a projected quarterly (seasonal) schedule for each year of the Contractor's construction and maintenance operations. The Weed Management Plan shall be updated annually. The plan's schedule shall include herbicide application methods, types and proposed uses of herbicides (including concentrations and spray volume rates per acre), mowing or string trimming events, discing and reseeding, and a description of the types of equipment and methods of calibration of spray volume per acre to be used for all weed management measures. The plan shall include a description of the types of equipment and methods to be used to conduct weed management operations on saturated work areas, as described herein. The plan shall propose a sequence of mowing and herbicide treatments, including combinations tailored to specific weed populations, and shall include a written delivery schedule and written Pest Control Advisor (PCA) recommendation.

E. HERBICIDE APPLICATION NOTICE: A written Herbicide Application Notice shall be submitted with 5 Business Days advanced notice of the proposed herbicide application. The Herbicide Application Notice shall include the herbicide trade name, EPA registration number and registered uses, chemical composition and other labeling specifications, formulation, concentration, application rate of active ingredients, methods of application for all materials furnished, equipment to be used for application, calibration methods, and the name and state license number of the state certified applicator. Herbicides and application methods shall avoid harm to seeded and planted species and areas, sensitive resource areas, and existing native vegetation. Certificates of Compliance certifying that herbicide materials meet the requirements specified shall be submitted before the delivery of materials. Once approved by the City, the Contractor shall receive written authorization to proceed with the treatment (see Section 10-20, "Construction Protocols for use of Pesticides" of the General Specifications).

F. AS-BUILT DRAWINGS: Shall be prepared in accordance with the General Specifications and Section 32 98 00, "Maintenance."

G. SUBMITTAL SUBSTITUTIONS: At no time during the Contract Period will substitutions be considered. A substitution of products, materials, and/or approaches may be proposed for approval by any bidding contractor as an "equal" to that specified in the construction documents before the close of the submittal of questions during the bid period. All substitutions submitted for approval as "an equal" shall be submitted as a package and not as individual requests for substitution of products, materials, and/or approaches; and shall be fully supported by documented proof of equivalent to the products, materials, and/or approaches specified.

H. EQUAL: The burden of proving the equality of materials shall be the bidding contractor's responsibility. The determination of suitability and compatibility of a proposed substitution shall be at the sole discretion of the City. Any such proposed products, materials, and/or approaches approved at the sole discretion of the City as an "equal" shall be communicated to all bidding contractors along with an invitation and reasonable time to re-submit their bid utilizing such "equal" products and/or materials, as appropriate, prior to the Bid Date.

## PART 2: PRODUCTS

### 2.01 MATERIALS

A. SEED MIXES: Seed mixes shall be provided by the Contractor and shall be grown within the Great Central Valley Region of California and surrounding foothills from seed collected from Sacramento, Sutter, Yolo, El Dorado, Placer, Yuba, Amador, Solano, and San Joaquin County sources. Ecotypes shall adhere to PLS lbs./acre for the mix as shown in the Drawings. Seed shall be pre-mixed by the supplier before shipment to the Project site. The seed mix shall not contain noxious weed seed or mold.

B. HERBICIDE: Herbicide shall be provided as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Article 1.04 in this Section.

C. STRAW MULCH: Straw shall be derived from seedless wheat, or native grasses. Straw mulch shall be mold-free, air-dry straw, certified as noxious weed free with a consistency for placing with commercial mulch blowing equipment. Mulch shall be free from noxious weeds and seeds, mold, and other deleterious materials. Mulch shall not contain any growth or germination inhibiting substances.

D. TACKIFIER: shall be a concentrated, biodegradable, organic derivative of corn, plantago, or other organic material. Provide tackifier in powder form in clearly marked bags stating the contents of each package. Tackifier shall be non-toxic to plant and animal life, non-corrosive, non-crystalline, and non-staining to concrete or painted surfaces

E. HYDROSEEDING EQUIPMENT: Equipment used for application of hydroseeding slurry shall be commercial type hydroseeder and shall have a built-in agitation system with an operation capacity sufficient to agitate, suspend, and homogeneously mix slurry. Tank capacity shall be a minimum of 1,500 gallons and tank shall be mounted on a truck to allow easy access to the site. Distribution lines shall be large enough to prevent stoppage and allow for even distribution of slurry over the site. Hydroseeder pump shall be able to generate 150 psi at the nozzle. Water shall be clean of contaminants. Prior to seeding operations, the Contractor shall adjust and calibrate seeding equipment in accordance with manufacturer's specifications.

F. HYDROMULCH: Mulch shall be free from noxious weeds and seeds, mold, and other deleterious materials. Mulch shall not contain any growth or germination inhibiting substances. Paper mulch shall not be used. Mulch shall be of the virgin wood cellulose fiber type and shall be commercially available and produced from virgin wood fiber. Fiber shall be of such character that it will disperse into uniform homogeneous slurry when mixed with water and shall be capable of being sprayed to form a porous mat. The water content of the fiber before mixing into the slurry shall not exceed 15 percent of the dry weight of the fiber. The moisture content of the fiber shall be clearly marked on the package. Fiber shall not contain more than 1 percent ash as determined by the Technical Association of the Pulp and Paper Industry (TAPPI) Standard T 413 and shall be nontoxic to plant or animal life. Fiber shall have a water-holding capacity by weight of not less than 1,200 percent. (1,200 grams of water per 100 grams of fiber.) Water-holding capacity of the fiber shall be marked on the package. Fiber shall have a pH in the range between 6.0 and 7.5 at 3 percent consistency. Fiber shall be dyed green to contrast the area on which the fiber is to be applied. The material used as dye shall be biodegradable, shall not inhibit plant growth and shall be nontoxic to plant and animal life. Fiber shall be packaged in wet-strength Kraft or plastic bags,

which shall not exceed 100 lbs. in weight. The package shall contain current labels, the manufacturer's name, and the weight.

## 2.02 DELIVERY, STORAGE, AND HANDLING

A. SEEDING MATERIAL DELIVERY: Seeding materials shall be delivered by the Contractor to the job site with durable, waterproof labels indicating the correct species, variety, percent PLS, other certifications, and the supplier's name, in conformance to the Drawings and these Specifications. The City will inspect the seed mixes as they are being delivered to the site for conformity to the Drawings and these Specifications. Such approvals shall not impair the right of additional observations during further progress of the work.

1. The Contractor shall provide the City with 5 Business Days advanced notice, in writing, for each request for approval of partial or complete deliveries to the Project site.

2. All seeding material problems shall be corrected at the Contractor's expense within 5 Business Days of the date of the initial delivery, before any seeding operations.

B. SEEDING MATERIAL STORAGE: The Contractor shall be responsible for storing and maintaining seeding materials in good condition as delivered until installed.

1. Seed materials shall be maintained in optimal condition and shall be protected at all times from animal damage; vandalism; and inclement weather conditions, including wind, frost, toxic water, heat, sunlight, moisture, fungus and rot; contact with vehicles, equipment, and tools and any other conditions that would damage or reduce the viability of the seed materials.

2. Unacceptable seeding materials shall be replaced before the start of seeding at the Contractor's expense. Seeding materials not meeting the City's approval shall immediately be removed from the Project site at the Contractor's expense. The Contractor shall incur any additional expenses required because of materials not meeting the requirements of these Specifications.

3. Seed mix shall not be stored where temperatures exceed 80 degrees Fahrenheit. If at any time, temperatures in the storage facilities exceed 80 degrees Fahrenheit, the seed will be considered defective. Additionally, improperly stored seed that has become wet, moldy or otherwise damaged will be considered defective. Defective seed materials shall be replaced by the Contractor at their expense.

C. HANDLING OF MATERIALS: The Contractor shall handle all materials to ensure that the seed mix is not damaged at any time. After acceptance by the City, handling and storage of materials delivered to the site shall become the responsibility of the Contractor. All materials and equipment delivered to the job site shall be clearly marked to identify the item or the materials. All materials shall be new, unblemished, and installed in accordance with the Drawings and these Specifications.

# PART 3: EXECUTION

## 3.01 SITE CONDITIONS AND COORDINATION

A. COORDINATION: The Contractor shall be responsible for all coordination required for this Project including, but not limited to the following:

1. In consultation with the City, the Contractor shall coordinate all activities required by the Drawings and these Specifications to avoid conflicts with roads, levees, utilities, existing habitat, work conducted by the City of West Sacramento and Reclamation District 900, existing vegetation, and any existing features or infrastructure. Coordination and communication with the City are of particular importance.

2. The Contractor shall be responsible for calling Underground Service Alert (USA) at 811 / 1-800-227-2600 to identify locations of underground utilities.

3. The Contractor shall be responsible for coordinating and scheduling the placement of materials and equipment necessary to complete the work and for ensuring that subcontractors do the same as quickly and efficiently as possible and in conformance with the Project Schedule included in these Specifications.

4. The Contractor shall submit a plan for City approval that shows proposed equipment and materials storage, and staging locations.

5. Any existing native perennial grassland or riparian woodland vegetation damaged by project activities shall be restored at the Contractor's expense.

B. LAYOUT:

1. Seed Mix Application: Contractor shall field mark the start and finish points and lateral boundaries of seeding areas for City review before seeding operations.

C. VANDALISM: The Contractor shall be responsible for securing the Project site to minimize adverse effects from vandalism and theft according to the Special Provisions.

D. EQUIPMENT OPERATION: At no time shall the Contractor’s equipment be operated during rain events or in saturated work areas, as defined herein. Contractor shall coordinate with the City to determine when work can begin following saturated work area conditions.

E. EXISTING FEATURES: During site preparation and seeding operations, care shall be taken to avoid damaging existing facilities, levees and berms, overhead and underground utilities, public and private roads, gates, access ramps, designated O&M roads, sensitive resources areas, existing native vegetation and planted and seeded areas, or any other items on or around the Project area.

## 3.02 PRE-PLANTING WEED MANAGEMENT

A. WEED MANAGEMENT: All areas to be seeded, and confirmed with the City, shall be kept clear of weeds and thatch until seeded. After Planting Field Acceptance and prior to seeding, weed management for areas to be seeded shall be conducted as defined in Section 32 98 00, “Maintenance.”

The purpose, methods, and timing of weed management treatments shall be to prevent dispersal of weed seed by killing weeds before flowering or viable seed has developed. Pre-seeding weed management shall be limited to mowing or string trimming, light discing, burn down contact herbicides, or systemic herbicides with no residual soil activity. Herbicides shall be applied as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Article 1.04 in this Section. Herbicides shall be applied as needed in advance of seeding to eliminate weeds and deplete the seed bank of undesirable species in the soil. The type and timing of herbicide applications shall be selected to prevent herbicide persistence in the soil and any adverse effect on existing or newly planted vegetation, and germination of native grass seedlings. If post-treatment conditions do not demonstrate near total weed kill of targeted species or effectiveness to the satisfaction of the City, the Contractor shall assume full responsibility for corrective actions to resolve deficiencies. Pre-seeding weed management shall be subject to the following:

1. After Planting Field Acceptance (i.e., completed and accepted installation of container plants) in the Riparian Woodland Establishment Areas, weed management for areas to be seeded shall be conducted as defined in Section 32 98 00, “Maintenance.”.

## 3.03 SEEDBED PREPARATION

A. Contractor shall remove nonnative vegetation within the Riparian Woodland Establishment Areas, and temporary impact areas to be seeded, as directed by the City. Contractor shall remove all trimmings, trash, and debris found within the Project site and recycle or otherwise dispose of materials in accordance with State and local regulations.

B. Areas for seeding shall be prepared consistent with 31 00 00, “Earthwork” prior to application of seeding. If seeding is delayed after completion of earthwork, additional discing or soil scarification of seeding areas may be needed. In this case, Contractor shall provide a dozer or tractor capable of pulling tillage equipment (e.g., double-row hydraulic offset disc, ring roller, drill seeder) needed to lightly disc or harrow soil surfaces to prepare a Suitable Seedbed, as defined in this Section, prior to seeding. The Contractor shall use appropriate equipment and confine equipment access to planting areas and staging areas/access routes only so as to not damage roots, trunks, or branches of planted and existing vegetation.

C. When conditions are such, by reason of excessive moisture or other factors, that satisfactory results are not likely to be obtained, the work shall be stopped and shall be resumed only when directed by the City.

## 3.04 SEEDING

A. PREPARATION: The areas to be seeded shall be prepared according to Article 3.02 “Pre-Seeding Weed Management”, and Article 3.03 “Seedbed Preparation”, of this Section. Unless noted otherwise, the Contractor shall confirm with the City any areas that have been previously seeded before starting work at the site and avoid disturbance to these areas, as feasible.

B. SEED MIX APPLICATION – BROADCAST SEEDING: In Riparian Woodland Establishment Areas (Seed Mix Type 1) and Riparian Understory Temporary Impact Areas (Seed

Mix Type 3) delineated on Drawings, Contractor shall use a broadcast seeding method to apply the respective seed mixes. Broadcast seeding shall take place with mechanical equipment that will accurately measure and apply the types of seed that will be planted, and it will keep all seeds mixed during planting. Contractor will additionally measure out seed to achieve seeding rates consistent as specified for all seeded sites. Following broadcast seeding, the Contractor shall use a light duty ring roller, Fuerst tine harrow, hand rake, or equal to ensure light soil coverage (1/4 to ½ inch) over broadcast seed. Contractor shall apply seed according to the seed application rates shown on the Drawings, and in accordance with Special Provisions SP-X, "Time of Completion" and SP-X, "Project Schedule". Following seeding and harrowing, the Contractor shall apply straw mulch to all seeded areas at a rate of 1 ton per acre. Straw mulch shall be applied evenly across the site to a maximum depth of 2 inches. Where slope allows, straw much shall be crimped or punched into the soil using sheepsfoot roller, or similar. The Contractor shall apply tackifier at a rate of 150 pounds per acre to secure straw mulch in place.

C. SEED MIX APPLICATION – HYDROSEEDING: Hydroseeding shall be the method of seed application in Grassland Temporary Impact Areas (Seed Mix Type 2).

1. Contractor shall thoroughly mix water, wood fiber, and tackifier at the rates shown below. Seed shall be added immediately before hydroseeding, and applied within 1 hour of mixing seed into slurry. Once fully loaded, the complete slurry shall be agitated for three to five (3 to 5) minutes to allow for uniform mixing. Slurry shall be completely homogeneous.

| **Material** | **Application Rate** |
|---|---|
| Hydromulch | 500 pounds per acre |
| Cellulose wood fiber | 500 pounds per acre |
| Organic tackifier | As specified by manufacturer based on site conditions |
| Seed | Rates per these specificaitons |

2. Contractor shall plan the layout of slurry hose to reduce potential damage to existing vegetation on site. Due diligence shall be practiced to preserve the newly hydro seeded areas. For example, areas furthest from the pump vehicle shall be hydro seeded first and areas nearest to the vehicle last. The slurry hose shall be retracted accordingly to minimize trampling and disturbance of newly hydroseeded areas. Contractor shall prevent foot traffic or storage of supplies in seeded areas.

3. Contractor shall apply slurry with a commercial hydro seeder having a built-in agitation system with capacity to continuously agitate, suspend, and homogeneously mix slurry. Slurry shall be sprayed to produce a uniform mat using "vertical hose work", where the applicators walk the site with the hoses and apply the hydroseed mix with the nozzle pointing down to ensure the mix

maximizes contact with the ground. If slurry (without seed) remains in the tank more than eight (8) hours, it shall be removed and disposed of offsite at the Contractor's expense.

3.05 CLEAN-UP

A. DAILY CLEAN-UP: Site clean-up shall occur daily. All garbage, construction debris, other discarded materials, and extraneous equipment caused by or due to the Contractor or Subcontractors shall be removed off site at the Contractor's expense and in accordance with State and local regulations.

B. SALVAGE: All materials determined to be salvageable shall be handled and removed with care. The Contractor shall be responsible for salvaging, removing off site, and recycling all seeding operation and weed control materials. At no time shall the City be responsible for recycling or disposing of seeding operation materials.

3.06 OBSERVATIONS

A. CONSTRUCTION OBSERVATIONS: Unless otherwise noted, the Contractor shall provide the City with 5 Business Days advance notice, prior to execution of the following tasks:

1. Pre-seeding weed management and applications of herbicides.

2. Field marking of start and finish points of seeding areas.

3. Seedbed preparation activities.

4. Seeding operations.

5. Seeding Field Acceptance: The Contractor shall complete seeding as specified herein. Any unacceptable seeding operations shall be corrected according to the City's direction and at the Contractor's expense before Seeding Field Acceptance is approved by the City.

**PART 4: MEASUREMENT AND PAYMENT**

4.01 MEASUREMENT

A. PRE-PLANTING WEED MANAGEMENT: Measurement for Pre-planting Weed Management shall be made per acre, to the nearest 0.1 acre, of areas completely treated by the Contractor and approved by the City.

B. SEEDBED PREPARATION: Measurement for Seedbed Preparation shall be made per acre, to the nearest 0.1 acre, of areas completely prepared for seeding by the Contractor and approved by the City.

C. SEEDING – SEED MIX TYPE 1: Measurement for seeding operations shall be made per acre, to the nearest 0.1 acre, of areas completely seeded by the Contractor and approved by the City.

D. SEEDING – SEED MIX TYPE 2: Measurement for seeding operations shall be made per acre, to the nearest 0.1 acre, of areas completely seeded by the Contractor and approved by the City.

E. SEEDING – SEED MIX TYPE 3: Measurement for seeding operations shall be made per acre, to the nearest 0.1 acre, of areas completely seeded by the Contractor and approved by the City.

## 4.02 PAYMENT

A. PRE-PLANTING WEED MANAGEMENT: Payment for Pre-planting Weed Management, shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

B. SEEDBED PREPARATION: Payment for Seedbed Preparation shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

C. SEEDING – SEED MIX TYPE 1: Payment for Seeding – Seed Mix Type 1 shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

D. SEEDING – SEED MIX TYPE 2: Payment for Seeding – Seed Mix Type 2 shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

E. SEEDING – SEED MIX TYPE 3: Payment for Seeding – Seed Mix Type 3 shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

## 4.03 PAYMENT ITEMS

A. PRE-PLANTING WEED MANAGEMENT: Payment for Pre-planting Weed Management shall be made under the item “Pre-planting Weed Management” on the Bid Form.

B. SEEDBED PREPARATION: Payment for Seedbed Preparation shall be made under the item “Seedbed Preparation” on the Bid Form.

C. SEEDING – SEED MIX TYPE 1: Payment for Seeding – Seed Mix Type 1 shall be made under the item “Seeding – Seed Mix Type 1” on the Bid Form.

D. SEEDING – SEED MIX TYPE 2: Payment for Seeding – Seed Mix Type 2 shall be made under the item “Seeding – Seed Mix Type 2” on the Bid Form.

E. SEEDING – SEED MIX TYPE 3: Payment for Seeding – Seed Mix Type 3 shall be made under the item “Seeding – Seed Mix Type 2” on the Bid Form.

## 4.04 INCIDENTAL WORK

A. DESCRIPTION: No measurement and payment will occur for the following items; this work is considered incidental to obligations defined in these specifications:

1. Field marking all soil preparation and weed management locations.
2. Field marking underground utilities.
3. Field marking seeding locations.
4. Removing debris and equipment, and clean-up according to Article 3.05 “Clean-up” of this Section.
5. Preparing all submittals and responses to City for comments and questions.
6. Coordination of work with City staff, or City representatives.

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

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SECTION 32 93 00

PLANTING

## PART 1: GENERAL

### 1.01 SCOPE

A. GENERAL PROVISIONS: The General Specifications and Special Provisions apply to the work prescribed in this Section.

B. REQUIRED WORK: Work shall be performed at the locations shown on the Drawings. Work under this Section shall include, but is not limited to, all labor, tools, materials, equipment, and incidentals required to complete the following activities as shown on the Drawings, contained in these Specifications, and directed by the City. No deviations from the Drawings or these Specifications shall be allowed without written approval from the City. The Contractor shall plan for appropriate crew sizes supplied with necessary equipment to complete the required work for plant installation, as described in this Section.

C. RELATED WORK: The work required under this Section is related to the following Sections of the Specifications.

Section 01 90 00, Mobilization and Demobilization
Section 31 00 00, Earthwork
Section 32 80 00, Irrigation
Section 32 92 00, Seeding
Section 32 98 00, Maintenance

D. MINIMUM QUALIFICATIONS: The Contractor shall meet or exceed the minimum qualifications and conform to requirements specified in the Notice to Contractors, Special Provisions, and Bidder Experience Form.

E. PROJECT SCHEDULE: The Contractor's strict conformance to the Project Schedule is essential for the success of this Project. The schedule for planting activities shall be developed to meet the requirements specified in Special Provisions SP-4, “Time of Completion” and SP-6, “Project Schedule.” The Contractor shall coordinate the sequencing of planting activities with the City.

F. PERFORMANCE STANDARDS: The Contractor shall be responsible for installing the plant materials in a healthy and vigorous state according to these Specifications and the City’s direction. No materials substitutions shall be allowed without approval from the City. At no time shall any plants show symptoms of damaged foliage, disease, chlorosis, defoliation, or vandalism. At no time shall any plants show symptoms of browsing by wildlife, insect damage, girdling or other damage to stems, structural deformities, circling roots, dieback, dry rootball, or sunburn. At no time shall any plant show symptoms of water stress (caused by overwatering or underwatering), stunted growth, wilting, herbicide damage, or premature loss or yellowing of leaves (for deciduous species).

### 1.02 DEFINITIONS

A. CONSTRUCTION PERIOD: See Section 32 80 00, “Irrigation” Article 1.02 “Construction Period” for definition.

B. PLANTING FIELD ACCEPTANCE: The milestone at which the City inspects and accepts all work related to planting, as described on the Drawings and in these Specifications, as complete.

C. SITE PREPARATION: Activities required to prepare an area for planting container plants. Site preparation activities include clearing debris, weeds, and thatch.

D. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA A: See Section 32 92 00, “Seeding” Article 1.02 “Mixed Riparian Woodland Establishment Area A” for definition.

E. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA B: See Section 32 92 00, “Seeding” Article 1.02 “Mixed Riparian Woodland Establishment Area B” for definition.

F. FLOATING WETLAND ISLANDS: Three floating wetland islands (Islands A, B, and C) will be planted and installed in the large pond on site, as shown on the Drawings.

G. SENSITIVE RESOURCE AREAS: See Section 01 90 00, “Mobilization and Demobilization” Article 1.02 “Sensitive Resource Areas” for definition.

H. SATURATED WORK AREA: See Section 32 80 00, “Irrigation” Article 1.02 “Saturated Work Area” for definition.

1.03 REFERENCES

A. PLANT NAMES: All plant material shall be true to scientific names and varietals as indicated in:

1. Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken (eds.). 2012. *The Jepson Manual: Vascular Plants of California, Second Edition*. University of California Press. Berkeley, CA.

2. United States Department of Agriculture, Natural Resources Conservation Service. 2020. The Plants Database. Available: <http://plants.usda.gov>. National Plant Data Team, Greensboro, NC 27401-4901 USA.

1.04 SUBMITTALS

A. GENERAL: The Contractor shall be responsible for delivering Construction Period submittals to the City for approval before ordering materials.

B. PLANT MATERIALS: The Contractor will subcontract with local nurseries to provide planting materials per these specifications. The Contractor and City shall conduct a final inspection of the plant materials upon delivery before acceptance from the nursery. The Contractor will be responsible for maintaining the Project Schedule, such that plants will be received within 30 days of the anticipated deliver date. If project delays occur, then the Contractor will incur the hold fees associated with plants being held after 30 days. All plants are to be

delivered within 60 days of the initial planned date of delivery. Any additional plant materials that are required due to lack of maintenance prior to plant installation, low survival, or poor performance during the Maintenance Period, shall be the responsibility of the Contractor. The Contractor shall be solely responsible for any additional expenses required because of materials not meeting the requirements of these Specifications. The City may at any time request to inspect planting materials to ensure their conformance to these Specifications. The following shall be submitted by the Contractor, at no additional cost, according to submittal procedures included in the Contract:

1. Prior to Planting Field Acceptance, the Contractor shall provide a written guarantee against defects resulting from poor installation or related materials to the City for a 3-year Maintenance Period after Planting Field Acceptance.

C. EQUIPMENT: Within 30 Calendar Days of the Notice to Proceed, the Contractor shall submit manufacturer specifications on all equipment to be used under this Contract.

D. WEED MANAGEMENT PLAN: Within 30 Calendar Days of the Notice to Proceed, the Contractor shall provide the City with a Weed Management Plan, as described in Section 32 92 00, “Seeding” Article 1.04 “Weed Management Plan.”

E. HERBICIDE APPLICATION NOTICE: A written Herbicide Application Notice shall be submitted within 5 Business Days advanced notice of the proposed herbicide application, as described in Section 32 92 00, “Seeding” Article 1.04 “Herbicide Application Notice.”

F. SUBMITTAL SUBSTITUTIONS: A substitution of products, materials, and/or approaches may be proposed for approval by any bidding contractor as an “equal” to that specified in the construction documents before the close of the submittal of questions during the bid period. All substitutions submitted for approval as “an equal” shall be submitted as a package and not as individual requests for substitution of products, materials, and/or approaches, and shall be fully supported by documented proof of equivalent to the products, materials, and/or approaches specified. At no time during the Contract Period will substitutions be considered, as described in Section 32 92 00, “Seeding” Article 1.04 “Submittal Substitutions,” except for the following.

1. During the Contract Period, substitutions for additional planting materials may be accepted with prior approval from the City. Acceptable container plant substitutions would be limited to the following: a minor adjustment to the quantity of a particular species in exchange for another species, as shown on the Drawings; or a change to the container size for a portion of the container plants.

G. EQUAL: The burden of proving the equality shall be the bidding contractor’s responsibility as described in Section 32 92 00, “Seeding” Article 1.04 “Equal.”

H. AS-BUILT DRAWINGS: Shall be prepared in accordance with Section 11-3, “Record Drawings” of the General Specifications and Section 32 98 00, “Maintenance.”

## PART 2: PRODUCTS

### 2.01 MATERIALS

A. CONTAINER PLANTS: The Contractor is responsible for providing 1-gallon pots, Treepot-4 (4-inches square x 14-inches deep), Treebands (typically 4-inches square x 4-inches deep), and plug (1.25-inches square x 2-inches deep) container plants from reputable nurseries specializing in native plant propagation. Container plant species and quantities are as shown on the Drawings. The Contractor shall be responsible for providing replacement plants, as per the Drawings and Specifications, in the case of poor performance or low survival prior to plant installation and during the Maintenance Period.

B. HERBICIDE: Herbicide shall be provided as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Section 32 92 00, “Seeding” Article 1.04.

C. FLOATING WETLAND ISLANDS PLANTING MEDIUM: Floating wetland islands planting pockets shall be filled with a quality hydroponic coco coir rooting medium with documented low salt content, or other demonstrated quality hydroponic rooting medium approved by the City.

## 2.02 INSPECTION, DELIVERY, STORAGE, AND HANDLING

A. CONTAINER PLANT INSPECTION: Upon execution of the container plant procurement order by the Contractor, the City may choose to inspect the container plants at the nursery or request representative color photos of the container plants for conformity to the Drawings and Specifications. Such approvals shall not impair the right of additional observations during further progress of the work. Any tagging of container plants by the City does not constitute City approval of the container plants’ health and vigor. The health and vigor of the container plants are the sole responsibility of the Contractor.

B. CONTAINER PLANT DELIVERY: Container plants procured by the Contractor will be delivered to the Project site by the Contractor or source nurseries. Delivery of replacement container plants to the Project site shall be the responsibility of the Contractor or its supplier. The City will inspect the container plants as they are being delivered to the Project site for conformity to the Drawings and these Specifications. Such approvals shall not impair the right of additional observations during further progress of the work.

1. The Contractor shall provide the City with 5 business days advanced notice, in writing, for each request for approval of partial or complete deliveries to the Project site.

2. Unacceptable container plants shall be replaced before the start of planting at the Contractor's expense. Container plants not meeting the City's approval shall be immediately removed from the Project site at the Contractor's expense. The Contractor shall be solely responsible for any additional expenses required because of container plants not meeting the requirements of these Specifications.

3. At the Contractor's expense, all container plant problems shall be corrected before initiating any planting operations.

C. CONTAINER PLANT STORAGE: Plants will be inspected at the time of delivery to the Project site and care of planting materials will be the responsibility of the Contractor. Planting materials that do not continue to meet the City's approval shall immediately be removed from the Project site at the Contractor's expense. The Contractor shall be responsible for storing and

maintaining the container plants as delivered throughout the Construction Period. The Contractor may wish to erect a temporary fence to protect container plants. Container plants shall be maintained in optimal condition and shall be protected at all times from animal damage; vandalism and theft; inclement weather conditions, including drought, wind, frost, toxic water, and excessive sunlight, heat, or moisture; fungus and rot; or contact with vehicles, equipment, and tools and any other conditions that would damage or reduce the health and vigor of the container plants. Soil in plant containers shall be kept moist at all times before planting, shall be completely watered 1 hour or less before installation, and shall be moist when installed.

D. HANDLING OF CONTAINER PLANTS: The Contractor shall handle City supplied and replacement container plants to ensure that they are not damaged at any time. After acceptance by the City, handling and storage of materials delivered (i.e., those supplied by the City and ordered by the Contractor) to the Project site shall remain the responsibility of the Contractor. All materials and equipment delivered to the Project site shall be clearly marked to identify the item or the materials. All materials shall be new, unblemished, and installed in accordance with the Drawings and these Specifications.

## PART 3: EXECUTION

### 3.01 SITE CONDITIONS AND COORDINATION

A. COORDINATION: The Contractor shall be responsible for all coordination required for this Project including, but not limited to the following:

1. In consultation with the City, the Contractor shall coordinate all activities required by the Drawings and these Specifications to avoid conflicts with roads, levees, utilities, existing habitat, work conducted by the City of West Sacramento and RD 900, and any existing features. Frequent coordination and communication with the City are of particular importance.

2. The Contractor shall be responsible for calling Underground Service Alert (USA) at 811 / 1-800-227-2600 to identify locations of underground utilities.

3. The Contractor shall be responsible for coordinating and scheduling the placement of materials and equipment necessary to complete the work and for ensuring that subcontractors do the same as quickly and efficiently as possible and in conformance with the construction schedule included in these Specifications.

4. The Contractor shall submit a plan for City approval that shows proposed equipment and materials storage and staging locations.

B. LAYOUT: Contractor shall field mark the start and finish points and lateral boundaries of planting areas/zones, as shown on Drawings, before beginning planting operations.

C. VANDALISM: Throughout the Contract Period, the Contactor shall carry insurance to cover vandalism and theft on the Project site. The Contractor shall be responsible for securing the Project site to minimize adverse effects from vandalism and theft according to the Special Provisions.

D. EQUIPMENT OPERATION: At no time shall the Contractor's equipment be operated during rain events or on saturated work areas, as defined in Section 32 80 00, "Irrigation" Article

1.02. The Contractor shall coordinate with the City to determine when work can begin following alleviation of saturated work area conditions.

E. EXISTING FEATURES: During site preparation and planting operations, care shall be taken to avoid damaging existing facilities, levees and berms, overhead and underground utilities, public and private roads, gates, and access ramps, designated O&M roads, sensitive resource areas, existing vegetation, or any other items on or around the Project area.

3.02 PRE-PLANTING WEED MANAGEMENT

A. WEED MANAGEMENT: All areas to be planted as shown on the Drawings and confirmed with the City shall be cleared of weeds and thatch. The purpose, methods, and timing of weed management treatments shall be to prevent dispersal of weed seed by killing weeds before flowering or viable seed has developed. Pre-planting weed management shall be limited to mowing or string trimming, discing, burn down contact herbicides, or systemic herbicides with no residual soil activity. As identified in Special Provisions SP-6, “Project Schedule” and on the Drawings, the Contractor shall conduct pre-planting weed management for the duration of the time between the Notice to Proceed and Final Planting Acceptance.

B. HERBICIDE APPLICATION: Herbicides shall be applied as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Section 32 92 00, “Seeding” Article 1.04. Herbicides shall be applied as needed in advance of planting to eliminate weeds and deplete the weed seed bank in the soil. The type and timing of herbicide applications shall be selected to prevent herbicide persistence in the soil and any adverse effect on plantings and germination of native grass seedlings.

C. MOWING OR STRING TRIMMING: Mowing or string trimming for pre-planting weed management shall consist of one or more passes with a mower set to produce a vegetation stubble height of approximately 6 inches or string trimming to chop vegetative matter to pieces such that mats of thatch are not present. Chopping of vegetation may be replaced by baling and removal of the cut vegetation. Before commencement of mowing operations, methods and timing of mowing shall be approved by the City.

D. DISCING: Discing for pre-planting weed management shall consist of one or more passes with a medium disc as required to till the soil to a depth of at least 12 inches with a clod size of less than 2 inches and chop vegetative matter into pieces less than 12 inches in dimension and incorporate the vegetative material into the soil. The type and timing of discing operations shall be chosen to prevent any adverse effect on plantings and germination of native grass seedlings. Before commencement of discing operations, methods and timing of discing shall be approved by the City.

E. EVALUATION OF WEED MANAGEMENT EFFICACY: Post-treatment conditions will be evaluated by the City. If post-treatment conditions do not demonstrate effectiveness in controlling targeted species or effectiveness of weed management operations to the satisfaction of the City, the Contractor shall assume full responsibility for corrective actions to resolve deficiencies at no extra cost to the City.

3.03 SITE PREPARATION

A. DEBRIS REMOVAL: Contractor shall remove all trimmings, trash, and debris found within the Project site and recycle or otherwise dispose of materials in accordance with State and

local regulations. Other site preparation activities for planting areas will have been conducted as described under Section 31 00 00, “Earthwork,”, and Section 32 92 00, “Seeding.”

## 3.04 CONTAINER PLANT INSTALLATION

A. GENERAL: Plant installation for container plants shall conform to the Drawings and these Specifications. If planting adjustments are necessary, the Contractor shall proceed only after receiving approval from the City for such adjustments. Species to be planted are indicated on the planting palettes included on the Drawings. The palette includes the plant name, container type (i.e., 1-Gallon pots, Treepot 4, Treeband, and plugs), spacing, and quantity for each plant species. Container plants shall be set out daily, ensuring that the number of plants distributed to the planting areas can be installed and watered on the same day as they are set out. Contractor shall meet the following conditions prior to installing plants:

1. Planting areas must be free of weeds, debris, and thatch.

2. A complete, operational irrigation system must be installed and meet City approval.

3. Plant locations must be watered for a minimum of 8 hours immediately prior to plant installation.

B. PLANT LOCATIONS: Individual planting locations shall be field marked (e.g., painted, staked or flagged) by plant species by the Contractor in coordination with the City. Species field markings in Mixed Riparian Woodland Establishment Areas shall remain in place after planting. Plants shall be spaced as shown on the Drawings. Quantities indicated on the Drawings are approximate; the Contractor shall confirm the quantities required when the locations are field marked. Field marking operations must be approved by the City before the start of any plant installation operations. At no time shall plants be installed within access roads, staging locations, mowed perimeters, utility corridors, on the new levee slope, within 10 feet of the O&M crossings, or other exclusion areas as indicated on the Drawings. Plants shall be installed as shown on the Drawings.

C. PLANT PLACEMENT AND BACKFILL: To install container plants in the in Mixed Riparian Woodland Establishment Areas, each plant shall be placed in the planting hole and the hole filled with moist, pulverized backfill which shall then be tamped and watered. Container plants shall be removed from the container with the rootball completely intact. The plant shall not be held by its stem or branches or in any way that may damage the plant. The rootball shall be lightly scarified, if visible at the soil surface, and inserted in the planting hole without bending or damaging the roots. Plants shall be installed vertically unless otherwise noted and braced in position until the backfill has been tamped solidly around the rootball. The plant shall be positioned with the root crown set no more than ½ inch above grade at the time of planting, and covered with a maximum of ¼–inch layer of backfill. Backfill material shall be firmly packed in place to make good contact with the rootball, leaving no air pockets. The Contractor shall be responsible for filling the planting hole to avoid settlement before plant placement. Additional fill shall be placed due to settlement of soil as required. A bamboo stake with labels to identify the species shall be placed adjacent to the installed plant and its associated plantings as shown on the Drawings. All stakes shall be removed at the end of the maintenance period.

D. WATERING: The Contractor shall be responsible for ensuring that the plants are properly watered before, during, and after the installation to maintain the plants in a healthy and vigorous condition during the entire Construction Period. The frequency and duration of the

watering shall depend on current weather patterns and site-specific planting area moisture conditions. The method, frequency, and duration of watering applications shall be according to Section 32 98 00, “Maintenance” Article 3.02 “Watering”, and shall be subject to observation by the City. At a minimum, all new plants shall be thoroughly watered immediately after installation. In addition, before departing from the Project site each day, the Contractor shall water those plants installed during that day a second time.

E. PLANTING FLOATING WETLAND ISLANDS: Container plants will be planted into planting pockets (4” diameter by 8” deep holes) in the Floating Wetland Island, as shown on the Drawings. Planting pockets where sandbar willows would be planted will be 6” diameter holes. Planting pockets shall be filled with an approved suitable hydroponic rooting medium, such as a high-quality, low salt content coco coir used for hydroponic plant production. Contractor shall carefully remove most potting soil from plant rootball before planting plant roots into coco coir (or other City-approved suitable medium) in planting pockets. The crown of each plant shall be set approximately ½ inch above the surface of the floating island to allow for future settling, and the rootball shall be lightly covered with approved planting medium. Planted plants shall be kept well-watered until islands are placed in pond, and may require supplemental watering during the first few weeks of growth until plant roots reach the water column.

## 3.05 CLEAN-UP

A. DAILY CLEAN-UP: Site clean-up shall occur daily. All garbage, construction debris, excess plants and dirt, other discarded materials, and extraneous equipment caused by or due to the Contractor shall be removed off site at the Contractor’s expense and in accordance with State and local regulations.

B. SALVAGE: All materials determined to be salvageable shall be handled and removed with care. The Contractor shall be responsible for salvaging, removing off site, and recycling all plant containers and racks and any surplus materials. At no time shall the City be responsible for recycling plant containers.

## 3.06 OBSERVATIONS

A. PLANTING OBSERVATIONS: The Contractor shall provide the City with 5 Business Days advance notification, unless otherwise noted, for the following, but not limited to, required planting stage acceptance observations (i.e., approval of a completed portion of the planting construction operations).

1. Observation of plant materials at nurseries before delivery to the Project site, and observation of plant storage after delivery.
2. Site discing and leveling.
3. Irrigation system layout, before field marking of planting hole locations.
4. Field marking of individual planting hole and plant species locations.
5. Plant installation operations and installation of bamboo stakes with labels for each species at each centralized planting location.
6. Watering plants during the Construction Period.
7. Planting Field Acceptance: The Contractor shall be responsible for the complete installation of plants according to the Drawings and as specified herein. Any unacceptable plants, site preparation, or planting operations shall be corrected according to the City’s direction and at the Contractor’s expense before the

Planting Field Acceptance Observation.

## PART 4: MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

A. PRE-PLANTING WEED MANAGEMENT: Measurement for Pre-planting Weed Management shall be made per acre, to the nearest 0.1 acre, of areas completely treated by the Contractor and approved by the City.

B. SITE PREPARATION: Measurement for Site Preparation shall be made per acre, to the nearest 0.1 acre, of areas completely prepared for planting by the Contractor and approved by the City.

C. CONTAINER PLANT INSTALLATION – RIPARIAN WOODLANDS: Measurement for Container Plant Installation in Mixed Riparian Woodland Establishment Areas shall be made for each individual container plant stored and installed by the Contractor and approved by the City. Installing bamboo stakes at each central plant with corresponding plant labels for Container Plantings, and associated Container Plantings shall be incidental to planting.

D. CONTAINER PLANT INSTALLATION – FLOATING WETLAND ISLANDS: Measurement for Container Plant Installation in Floating Wetland Islands shall be made for each individual container plant stored and installed by the Contractor and approved by the City. Providing approved coco coir hydroponic rooting medium for planting pockets and associated Container Plantings shall be incidental to planting.

### 4.02 PAYMENT

A. PRE-PLANTING WEED MANAGEMENT: Payment for Pre-planting Weed Management shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

B. SITE PREPARATION: Payment for Site Preparation shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

C. CONTAINER PLANT INSTALLATION – RIPARIAN WOODLANDS: Payment for Container Plant Installation in Mixed Riparian Woodland Establishment Areas shall be made at the Contract unit price for each installed container plant, which price shall include all costs in connection therewith.

D. CONTAINER PLANT INSTALLATION – FLOATING WETLAND ISLANDS: Payment for Container Plant Installation in Floating Wetland Islands shall be made at the Contract unit price for each installed container plant, which price shall include all costs in connection therewith.

### 4.03 PAYMENT ITEMS

A. PRE-PLANTING WEED MANAGEMENT: Payment for Pre-planting Weed Management shall be made under the item “Pre-planting Weed Management” on the Bid Form.

B. SITE PREPARATION: Payment for Site Preparation shall be made under the item “Site Preparation” on the Bid Form.

C. CONTAINER PLANT INSTALLATION: Payment for Container Plant Installation shall be made under the item “Container Plant Installation” on the Bid Form.

## 4.04 INCIDENTAL WORK

A. DESCRIPTION: No measurement and payment will occur for the following items; this work is considered incidental to obligations defined in these specifications:

1. Field marking underground utilities.
2. Field marking planting locations.
3. Watering plants as necessary during Construction Period.
4. Removing debris and equipment and clean-up according to Article 3.06 “Clean-up” of this Section.
5. Preparing all submittals.
6. Coordination of work with City staff, or City representatives.

*** END OF SECTION **

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SECTION 32 98 00

MAINTENANCE

## PART 1: GENERAL

1.01 SCOPE

A. GENERAL PROVISIONS: The General Requirements and Special Provisions apply to the work prescribed in this Section.

B. REQUIRED WORK: Work shall be performed at the locations shown on the Drawings. Work under this Section shall include, but is not limited to, all labor, tools, materials, equipment, and incidentals required to complete the following activities as shown on the Drawings, contained in these Specifications, and directed by the City. No deviations from the Drawings or these Specifications shall be allowed without written approval from the City. The Contractor shall plan for appropriate crew sizes supplied with necessary equipment to complete the required work for planted and seeded area maintenance, as described in this Section.

C. RELATED WORK: The work required under this Section is related to the following Sections of the Specifications.

Section 01 90 00, Mobilization and Demobilization
Section 32 80 00, Irrigation
Section 32 92 00, Seeding
Section 32 93 00, Planting

D. MINIMUM QUALIFICATIONS: The Contractor shall meet or exceed the minimum qualifications and conform to requirements specified in the Notice to Contractors, Special Provisions, and Bidder Experience Form.

E. PROJECT SCHEDULE: The Contractor's strict conformance to the Project Schedule is essential for the success of this Project. Contractor shall conduct maintenance during 3 complete years, as described on the Drawings and in the Special Provisions. The schedule for maintenance activities for each year shall be developed to meet the requirements specified in Special Provisions SP-4, “Time of Completion” and SP-6, “Project Schedule.” Contractor shall coordinate maintenance activities with the City.

F. CONTRACTOR’S RESPONSIBILITIES: Maintenance shall include the Contractor checking each planting zone and treatment area to examine the condition of plant establishment, and evidence and stage of competitive weed growth. The Contractor shall be responsible for a good faith effort in maintaining seeded and planted areas, as required, throughout the Maintenance Period, and shall be subject to observations of this work.

G. PERFORMANCE STANDARDS: Performance standards shall be evaluated independently for each planting and seeding area. The percent survival and vigor of installed woody plants in the Mixed Riparian Woodland Establishment Areas A and B, as shown on the Drawings, shall meet the performance standards in Table 1 below. The determination of vigor shall include these factors: disease symptoms, low-density foliage, atypical leaf color, stem and

foliar vigor (e.g., signs of desiccation, leaf curl), browsing or other wildlife-related damage, and vandalism. A vigor rating of good, fair, or poor (values of 3.0, 2.0, and 1.0, respectively) shall be assigned to each plant. Dead plants shall not be assigned a vigor rating. These ratings are defined below.

- Good (3.0): a plant with less than 25% of its aboveground growth exhibiting one or more of the factors listed above.
- Fair (2.0): a plant with 25–75% of its aboveground growth exhibiting one or more of the factors listed above.
- Poor (1.0): a plant with more than 75% of its aboveground growth exhibiting one or more of the factors listed above.
- Dead: a plant that does not appear capable of growth.

| **Table 1. Performance Standards for Woody Plant Survival and Vigor During the Maintenance Period** | | |
|---|---|---|
| ***Year*** | ***Survival of Woody Plants (%)*** | ***Vigor of Woody Plants*** |
| 1 | 80 | > 2 |
| 2 | 70 | > 2 |
| 3 | 60 | > 2 |
| Assessment Timing: Late Summer (between August 1 and September 15). Assessment will be performed by an ecologist appointed by the City. | | |

The percent cover for seeded areas, as shown on the Drawings, shall meet the performance standards in Table 2 below.

If the performance is less than the standards indicated in Tables 1 and 2, remedial actions shall be taken, in conformance to the Drawings and these Specifications, as required to achieve the identified performance standards. If the performance standards are not met at the time of Final Project Acceptance, the Project will not be accepted until the identified remedial actions are implemented by the Contractor, at the Contractors expense, and as directed by the City. Remedial actions could include additional weed control, or additional soil preparation and replanting or reseeding, followed by up to 3 additional years of maintenance as determined by the City. All remedial actions shall be conducted in strict coordination with, and upon the approval of, the City.

| **Table 2. Performance Standard for Seeded Areas During Year 3 of the Maintenance Period** | |
|---|---|
| ***Vegetation Type*** | ***Absolute Cover*** |
| All native and nonnative vegetation | ≥ 60% |
| Native vegetation | ≥ 25% |
| Nonnative broadleaf (dicot) weeds | < 15% |
| Performance standard applies to cover surveyed during Year 3 of the Maintenance Period (3 years after seeding). Assessment timing: Late spring (between April 1 and May 30). Assessment will be performed by an ecologist appointed by the City. | |

## 1.02 DEFINITIONS

A. WEED: Weeds are defined as those species listed in the California Invasive Plant Inventory available at: http://cal-ipc.org/paf/.

B. MAINTENANCE PERIOD: Maintenance work shall commence following Planting Field Acceptance and shall be executed over a 3-year period. The Contractor shall be responsible for the maintenance of Mixed Riparian Woodland Establishment Areas, Floating Wetland Islands, and seeded areas as defined by the Drawings and these specifications during the Maintenance Period. Specific maintenance actions required will be based on seasonality, weather, flood events, soil conditions, weed populations and distribution, condition of planting areas, percent survival, and the condition and percent cover of the seeded areas. Maintenance actions include: operation and repair of the irrigation system; controlling weeds using appropriate methods (hand pulling, string trimming, mowing, selective herbicide application, discing); replanting trees and shrubs; reseeding in under-performing areas; removing trash; and executing any other actions necessary to successfully meet the performance standards prescribed herein. Optional maintenance activities include controlling weeds using hand pulling, and installing and removing plant protection cages. The Contractor shall be responsible for the work as required by the Specifications and the Drawings, until the City provides Final Project Acceptance of the Project in writing.

C. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA A: See Section 32 92 00, “Seeding” Article 1.02 “Mixed Riparian Woodland Establishment Area A” for definition.

D. MIXED RIPARIAN WOODLAND ESTABLISHMENT AREA B: See Section 32 92 00, “Seeding” Article 1.02 “Mixed Riparian Woodland Establishment Area B” for definition.

E. GRASSLAND TEMPORARY IMPACT SEEDING AREAS: See Section 32 92 00, “Seeding” Article 1.02 “Native Grassland Seeding Areas” for definition.

F. RIPARIAN UNDERSTORY TEMPORARY IMPACT SEEDING AREAS: See Section 32 92 00, “Seeding” Article 1.02 “Riparian Understory Temporary Impact Seeding Areas” for definition.

G. TARGETED WOODY INVASIVE PLANT TREATMENT AREAS: The Contractor shall conduct targeted woody invasive plant treatment and removal activities within existing riparian forest areas to be preserved and enhanced within the project site. This work will be directed by an ecologist appointed by the City and will be completed on an event basis. Following targeted invasive plant removal events and retreatments (as necessary), any unvegetated understory areas 100 square feet or larger will be broadcast seeded as described in Section 32 92 00, “Seeding,” for Riparian Understory Temporary Impact Seeding Areas, and maintenance as described in Section 32 98 00, “Maintenance.”

H. SENSITIVE RESOURCE AREAS: See Section 01 90 00, “Mobilization and Demobilization” Article 1.02 “Sensitive Resource Areas” for definition.

J. SEEDING FIELD ACCEPTANCE: See Section 32 92 00, “Seeding,” Article 1.02 “Seeding Field Acceptance” for definition.

K. PLANTING FIELD ACCEPTANCE: See Section 32 93 00, “Planting,” Article 1.02 “Planting Field Acceptance” for definition.

L. FINAL PROJECT ACCEPTANCE: The conclusion of the Maintenance Period will be determined in consultation with the Contractor and the City and will be based upon satisfactory achievement of the required performance standards prescribed herein.

M. ESTABLISHMENT OF SEEDED AREAS: Establishment of seeded areas is the process of creating self-sustaining native vegetation cover, typically completed in 3 years (i.e., duration of time required to achieve desired conditions as set forth in Table 3). Activities carried out for management of seeded areas include, but are not limited to, weed management (e.g., mowing and herbicide applications) and reseeding where necessary.

N. RIPARIAN WOODLAND HABITAT ESTABLISHMENT: Establishment of the riparian habitat is the process of creating self-sustaining native habitats, typically completed in 3 years (i.e., duration of time required to achieve desired conditions as set forth in Table 1). Establishment activities include, but are not limited to, weed management (e.g., mowing and herbicide applications) and replanting where necessary.

O. SATURATED WORK AREA: See Section 32 80 00, “Irrigation”, Article 1.02 “Saturated Work Area” for definition.

1.03 REFERENCES

A. No references provided

1.04 SUBMITTALS

A. WATERING SCHEDULE. A written schedule for watering, including rate and length of application for each year over the duration of the Maintenance Period shall be submitted to the City within 5 Business Days of the initiation of the Maintenance Period. Watering frequency shall be as specified in Article 3.02.

B. WEED MANAGEMENT PLAN UPDATE: Contractor shall submit quarterly updates to the Weed Management Plan, as described in Section 32 92 00, “Seeding” Article 1.04 “Weed Management Plan.”

C. HERBICIDE APPLICATION NOTICE: A written Herbicide Application Notice shall be submitted within 5 Business Days advanced notice of all proposed herbicide applications, as described Section 32 92 00, “Seeding” Article 1.04 “Herbicide Application Notice.”

D. REPLACEMENT PLANTS: Submittals for replacement plants shall be according to specifications in Section 32 93 00, “Planting.”

E. RESEEDING MATERIALS: Submittals for replacement seed shall be according to specifications in Section 32 92 00, “Seeding.”

F. ‘AS-BUILT’ DRAWINGS: Contractor shall be responsible for preparing and submitting to the City one set of final red-lined ‘As-Built’ Drawings and revised specifications of all modifications to the Project design that occurred during the Maintenance Period, as described Section 11-3, “Record Drawings” of the General Specifications and this Section.

G. ANNUAL VEGETATION ESTABLISHMENT REPORTS. Annual Vegetation Establishment Reports covering the planted and seeded areas shall be submitted to the City as indicated in Article 3.06 “Vegetation Establishment Reports” of this Section.

## PART 2: PRODUCTS

### 2.01 GENERAL

A. PRODUCTS, MATERIALS AND EQUIPMENT: All products, materials, and equipment shall conform to the Drawings and previous related sections of these Specifications. The products, materials, and equipment shall be subject to the City’s approval. All materials shall be new and shall be delivered to the Project site in their original, unopened packaging containing the manufacturer's guarantee. All materials and equipment delivered to the Project site shall be clearly marked to identify the item or the materials. Materials shall be stored with protection from weather or other conditions that may damage or impair the effectiveness of the product.

### 2.02 MATERIALS

A. REPLACEMENT PLANTS: Purchase, delivery, storage, and handling of replacement plants shall be according to specifications in Section 32 93 00 “Planting”.

B. RESEEDING MATERIALS: Purchase, delivery, storage, and handling of replacement seed shall be according to specifications in Section 32 92 00 “Seeding”.

C. HERBICIDE: Herbicide shall be provided as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Section 32 92 00 “Seeding” Article 1.04.

## PART 3: EXECUTION

### 3.01 SITE CONDITIONS AND COORDINATION

A. COORDINATION: The Contractor shall be responsible for all coordination required for this Project including, but not limited to the following.

1. In consultation with the City, the Contractor shall coordinate all activities required by the Drawings and these Specifications to avoid conflicts with levees, roads, utilities, existing habitat, work conducted by the City of West Sacramento and RD 900, and any existing features. Coordination and communication with the City are of particular importance.

2. The Contractor shall be responsible for calling Underground Service Alert (USA) at 811 / 1-800-227-2600 to identify locations of underground utilities.

3. The Contractor shall be responsible for coordinating and scheduling the placement of materials and equipment necessary to complete the work and for ensuring that subcontractors do the same as quickly and efficiently as possible and in conformance with the construction schedule included in these Specifications.

4. The Contractor shall submit a plan for City approval that shows proposed equipment and materials storage and staging locations.

B. REGULAR OBSERVATIONS: The Contractor shall observe individual seeded and planted areas to confirm that native herbaceous cover and woodland plantings are in a healthy and vigorous condition, and to evaluate compliance with Project performance standards. During the first 2 years of the Maintenance Period, the Contractor shall conduct bi-weekly site evaluations (once every 2 weeks) during the irrigation season and at least monthly during the non-irrigation period. During Year 3 of the Maintenance Period, the Contractor shall conduct monthly site evaluations during the irrigation season and bi-monthly (once every 2 months) during the non-irrigation period. Observations shall include assessments of the following: irrigation systems function, plant condition (growth stage, stand height, plant vigor, insect and herbivore damage, herbicide burn, etc.), weed competition and growth stage, herbicide efficacy, and damage from unauthorized vehicles or equipment operated on seeded areas. If flood events inundate the planting areas, the Contractor shall inspect site conditions within 5 days after floodwaters recede. Any damage to plants or the irrigation system should be reported to the City. The Contractor shall be responsible for corrective measures, to maintain all planted and seeded areas as installed, according to these Specifications and as shown on the Drawings. All maintenance activities and observations shall be recorded and provided to the City in the Annual Vegetation Establishment Reports according to Article 3.06 of this Section.

C. PERFORMANCE MONITORING: The Contractor shall conduct performance monitoring to assess the Mixed Riparian Woodland Establishment Areas, Grassland Temporary Impact Seeding Areas, and Riparian Understory Temporary Impact Seeding Areas relative to the performance standards provided in Article 1.01 “Performance Standards” of this Section.

D. VANDALISM: Throughout the Contract Period, the Contractor shall carry insurance to cover vandalism and theft on the Project site. The Contractor shall be responsible for securing the Project site to minimize adverse effects from vandalism and theft per the Special Provisions.

E. EQUIPMENT OPERATION: At no time shall the Contractor’s equipment be operated during rain events or on Saturated Work Areas, as defined herein. The Contractor shall coordinate with the City to determine when work can begin following alleviation of Saturated Work Area conditions.

F. EXISTING FEATURES: During maintenance operations, Contractor shall avoid damaging existing facilities, levees and berms, overhead and underground utilities, public roads, access ramps, designated O&M roads, sensitive resource areas, or any other items on or around the Project area. Contractor shall be responsible for any damage caused to these existing features identified in this Section 3.01F.

## 3.02 IRRIGATION APPLICATION

A. WATER SOURCE: No on-site water source is available for irrigation; contractor shall supply water to the temporary irrigation systems via a mobile water source or by temporary water storage tank(s) placed within the woodland restoration area(s). Contractor shall confirm water source(s) used meet local and State standards for irrigation water quality.

B. APPLICATION: Watering shall consist of the application of water to all planted woody plants in a manner that is sufficient to wet the soil and saturate the root zone, without damaging plants or the surrounding grade. The plants shall receive water by way of the installed irrigation

system. The Contractor shall observe said system to ensure that it is functioning and providing adequate water to the plants. Water pressure shall be regulated to a level that applies sufficient water without causing excessive runoff, ponding, damage to plants, or erosion. Should the watering application rates need adjustment, the Contractor shall immediately contact the City for direction. The Contractor shall assume full responsibility for corrective actions resulting from inappropriate water applications and failure to contact the City for direction.

C. FREQUENCY AND DURATION: Long-duration (i.e., minimum 8 hours) watering events shall be conducted by the Contractor as estimated by the watering schedule provided in Table 4. Watering frequency and duration will be based on observations, as determined by the Contractor and the City. Throughout warm weather conditions, the plants may require additional watering events. In any given year, irrigation will typically begin in April and end by October. The beginning and ending dates and a schedule for watering shall be determined collaboratively by the Contractor and the City. If most of the plants appear to be stressed and in danger of perishing, the Contractor shall consult the City to determine the frequency and duration of additional or decreased watering. If modifications are made to the watering schedule, the Contractor shall provide the City with 2 copies of the adjusted watering schedule within 2 weeks of receiving the City's verbal acceptance plus subsequent written approval of the modifications.

**Table 4**
**Estimated Watering Schedule**

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Approximate Application Period | April – Oct<br>7 months | April – Oct<br>7 months | May – Oct<br>6 months |
| Frequency | 2–3 days | 3–5 days | 10–14 days |
| Duration | 8 hours | 8 hours | 8 hours |
| Estimated Watering Events | 70 | 42 | 18 |

## 3.03 PLANTED AND SEEDED AREA ESTABLISHMENT

A. REQUIREMENTS: Maintenance shall include Riparian Woodland Establishment Areas and seeded areas as designated on the Drawings. Maintenance shall be consistent with the Weed Management Plan required according to Section 32 92 00, "Seeding" Article 1.04 "Weed Management Plan." Weed control shall be conducted for all weed species that are establishing in these areas (see Article 1.02 in this Section). All planted areas shall receive 3 years of maintenance from the date of Planting Field Acceptance, including pre-seeding weed management for areas to be subsequently seeded. Following Seeding Field Acceptance, all planted and seeded areas shall be maintained until the end of the Maintenance Period, as defined in this Section.

B. MOWING OR STRING TRIMMING: Mowing or string trimming shall be conducted according to these Specifications and as prescribed in the updated Weed Management Plan prepared according to Section 32 92 00 "Seeding" Article 1.04 "Weed Management Plan". On approval of the City, the Contractor shall mow Project areas as necessary to achieve Project performance standards, to suppress weeds, and prevent weed seed set. Mowing or string trimming shall be conducted at a 6– to 12–inch cut height, with care taken to avoid damage to the

growth crowns of perennial native grasses. The purpose, methods, and timing of mowing events shall be to prevent shading of native grasses and young seedlings; competition from nonnative annual grasses, broadleaved and woody weed species; and prevent maturation of weed seed by cutting flowering weed stalks before viable seed has developed. Mowing at the most appropriate and effective times in the first year of maintenance is especially critical to the development of native grass seedlings. Contractor shall conduct frequent observations and complete mowing before nonnative annual grasses and broadleaved weeds shade and crowd out the developing native grass and planted seedlings.

C. HERBICIDE APPLICATION: Herbicide shall be applied as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Section 32 92 00, "Seeding" Article 1.04. A written Herbicide Application Notice shall be submitted within 5 Business Days advanced notice of the proposed herbicide application. On approval by the City, Contractor shall apply selective and/or registered soil active herbicide to Project areas as necessary to achieve Project performance standards and control warm- and cool-season weeds. The timing, method, and type of herbicide application shall be determined by field observations (e.g., dominant weed species and characteristics; incipient infestations; weed growth stage and size), weather conditions, and PCA recommendations. The purpose, methods, and timing of herbicide treatments shall be to prevent shading of native grasses, weed competition for nutrients and soil moisture, and to prevent weed seed production and dispersal by killing weeds before flowering or viable seed has developed. Late fall/winter and early spring selective herbicide treatments in seeded areas, following native grass seedling emergence, is especially critical to the establishment of native grass seedlings. Contractor shall conduct frequent observations and complete herbicide treatments before nonnative annual grasses, broadleaved and woody weed species shade and crowd out the developing native grass seedlings. Post-treatment conditions will be evaluated by the City. If post-treatment conditions do not demonstrate near total weed kill of targeted species or otherwise effectiveness to the satisfaction of the City, the Contractor shall assume full responsibility for corrective actions to resolve deficiencies.

D. HAND WEEDING: As deemed appropriate and approved by the City to improve performance of planted and seeded areas, the Contractor shall provide a 5-person hand weeding crew working 8 hours per day to hand pull, hoe, or cut target weeds. Each day the crew is on site will be considered one hand weeding event.

E. IRRIGATION SYSTEM REMOVAL: The irrigation system installed by the Contractor shall be removed at the end of the Maintenance Period, or as directed by the City. The Contractor shall furnish all labor, equipment, and incidental materials to completely remove the irrigation system and recycle or dispose of materials in accordance with State and local regulations.

F. REPLANTING: The Contractor shall replant habitat areas that exhibit less than the percent survival prescribed in the performance standards provided herein. Contractor shall not receive payment for replanting when mortality was caused by conditions within their control. Replanting shall use specified species and plant installation methods prescribed in Section 32 93 00, "Planting," and shown on the Drawings. At no time shall nonnative or unlisted species be planted unless approved by City.

G. REPLACEMENT PLANTING: The Contractor shall replant habitat areas that exhibit less than the percent survival prescribed in the performance standards provided herein. Contractor shall receive payment for replacement planting when mortality was caused by conditions beyond Contractor control. Replacement planting shall use specified species and plant

installation methods prescribed in Section 32 93 00, “Planting,” and shown on the Drawings. At no time shall nonnative or unlisted species be planted unless approved by City.

H. RESEEDING: The Contractor shall reseed areas larger than 400 square feet that exhibit less than the native percent cover per area by target species as prescribed in the performance standards provided herein, at Contractors expense. Reseeding shall use specified seed mixes, soil preparation, and application methods prescribed in Section 32 92 00, “Seeding,” and shown on the Drawings. At no time shall nonnative or unlisted species be seeded unless approved by City.

## 1.04 TARGETED INVASIVE WOODY PLANT TREATMENT AREAS

A. REQUIREMENTS: Targeted Invasive Woody Plant Treatment Areas will be identified within extant riparian forests of the project site, by an ecologist appointed by the City, in coordination with the Contractor. The Contractor shall conduct targeted woody invasive plant treatment and removal activities in identified prioritized locations, following methods consistent with the Weed Management Plan required according to Section 32 92 00, “Seeding” Article 1.04 “Weed Management Plan.” Targeted invasive woody plant removal shall consist of hand pulling, targeted mechanical removal, targeted herbicide applications or a combination of the above. Targeted invasive woody plant removal shall be conducted on an event basis; each event consists of a qualified 5-person hand crew working 8 hours per day to hand pull, hoe, cut, and/or herbicide treat target weeds. Each day the crew is on site will be considered one hand weeding/targeted woody invasive plant removal event.

B. HERBICIDE APPLICATION: Herbicide shall be spot applied to target woody invasive plants (using foliar spray or cut and paint methods) as prescribed in the Weed Management Plan and Herbicide Application Notice prepared according to Section 32 92 00, “Seeding” Article 1.04. A written Herbicide Application Notice shall be submitted within 5 Business Days advanced notice of the proposed herbicide application. The timing, method, and type of herbicide application shall be determined by field observations (e.g., prioritized target woody invasive plants and characteristics; incipient infestations; plant stage and size), weather conditions, and PCA recommendations. The purpose, methods, and timing of herbicide treatments shall be to reduce the prevalence of target woody invasive plants within the extant riparian forests of the project site for habitat quality enhancements. Post-treatment conditions will be evaluated by the Contractor and the City. If post-treatment conditions do not demonstrate near total kill of targeted invasive woody plants within a defined treatment area or otherwise effectiveness to the satisfaction of the City, the Contractor shall assume full responsibility for corrective actions to resolve deficiencies. Retreatments of invasive woody plant resprouts may be required. Damage to non-target native vegetation shall be minimized to the maximum extent practicable during targeted invasive woody plant removal and treatments.

C. HAND WEEDING/MECHANICAL REMOVAL: In Project areas unsuitable for herbicide application, or where hand pulling or other mechanical plant removal is deemed a more effective (or complimentary) method of targeted removal than herbicide application, the Contractor shall provide a 5-person hand weeding crew working 8 hours per day to hand pull, hoe, or cut target weeds. Each day the crew is on site will be considered one hand weeding event. Impacts to nontarget vegetation shall be minimized.

D. SEEDING: Following targeted invasive plant removal events and retreatments (as necessary), any riparian understory areas 100 square feet or larger that would benefit from

revegetation following targeted invasive plant removal will be broadcast seeded in the subsequent fall/winter season as described in Section 32 92 00, “Seeding,” for Riparian Understory Temporary Impact Seeding Areas, and monitored and maintained as described in Section 32 98 00, “Maintenance.” If it is determined that seeding efforts were unsuccessful in establishing native cover in targeted invasive plant removal areas, reseeding or replanting may be required by the City.

E. PERFORMANCE STANDARDS: The Contractor shall be responsible for ensuring successful removal of targeted invasives in treatment areas, and for installing seeding materials in good condition according to these Specifications and the City’s direction. No materials substitutions shall be allowed without prior approval from the City. The Contractor shall be responsible for providing evidence of successful germination of seeded areas before Treatment Areas Field Acceptance is provided.

1. TREATMENT AREAS FIELD ACCEPTANCE: The milestone at which the City inspects and accepts all work related to targeted invasive woody plant removal and reseeding within existing riparian woodlands, as complete.

2. SITE PREPARATION: Activities required to prepare an area for seeding. Site preparation activities include clearing debris, weeds, and thatch and hand raking soil surface.

## 3.05 CLEAN-UP AND DEBRIS REMOVAL

A. CLEAN-UP: Site clean-up shall occur monthly or more frequently, as necessary. Throughout the Maintenance Period, the Contractor shall be responsible for removal of all trash and debris that flows into or is placed in the Project area. All garbage, construction and any other debris, and dirt, other discarded materials, and extraneous equipment shall be removed off site at the Contractor’s expense and in accordance with State and local regulations.

B. NATURAL DEBRIS AND NONNATIVE VEGETATION: Natural debris shall be evaluated by the City and shall be removed by the Contractor as directed by the City. Any clearing of debris and vegetation within the Project areas shall be performed using hand-clearing or low-impact methods.

C. HUMAN-MADE DEBRIS: Any human-made debris within the Project areas shall be removed by the Contractor.

D. EQUIPMENT ACCESS: Any equipment needed to remove debris within the Project areas shall be restricted to designated access and maintenance roads and staging areas, as shown on the Drawings. Access shall be conducted according to the Special Provisions.

## 3.05 ‘AS-BUILT’ DRAWINGS

A. GENERAL: Updated ‘As-Built’ Drawings shall be prepared by the Contractor and submitted to the City after completion of all maintenance activities before Final Project Acceptance. The ‘As-Built’ Drawings and any modified specifications shall be kept current monthly and shall document any modifications to the Project or replanted and reseeded areas that were made during the Maintenance Period. These drawings and modified specifications shall be

available at the Project site during these operations (see Section 11-3, “Record Drawings” of the General Specifications for additional requirements).

B. PREPARATION: Within 30 Calendar Days of the completion of maintenance and establishment for the Project, the Contractor shall be responsible for preparing one set of final red-lined ‘As-Built’ Drawings of all modifications to the Project design and specifications that occurred during the Construction Period and Maintenance Period for use by others. The ‘As-Built’ Drawings shall be prepared by the Contractor, drafting all changes on one set of reproducible prints of the Construction Drawings, including any addendums shall be titled as “Final ‘As-Built’ Drawings and Specifications” and provided to the City.

C. CONTENT: Based on actual construction, the ‘As-Built’ Drawings and Specifications shall show as-built conditions at the end of the Maintenance Period for the following:

1. A description of site conditions, subtotals of planted and seeded acres, planting dates, species planted, and the percent cover and percent survival performance, listed by each habitat type and Project planting or seeding area as shown on these Drawings.

2. Identification of any reseeded areas and documentation of dates conducted, and percent performance before reseeding occurred, if required during the Maintenance Period.

3. General description of weed populations and weed management measures taken, including mowing and herbicide application dates and locations. Species and locations of persistent weed populations shall be indicated.

## 3.06 VEGETATION ESTABLISHMENT REPORTS

A. RECORD KEEPING: The Contractor shall be responsible for record keeping throughout the Maintenance Period. The City will provide a maintenance activity log template to the Contractor. A copy of the maintenance activity log template is provided in the References section. The Contractor shall be responsible for recording all regular observations and maintenance activities during the maintenance period. The City may request the maintenance log at any time. The City will provide the contractor with at least 5 Business Days advance notice of the request.

B. CONTENT: Record keeping shall include, but is not limited to:

1. Weed Management Activities: For all weed management activities the following information shall be recorded: date, location, type of activity undertaken, equipment used, pre-activity site conditions, and post-activity results.. For herbicide applications, record target weeds, herbicide names, concentrations, and application methods.

2. Riparian Woodland Establishment: Based on observations for all planted areas, the following information shall be recorded: date, location, description of growth stage, areas of exceptional growth, areas of poor growth or low survival, probable causes for performance, replanted areas and quantities by species replaced, and percent survival and vigor by species.

3. Replanting: For all replanted areas, record date, location, conditions contributing to poor performance, and species replanted. Replanted areas shall be identified on the 'As-Built' Drawings.

4. Irrigation: For planted areas, irrigation frequency and duration, and system maintenance shall be recorded.

5. Establishment of Seeded Areas: Based on observations for all seeded areas, record date, location, and description of growth stage, dominant species, areas of exceptional establishment, areas of poor establishment, probable causes for performance, and reseeded areas.

6. Reseeding: For all reseeded areas, record date, location, conditions contributing to poor performance, seed mix used for reseeding, soil preparation and seeding methods. Reseeded areas shall be identified on the 'As-Built' Drawings.

7. Annual Performance Survey: For all planted and seeded areas, provide data and summarized results from annual performance monitoring as described in Article 3.01 of this Section.

D. ANNUAL VEGETATION ESTABLISHMENT REPORT: At the end of each year of the Maintenance Period, the Contractor shall summarize the record keeping efforts for that year by compiling said records into an Annual Vegetation Establishment Report for submittal to the City. Results of the Annual Performance Surveys shall also be included.

1. The annual report shall include a title page and table of contents and include the following: regular observations, maintenance activity log, annual performance survey results, replanting records, reseeding records, updated 'As-Built' Drawings.

2. Each report shall be submitted as a current electronic copy in Microsoft Word and Adobe PDF. When drawings are submitted, 11"x17" pdf sheets are acceptable.

3.07 OBSERVATIONS

A. PROGRESS OBSERVATIONS: Progress observations of the Contractor's Maintenance Period operations will be conducted by the City according to these Specifications. Observations will typically be conducted around April 1 and July 1 of each maintenance year.

B. FINAL PROJECT ACCEPTANCE OBSERVATION: The Contractor shall provide 90 days advance written notice to the City for the Final Project Acceptance Observation, which will coincide with the Final Maintenance Observation. At the time of the Final Project Acceptance Observation, the Contractor shall have maintained the Project in its entirety and achieved the performance standards prescribed herein and approved by the City. The Contractor shall remediate conditions determined as unacceptable by the City per the Drawings and Specifications. Following completion of identified remedial actions, the City, in consultation with the Contractor, will assess the status of those remedial actions before Final Project Acceptance is issued. The Contractor shall be responsible for any resulting extension of the Contract Period and shall do so at no additional cost.

C. FINAL PROJECT ACCEPTANCE: Final Project Acceptance will be issued by the City when the Contractor has met the Performance Standards prescribed herein.

## PART 4: MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

A. IRRIGATION APPLICATION: Measurement for Irrigation Application shall be on a unit price basis for each irrigation application event to all installed plants completely supplied and conducted by the Contractor and approved by the City.

B. MOWING OR STRING TRIMMING: Measurement for Mowing or String Trimming shall be made on a unit price basis per acre, to the nearest 0.1 acre, completely supplied and conducted by the Contractor and approved by the City.

C. HERBICIDE APPLICATION: Measurement for Herbicide Application in seeded and planted areas shall be made on a unit price basis per acre, to the nearest 0.1 acre, completely supplied and conducted by the Contractor and approved by the City.

D. HAND WEEDING: Measurement for Hand Weeding in seeded and planted areas shall be made on a unit price basis for each event completely supplied and conducted by the Contractor and approved by the City.

E. TARGETED WOODY INVASIVE PLANT REMOVAL: Measurement for Targeted Woody Invasive Plant Removal within existing site riparian woodlands shall be made on a unit price basis for each event completely supplied and conducted by the Contractor and approved by the City.

F. IRRIGATION SYSTEM REMOVAL: Measurement for Irrigation System Removal shall be made on a lump sum basis for the irrigation system completely removed by the Contractor and approved by the City.

G. REPLACEMENT PLANTING: Measurement for Replacement Planting shall be made for each individual container plant completely supplied and installed by the Contractor and approved by the City.

### 4.02 PAYMENT

A. IRRIGATION APPLICATION: Payment for Irrigation Application, measured as specified, shall be made at the Contract unit price for each irrigation application event, which price shall include all costs in connection therewith.

B. MOWING OR STRING TRIMMING: Payment for Mowing or String Trimming, measured as specified, shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

C. HERBICIDE APPLICATION: Payment for Herbicide Application in Seeded and Planted Areas, measured as specified, shall be made at the Contract unit price per acre, which price shall include all costs in connection therewith.

D. HAND WEEDING: Payment for Hand Weeding in seeded and planted areas, measured as specified, shall be made at the Contract unit price per event which price shall include all costs in connection therewith.

E. TARGETED WOODY INVASIVE PLANT REMOVAL: Payment for Targeted Woody Invasive Plant Removal within existing riparian woodlands, measured as specified, shall be made at the Contract unit price per event which price shall include all costs in connection therewith.

F. IRRIGATION SYSTEM REMOVAL: Payment for Irrigation System Removal, measured as specified, shall be made on a Contract lump sum price for removal of the irrigation system, which price shall include all costs in connection therewith.

G. REPLACEMENT PLANTING: Payment for Replacement Planting shall be made at the Contract unit price for each installed container plant, which price shall include all costs in connection therewith.

4.03 PAYMENT ITEMS

A. IRRIGATION APPLICATION: Payment for Irrigation Application shall be made under the item “Irrigation Application” under the header “Maintenance” on the Bid Form.

B. MOWING OR STRING TRIMMING: Payment for Mowing or String Trimming shall be made under the item “Mowing or String Trimming” under the header “Maintenance” on the Bid Form.

C. HERBICIDE APPLICATION: Payment for Herbicide Application shall be made under the item “Herbicide Application” under the header “Maintenance” on the Bid Form.

D. HAND WEEDING: Payment for Hand Weeding in seeded and planted areas shall be made under the item “Hand Weeding” under the header “Maintenance” on the Bid Form.

E. TARGETED WOODY INVASIVE PLANT REMOVAL: Payment for Targeted Woody Invasive Plant Removal within existing riparian woodlands shall be made under the item “Targeted Woody Invasive Plant Removal” under the header “Maintenance” on the Bid Form.

F. IRRIGATION SYSTEM REMOVAL: Payment for Irrigation System Removal shall be made under the item “Irrigation System Removal” on the Bid Form.

G. REPLACEMENT PLANTING: Payment for Replacement Planting shall be made under the item “Replacement Planting” on the Bid Form.

4.04 INCIDENTAL WORK

A. DESCRIPTION: No measurement and payment will occur for the following items; this work is considered incidental to the other maintenance operations:

1. Monitoring planted and seeded area performance.
2. Replanting woody and herbaceous species.
3. Reseeding areas.
4. Maintaining irrigation systems and irrigation system components.

5. Repair or replacement of vandalized or stolen equipment and materials.
6. Removing debris and/or trash.
7. Preparing maintenance activity logs.
8. Preparing Weed Management Plan quarterly updates.
9. Preparing Herbicide Application Notices.
10. Preparing Annual Vegetation Establishment Reports.
11. Preparing As-Built Drawings.
12. Gaining Final Project Acceptance.

*** END OF SECTION ***

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# SECTION 33 46 16

# SUBDRAINAGE PIPING

## PART 1 GENERAL

### 1.1 UNIT PRICES

#### 1.1.1 Pipe Subdrains

Measure the length of pipe installed from end to end along the centerlines without any deduction for the diameter of the manholes. Pipe will be paid for according to the number of linear feet of subdrains placed in the accepted work. Payment for bedding and [drainage layer] [filter] materials, except geotextiles, will be included in the payment for the pipe subdrain system.

#### 1.1.2 Blind or French Drains

Blind or french drains will be paid for by the linear foot and measured from end to end along the centerlines of the completed drains.

#### 1.1.3 Manholes

Manholes to be paid for will be the number of manholes completed with base, rungs or ladders, frames, and covers or gratings (where specified) constructed in the accepted work.

#### 1.1.4 Flushing and Observation Risers

Flushing and observation risers to be paid for will be the number of flushing and observation risers completed with frames and covers (where specified) constructed in the accepted work.

#### 1.1.5 Geotextile

Measure geotextile for payment by the square [yard][foot] in place. Measure overlapped joints and seams as a single layer of cloth.

### 1.2 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M 190 | (2004; R 2019) Standard Specification for Asphalt-Coated Corrugated Metal Culvert Pipe and Pipe Arches |
| AASHTO M 252 | (2009; R 2017) Standard Specification for Corrugated Polyethylene Drainage Pipe |
| AASHTO M 288 | (2021) Standard Specification for Geosynthetic Specification for Highway |

Applications

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A27/A27M | (2020) Standard Specification for Steel Castings, Carbon, for General Application |
| ASTM A47/A47M | (1999; R 2022; E 2022) Standard Specification for Ferritic Malleable Iron Castings |
| ASTM A48/A48M | (2003; R 2021) Standard Specification for Gray Iron Castings |
| ASTM A123/A123M | (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products |
| ASTM A760/A760M | (2015, R 2020) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains |
| ASTM A762/A762M | (2019) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains |
| ASTM A798/A798M | (2022) Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications |
| ASTM B745/B745M | (2015; R 2021) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains |
| ASTM C33/C33M | (2018) Standard Specification for Concrete Aggregates |
| ASTM C136/C136M | (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C478 | (2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections |
| ASTM D2321 | (2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| ASTM D2487 | (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) |
| ASTM D3034 | (2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D3753 | (2019) Glass-Fiber-Reinforced Polyester Manholes and Wetwells |

| | |
|---|---|
| ASTM D4632/D4632M | (2015a) Grab Breaking Load and Elongation of Geotextiles |
| ASTM F758 | (2014) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage |
| ASTM F949 | (2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings |

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Geotextile

Pipe and Pipe Fittings

SD-06 Test Reports

Geotextile JP-8 Fuel Resistance Test

SD-07 Certificates

Geotextile

Pipe and Pipe Fittings

## 1.4 DELIVERY, STORAGE, AND HANDLING

### 1.4.1 Delivery and Storage

Inspect materials delivered to site for damage; unload, and store with minimum handling. Do not store materials directly on the ground. Keep the inside of pipes and fittings sfree of dirt and debris. Keep, during shipment and storage, geotextile wrapped in burlap or similar heavy duty protective covering. Protect the geotextile from mud, soil, dust, and debris. Do not store geotextile materials in direct sunlight. Install plastic pipe within 6 months from the date of manufacture unless otherwise approved.

### 1.4.2 Handling

Handle materials in such a manner as to ensure delivery to the trench in sound undamaged condition. Carry pipe to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

Submit samples of pipe and pipe fittings, before starting the work. Provide type and sizes of subdrain pipe indicated. Submit certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe and fittings.

2.1.1 Plastic

Provide plastic pipe containing ultraviolet inhibitor to provide protection from exposure to direct sunlight. Provide pipe with with bell and spigot or solvent cement joints. Provide manufacturer's standard type fittings conforming to the indicated specification.

2.1.1.1 Polyvinyl Chloride (PVC) and Fittings

ASTM D3034, ASTM F949 or ASTM F758, Type PS 46.

2.1.1.2 Corrugated Polyethylene (PE) and Fittings

AASHTO M 252, Type S or SP as indicated.

2.1.1.3 Pipe Perforations

Provide pipe perforations with a minimum water inlet area of 0.5 square inch per linear foot and as specified below.

2.1.1.3.1 Circular Perforations in Plastic Pipe

Cleanly cut circular holes not more than 3/8 inch or less than 3/16 inch in diameter and arrange in rows parallel to the longitudinal axis of the pipe. Provide pipe with perforations spaced uniformly along rows. Unless otherwise recommended by the pipe manufacturer, provide pipe with rows approximately 1-1/2 inches apart and arranged in a staggered pattern so that all perforations lie at the midpoint between perforations in adjacent rows. Space the rows over not more than 155 degrees of circumference. Provide pipe that is not perforated for a length equal to the depth of the socket at the spigot or tongue end and provide perforations that continue at uniform spacing over the entire length of the pipe.

2.1.1.3.2 Slotted Perforations in Plastic Pipe

Cleanly cut circumferential slots so as not to restrict the inflow of water and uniformly spaced along the length and circumference of the pipe. Provide pipe with slots not exceeding 1/8 inch nor less than 1/32 inch in width. Provide pipe with individual slot lengths not exceeding 10 percent of the pipe inside nominal circumference on 6 to 8 inch diameter pipe, and 2-1/2 inches on 10 inch diameter pipe. Symmetrically space rows of slots so that they are fully contained in 2 quadrants of the pipe. Center slots in the valleys of the corrugations of profile wall pipe.

2.1.2 Corrugated Steel

ASTM A760/A760M, Type I or III, as indicated [with a coating conforming to AASHTO M 190, Type A]. Provide Class 1 perforations in Type III pipe. Pipe sheet thickness 0.064 inch.

2.1.3 Corrugated Aluminum Alloy

ASTM B745/B745M, Type I or III, as indicated [with a bituminous coating conforming to AASHTO M 190, Type A]. Provide Class 1 perforations in Type III pipe. Pipe sheet thickness 0.064 inch.

2.1.4 Precoated Corrugated Steel

ASTM A762/A762M, Type I or III, as indicated. Provide Class 1 perforations in Type III pipe.

2.2 GEOTEXTILE

[Provide geotextile conforming to AASHTO M 288 and meeting the subsurface drainage requirements.] [Provide geotextile meeting the requirements in Section 31 05 19.13 GEOTEXTILES FOR EARTHWORK.][Provide geotextile that is a [woven] [nonwoven] pervious sheet of polymeric material consisting of long-chain synthetic polymers composed of at least 95 percent by weight polypropylene (PP) or polyester (PET). The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Add stabilizers and/or inhibitors to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. The equivalent opening size (AOS) will be no finer than US Standard Sieve No. [_____] and no coarser than US Standard Sieve No. [_____]. AOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings. [The percent open area will not be less than [_____] percent and not more than [_____] percent. Percent open area is defined as the summation of open areas divided by the total area of the filter fabric and expressed as a percent.] The minimum grab strength will be 160 pounds in accordance with ASTM D4632/D4632M. Provide geotextile with filaments constructed so as to retain their relative position with respect to each other. [Selvage or otherwise finish the edges of the geotextile to prevent the outer material from pulling away from the fabric.] [Provide geotextile that is woven into a width that may be installed as shown without longitudinal seams.]]

Submit samples of geotextile and certifications from the manufacturers attesting that geotextile meets specification requirements.

2.3 [DRAINAGE LAYER] [SUBDRAIN FILTER AND BEDDING] MATERIAL

[Provide drainage layer material meeting the requirements in Section 32 11 23.23 BASE COURSE DRAINAGE LAYERS][Provide subdrain filter and bedding material composed of washed sand, sand and gravel, crushed stone, crushed stone screenings, or slag composed of hard, tough, durable particles free from adherent coatings. Filter material may not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles. Provide filter material that is evenly graded between the limits specified in TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Provide filter materials that are clean and free from soil and foreign materials. Remove and replace filter blankets found to be dirty or otherwise contaminated with material meeting the specific requirements, at no additional cost to the Government.

| TABLE I | | | |
|---|---|---|---|
| | Type I Gradation E 11 ASTM C33/C33M | Type II Gradation 57 ASTM C33/C33M | Type III Gradation [_____] [_____] |
| ASTM C136/C136M Sieve Size | Percent Passing | Percent Passing | Percent Passing |
| 1-1/2 inch | -- | 100 | [_____] |
| 1 inch | -- | 90 - 100 | [_____] |
| 3/8 inch | 100 | 25 - 60 | [_____] |
| No. 4 | 95 - 100 | 5 - 40 | [_____] |
| No. 8 | -- | 0 - 20 | [_____] |
| No. 16 | 45 - 80 | -- | [_____] |
| No. 50 | 10 - 30 | -- | [_____] |
| No. 100 | 0 - 10 | -- | [_____] |

]

## 2.4 DRAINAGE STRUCTURES

### 2.4.1 Concrete

Provide concrete and reinforced concrete conforming to the requirements for [3,000] [_____] psi concrete in Section 03 30 00 CAST-IN-PLACE CONCRETE.

### 2.4.2 Mortar

Provide mortar for connections to drainage structures that is composed of one part by volume of portland cement and two parts of sand. Provide sufficient quantity of water in the mixture to produce a stiff workable mortar. Use water that is clean and free of injurious acids, alkalies, and organic impurities. Use the mortar within 30 minutes from the time the ingredients are mixed with water.

### 2.4.3 Manholes and Appurtenances

#### 2.4.3.1 Precast Reinforced Concrete Manhole Risers and Tops

ASTM C478.

#### 2.4.3.2 Precast Concrete Manhole Bases

ASTM C478. Provide bases that allow suitable connection with influent and effluent lines and to provide a suitable base structure for riser sections.

#### 2.4.3.3 Glass Fiber-Reinforced Polyester (FRP)

ASTM D3753.

#### 2.4.3.4 Frames and Covers or Gratings

Except as otherwise permitted, provide frames and gratings, or frames and covers of either cast iron with tensile strength test not less than ASTM A48/A48M Class 25 or steel conforming to ASTM A27/A27M, Class 65-35. Required weight, shape, and size are indicated on the drawings. Frames and covers not subjected to vehicular traffic or storage may be of malleable iron where indicated. Provide malleable-iron frames and covers conforming to ASTM A47/A47M and of the weight, shape, and size indicated.

#### 2.4.3.5 Steel Ladder

Provide a steel ladder where the depth of a manhole exceeds 12 feet. The ladder will be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. Provide two stringers that are a minimum 3/8 inch thick and 2 inches wide. Adequately anchor ladder to the wall by means of steel inserts spaced not more than 6 feet apart vertically, and install so as to provide at least 6 inches of space between the wall and the rungs. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

## 2.5 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.5.1 Geotextile JP-8 Fuel Resistance Test

Immerse five unaged geotextile samples, 4 (plus or minus 0.2) by 6 (plus or minus 0.2) inches in JP-8 fuel at room temperature for a period of 7 days. Test each sample for tensile strength and elongation in accordance with ASTM D4632/D4632M. Provide geotextile with a strength in any direction of not less than 85 percent of the strength specified in paragraph GEOTEXTILE.

# PART 3 EXECUTION

## 3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Excavate trenches, including the removal of rock and unstable material, in accordance with Section 31 00 00 EARTHWORK. Place bedding material in the trench as indicated or as required as replacement materials used in those areas where unstable materials were removed. Compact bedding material as specified for cohesionless material in Section 31 00 00 EARTHWORK.

## 3.2 MANHOLES AND FLUSHING AND OBSERVATION RISERS

### 3.2.1 Manholes

Install manholes complete with frames and covers or gratings at the locations and within the limits and sizes indicated. Construct manholes of one of the materials specified for manholes in paragraph DRAINAGE STRUCTURES. [Completely fill precast concrete manhole joints so that they are smooth and free of surplus mortar or mastic on the inside of the structure.] Use either precast or cast-in-place concrete manhole bases.

### 3.2.2 Flushing and Observation Risers

Install flushing and observation riser pipes with frames and covers at the locations indicated. Construct risers of non-perforated [plastic] [or] [galvanized] [bituminous coated] [corrugated metal] pipe. Join riser pipes to the subdrain system as indicated.

## 3.3 INSTALLATION OF GEOTEXTILE AND PIPE FOR SUBDRAINS

### 3.3.1 Installation of Geotextile

#### 3.3.1.1 Trench Lining and Overlaps

Grade trenches to be lined with geotextile to obtain smooth side and bottom surfaces so that the geotextile will not bridge cavities in the soil or be damaged by projecting rock. Lay the geotextile flat but not stretched on the soil, and secure it with anchor pins in accordance with manufacturer's instructions. Overlap at least 6 to 12 inches, and secure with anchor pins along the overlaps.

### 3.3.2 Installation of Pipe for Subdrains

#### 3.3.2.1 Pipelaying

Install pipe in accordance with the manufacturer's recommendations. Thoroughly examine each section of pipe before being laid; do not use defective or damaged pipe. Do not lay pipe when the trench conditions or weather is unsuitable for such work. Remove water from trenches by sump pumping or other approved methods. Lay the pipe to the grades and alignment as indicated. Bed the pipe to the established gradeline. Center perforations on the bottom of the pipe. Lay bell-and-spigot type with the bell ends upstream. Approval of all in-place pipes by the Contracting Officer is required prior to backfilling.

#### 3.3.2.2 Jointings

##### 3.3.2.2.1 Perforated Corrugated Metal Pipe or Bituminous Coated, Perforated Corrugated Metal Pipe

Securely fasten together the sections of perforated corrugated metal pipe or bituminous coated, perforated corrugated metal pipe standard connecting bands furnished by the manufacturer of the pipe.

##### 3.3.2.2.2 Bituminous Coated or Uncoated Corrugated Aluminum Pipe

If aluminum pipe is to be connected to dissimilar metal, insulate the connection by bituminous coating or other nonconductive material. Securely fasten standard joints between corrugated aluminum pipe with standard connecting bands furnished by the manufacturer of the pipe.

## 3.4 INSTALLATION OF [DRAINAGE LAYER][FILTER] MATERIAL AND BACKFILLING FOR PERFORATED SUBDRAINS

After perforated pipe for subdrains has been laid, inspected, and approved, place [drainage layer] [filter] material around and over the pipe to the depth indicated. Place the [drainage layer] [filter] material in layers not to exceed 8 inches thick. [Saturate by flooding.] [Thoroughly compact each layer using mechanical tampers or rammers.]

## 3.5 INSTALLATION OF BEDDING AND BACKFILL FOR NON-PERFORATED SUBRAIN OUTFALL PIPE

### 3.5.1 Plastic Pipe

Place and compact pipe embedment for plastic pipe in accordance with ASTM D2321. Use Class IB or II embedment materials.

### 3.5.2 Corrugated Metal Pipe

Place and compact bedding ans structural backfill for corrugated metal pipe in accordance with ASTM A798/A798M. Use structural backfill materials classified by ASTM D2487 as either GW, GM, GP-GM, GW-GM, GC, GP-GC or SW.

## 3.6 INSTALLATION OF AND BACKFILLING FOR BLIND OR FRENCH DRAINS

Place filter material as indicated and compact as specified for cohesionless materials in Section 31 00 00 EARTHWORK. Extend filter material to a suitable outlet or to an outlet through a pipeline as indicated. Place and compact overlying backfill material as specified in Section 31 00 00 EARTHWORK.

-- End of Section --

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# SECTION 33 71 02

# UNDERGROUND ELECTRICAL DISTRIBUTION

## PART 1 GENERAL

### 1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO HB-17 | (2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges |

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 318M | (2014; ERTA 2015) Building Code Requirements for Structural Concrete & Commentary |
| ACI SP-66 | (2004) ACI Detailing Manual |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

| | |
|---|---|
| AEIC CS8 | (2013) Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A48/A48M | (2003; R 2021) Standard Specification for Gray Iron Castings |
| ASTM B1 | (2013) Standard Specification for Hard-Drawn Copper Wire |
| ASTM B3 | (2013) Standard Specification for Soft or Annealed Copper Wire |
| ASTM B8 | (2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft |
| ASTM B231/B231M | (2016; R 2021) Standard Specification for Concentric-Lay-Stranded Aluminum 1350 Conductors |

| | |
|---|---|
| ASTM B400/B400M | (2019) Standard Specification for Compact Round Concentric-Lay-Stranded Aluminum 1350 Conductors |
| ASTM B496 | (2016; R 2021) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors |
| ASTM B609/B609M | (2012; R 2021) Standard Specification for Aluminum 1350 Round Wire, Annealed and Intermediate Tempers, for Electrical purposes |
| ASTM B800 | (2005; R 2021) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers |
| ASTM B801 | (2018) Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation |
| ASTM C32 | (2013; R 2017) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale) |
| ASTM C139 | (2022) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes |
| ASTM C309 | (2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C478 | (2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections |
| ASTM C857 | (2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures |
| ASTM C990 | (2009; R 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| ASTM F512 | (2019) Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation |
| ASTM F2160 | (2022a) Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD) |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 48 | (2020) Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV |
| IEEE 81 | (2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System |
| IEEE 386 | (2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV |
| IEEE 400.2 | (2013) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) |
| IEEE 404 | (2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V |
| IEEE 495 | (2007) Guide for Testing Faulted Circuit Indicators |
| IEEE C2 | (2023) National Electrical Safety Code |
| IEEE C37.20.3 | (2013) Standard for Metal-Enclosed Interrupter Switchgear |
| IEEE Stds Dictionary | (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions |

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

| | |
|---|---|
| ICEA S-94-649 | (2021) Concentric Neutral Cables Rated 5 Through 46 KV |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| ANSI C119.1 | (2016) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts |
| ANSI/NEMA WC 71/ICEA S-96-659 | (2014; R 2022) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy |
| NEMA C119.4 | (2011) Electric Connectors - Connectors for Use Between Aluminum-to-Aluminum or |

| | |
|---|---|
| | Aluminum-to-Copper Conductors Designed for Normal Operation at or Below 93 Degrees C and Copper-to-Copper Conductors Designed for Normal Operation at or Below 100 Degrees C |
| NEMA RN 1 | (2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit |
| NEMA TC 2 | (2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit |
| NEMA TC 3 | (2021) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing |
| NEMA TC 6 & 8 | (2020) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations |
| NEMA TC 7 | (2021) Smooth-Wall Coilable and Straight Electrical Polyethylene Conduit |
| NEMA TC 9 | (2020) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation |
| NEMA WC 70 | (2021) Power Cable Rated 2000 Volts or Less for the Distribution of Electrical Energy |
| NEMA WC 74/ICEA S-93-639 | (2022) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2023) National Electrical Code |

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS (SCTE)

| | |
|---|---|
| ANSI/SCTE 77 | (2013) Specification for Underground Enclosure Integrity |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-758 | (2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard |

U.S. DEPARTMENT OF AGRICULTURE (USDA)

| | |
|---|---|
| RUS Bull 1751F-644 | (2002) Underground Plant Construction |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-60005 | (Basic; Notice 2) Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 6 | (2022) UL Standard for Safety Electrical Rigid Metal Conduit-Steel |
| UL 44 | (2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables |
| UL 83 | (2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables |
| UL 94 | (2023; Reprint May 2023) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| UL 467 | (2022) UL Standard for Safety Grounding and Bonding Equipment |
| UL 486A-486B | (2018; Reprint May 2021) UL Standard for Safety Wire Connectors |
| UL 510 | (2020; Dec 2022) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape |
| UL 514A | (2013; Reprint Jun 2022) UL Standard for Safety Metallic Outlet Boxes |
| UL 514B | (2012; Reprint May 2020) Conduit, Tubing and Cable Fittings |
| UL 651 | (2011; Reprint May 2022) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings |
| UL 854 | (2020; Reprint Jan 2022) Standard for Service-Entrance Cables |
| UL 1072 | (2006; Reprint Apr 2020) Medium-Voltage Power Cables |
| UL 1242 | (2006; Reprint Apr 2022) UL Standard for Safety Electrical Intermediate Metal Conduit -- Steel |

[1.2 SYSTEM DESCRIPTION

Items provided under this section must be specifically suitable for the following service conditions. Seismic details must [conform to UFC 3-301-01, "Structural Engineering" and Sections 13 48 73 SEISMIC CONTROL FOR MISCELLANEOUS EQUIPMENT and 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT] [be as indicated].

a. Fungus Control [_____]

b. Altitude [_____] feet.

c. Ambient Temperature [_____] degrees F.

d. Frequency [_____]

e. Ventilation [_____]

f. Seismic Parameters [_____]

g. Humidity Control [_____]

h. Corrosive Areas [_____]

i. [_____]

]1.3 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

c. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

[ d. Underground structures subject to aircraft loading are indicated on the drawings.

]1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

[ Aluminum Conductors; G[, [_____]]

][ Submit modified drawings and engineering calculations associated with design changes required for use of aluminum conductors.

] Precast Underground Structures; G[, [_____]]

SD-03 Product Data

Medium Voltage Cable; G[, [_____]]

Medium Voltage Cable Joints; G[, [_____]]

Medium Voltage Cable Terminations; G[, [_____]]

[ Live End Caps; G[, [_____]]

] Precast Concrete Structures; G[, [_____]]

Sealing Material

Pulling-In Irons

Manhole Frames and Covers; G[, [_____]]

Handhole Frames and Covers; G[, [_____]]

[ Frames and Covers for Airfield Facilities; G[, [_____]]

][ Ductile Iron Frames and Covers for Airfield Facilities; G[, [_____]]

] Composite/Fiberglass Handholes; G[, [_____]]

Cable Supports (racks, arms and insulators); G[, [_____]]

[ Protective Devices and Coordination Study; G[, [_____]]

][ Submit the study with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government will not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered or procured prior to approval of the study.

] SD-06 Test Reports

Medium Voltage Cable Qualification and Production Tests; G[, [_____]]

Field Acceptance Checks and Tests; G[, [_____]]

Arc-proofing Test for cable fireproofing tape; G[, [_____]]

[ Cable Installation Plan and Procedure; G[, [_____]]

][ [Six][_____] copies of the information described below in 8-1/2 by 11 inch binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Separate sections by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

][ a. Site layout drawing with cable pulls numerically identified.

][ b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.

][ c. The cable manufacturer and type of cable.

][ d. The dates of cable pulls, time of day, and ambient temperature.

][ e. The length of cable pull and calculated cable pulling tensions.

][ f. The actual cable pulling tensions encountered during pull.

] SD-07 Certificates

Cable splicer/terminator; G[, [_____]]

Cable Installer Qualifications; G[, [_____]]

[ Directional Boring Certificate of Conformance; G[, [_____]]

]1.6 QUALITY ASSURANCE

1.6.1 Precast Underground Structures

Submittal required for each type used. Provide calculations and drawings for precast manholes and handholes bearing the seal of a registered professional engineer including:

a. Material description (i.e., f'c and Fy)

b. Manufacturer's printed assembly and installation instructions

c. Design calculations

d. Reinforcing shop drawings in accordance with ACI SP-66

e. Plans and elevations showing opening and pulling-in iron locations and details

[1.6.2 Certificate of Competency for Cable Splicer/Terminator

[ The cable splicer/terminator must have a certification from the National Cable Splicing Certification Board (NCSCB) in the field of splicing and terminating shielded medium voltage (5 kV to 35 kV) power cable using pre-manufactured kits (pre-molded, heat-shrink, cold shrink). Submit "Proof of Certification" for approval, for the individuals that will be performing cable splicer and termination work, 30 days before splices or terminations are to be made.

][Submit certification of the qualification of the cable splicer/terminator for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. Include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. Indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. List a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor must provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

]]1.6.3 Cable Installer Qualifications

Provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. Provide a resume showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers. Cable installer must demonstrate experience with a minimum of three medium voltage cable installations. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for an alternate qualified cable installer.

[1.6.4 Directional Boring Certificate of Conformance

Provide certification of compliance with the registered Professional Engineer's design requirements for each directional bore, including: HDPE conduit size and type, bend radius, elevation changes, vertical and horizontal path deviations, conductor size and type and any conductor derating due to depth of conduit. Record location and depth of all directional-bore installed HDPE conduits using Global Positioning System (GPS) recording means with "resource grade" accuracy.

]1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of IEEE C2 and NFPA 70 unless more stringent requirements are specified or indicated.

1.6.6 Standard Products

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

1.6.6.1 Alternative Qualifications

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

1.6.6.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable, unless specified otherwise.

PART 2 PRODUCTS

2.1 CONDUIT, DUCTS, AND FITTINGS

2.1.1 Rigid Metal Conduit

UL 6.

2.1.1.1 Rigid Metallic Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.2 Intermediate Metal Conduit

UL 1242.

2.1.2.1 Intermediate Metal Conduit, PVC Coated

NEMA RN 1, Type A40, except that hardness must be nominal 85 Shore A durometer, dielectric strength must be minimum 400 volts per mil at 60 Hz, and tensile strength must be minimum 3500 psi.

2.1.3 Plastic Conduit for Direct Burial and Riser Applications

UL 651 and NEMA TC 2,[ EPC-40][ or][ EPC-80][ as indicated].

2.1.4 Plastic Duct for Concrete Encasement

Provide[[ Type EB-20][ Type EB-35] per UL 651, ASTM F512, and NEMA TC 6 & 8 ][ or][ Type EPC-40 per UL 651 and NEMA TC 2][, as indicated].

[2.1.5 High Density Polyethylene (HDPE) Electrical Conduit for Directional Boring

Smoothwall, approved/listed for directional boring, minimum Schedule 80, ASTM F2160, NEMA TC 7.

]2.1.6 Duct Sealant

UL 94, Class HBF. Provide high-expansion urethane foam duct sealant that expands and hardens to form a closed, chemically and water resistant, rigid structure. Sealant must be compatible with common cable and wire jackets and capable of adhering to metals, plastics and concrete. Sealant must be capable of curing in temperature ranges of 35 degrees F to 95 degrees F. Cured sealant must withstand temperature ranges of -20 degrees F to 200 degrees F without loss of function.

2.1.7 Fittings

2.1.7.1 Metal Fittings

UL 514B.

2.1.7.2 PVC Conduit Fittings

[UL 514B, UL 651][NEMA TC 3].

2.1.7.3 PVC Duct Fittings

NEMA TC 9.

[2.1.7.4 Outlet Boxes for Steel Conduit

Outlet boxes for use with rigid or flexible steel conduit must be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and must conform to UL 514A.

]2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES

Insulated conductors must be rated 600 volts and conform to the requirements of NFPA 70, including listing requirements[, or in accordance with NEMA WC 70]. Wires and cables manufactured more than [24][12] months prior to date of delivery to the site are not acceptable. Service entrance conductors must conform to UL 854, type USE.

2.2.1 Conductor Types

Cable and duct sizes indicated are for copper conductors and THHN/THWN unless otherwise noted. Conductors No. 10 AWG and smaller must be solid. Conductors No. 8 AWG and larger must be stranded.[ Conductors No. 6 AWG and smaller must be copper. Conductors No. 4 AWG and larger may be either copper or aluminum, at the Contractor's option. Do not substitute aluminum for copper if the equivalent aluminum conductor size would exceed 500 kcmil. When the Contractor chooses to use aluminum for conductors No. 4 AWG and larger, the Contractor must: increase the conductor size to have the same ampacity as the copper size indicated; increase the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with NFPA 70; ensure that the pulling tension rating of the aluminum conductor is sufficient; relocate equipment, modify equipment terminations, resize equipment, and resolve to the satisfaction of the Contracting Officer problems that are direct results of the use of aluminum conductors in lieu of copper.][ All conductors must be copper.]

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, must be 600-volt,[ Type THWN/THHN conforming to UL 83][ or][ Type[ XHHW][ or][ RHW] conforming to UL 44]. Copper conductors must be annealed copper complying with ASTM B3 and ASTM B8.[ Aluminum conductors must be Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801, and must be of an aluminum alloy listed or labeled by UL as "component aluminum-wire stock (conductor material). Type 1350 is not acceptable. Intermixing of copper and aluminum conductors in the same raceway is not permitted.]

[2.2.3 Jackets

Provide multiconductor cables with an overall PVC outer jacket.

][2.2.4 Direct Buried

Provide single-conductor [and multi-conductor ]cables identified for direct burial.

]2.2.5 In Duct

Cables must be single-conductor cable.[ Cables in factory-installed, coilable-plastic-duct assemblies must conform to NEMA TC 7.]

2.2.6 Cable Marking

Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length.

Identify each cable by means of a fiber, laminated plastic, or non-ferrous metal tags in each manhole, handhole, junction box, and each terminal. Each tag must contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

Color code conductors. Provide conductor identification within each enclosure where a tap, splice, or termination is made. Conductor identification must be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, heat shrink type sleeves,or colored electrical tape. Properly identify control circuit terminations. Color must be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutrals may be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems are as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

b. 480/277 volt, three-phase

(1) Phase A - brown

(2) Phase B - orange

(3) Phase C - yellow

c. 120/240 volt, single phase: Black and red

[ d. On three-phase, four-wire delta system, high leg must be orange, as required by NFPA 70.

]2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

Provide a uniform compression over the entire conductor contact surface. Use solderless terminal lugs on stranded conductors.

a. For use with copper conductors: UL 486A-486B.

[ b. For use with aluminum conductors: UL 486A-486B. For connecting aluminum to copper, connectors must be the circumferentially compressed, metallurgically bonded type.

]2.4 LOW VOLTAGE SPLICES

Provide splices in conductors with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

### 2.4.1 Heat Shrinkable Splice

Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material applied in accordance with the manufacturer's written instructions.

### 2.4.2 Cold Shrink Rubber Splice

Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation must not require heat or flame, or any additional materials such as covering or adhesive. It must be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

## 2.5 MEDIUM VOLTAGE CABLE

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors must have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than [24][12] months prior to date of delivery to the site are not acceptable. Provide single conductor type cables unless otherwise indicated.

### 2.5.1 Cable Configuration

Provide [Type MV cable, conforming to NEMA WC 74/ICEA S-93-639 and UL 1072] [concentric neutral underground distribution cable conforming to ICEA S-94-649][metallic armored cables, consisting of three-conductor, multi-conductor cables, with insulation and shielding, as specified, using [a galvanized steel][an aluminum] interlocked tape armor and thermoplastic jacket]. Provide cables manufactured for use in[ duct][ or][ direct burial] applications[ as indicated]. Cable must be rated [5 kV][15 kV][25 kV][28 kV][35 kV][as indicated] with [100][133] percent insulation level.

### 2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B[ compact round] conductors. Provide[ aluminum alloy Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801][ aluminum alloy 1350 cables, 3/4 hard minimum complying with ASTM B609/B609M and ASTM B231/B231M for regular concentric and compressed stranding or ASTM B400/B400M for compacted stranding][ soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding].

### 2.5.3 Insulation

Provide [ethylene-propylene-rubber (EPR) insulation conforming to the requirements of [ANSI/NEMA WC 71/ICEA S-96-659][ANSI/NEMA WC 74/ICEA S-93-639] and [AEIC CS8][ICEA S-94-649]][tree-retardant cross-linked thermosetting polyethylene (XLP) insulation conforming to the requirements of NEMA WC 74/ICEA S-93-639 and [AEIC CS8][ICEA S-94-649]].

### 2.5.4 Shielding

Cables rated for 2 kV and above must have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper[ tape][ or][ wire] shield for each phase.

2.5.5 Neutrals

[Neutral conductors must be [copper][aluminum], employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.][ Concentric neutrals conductors must be copper, having a combined ampacity [equal to][1/3 of] the phase conductor ampacity rating.][ For high impedance grounded neutral systems, the neutral conductors from the neutral point of the transformer or generator to the connection point at the impedance must utilize [copper][aluminum] conductors, employing the same insulation level and construction as the phase conductors.]

2.5.6 Jackets

Provide cables with a [PVC][_____] jacket.[ Direct buried cables must be rated for direct burial.][ Provide type UD cables with an overall jacket.] [ Provide PVC jackets with a separator that prevents contact with underlying semiconducting insulating shield.]

2.6 MEDIUM VOLTAGE CABLE TERMINATIONS

IEEE 48 Class 1; of the molded elastomer, prestretched elastomer, or heat-shrinkable elastomer. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Provide terminations, where required, with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Provide terminations in a kit, including: skirts, stress control terminator, ground clamp, connectors, lugs, and complete instructions for assembly and installation. Terminations must be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.6.1 Cold-Shrink Type

Terminator must be a one-piece design, utilizing the manufacturer's latest technology, where high-dielectric constant (capacitive) stress control is integrated within a skirted insulator made of silicone rubber. Termination must not require heat or flame for installation. Termination kit must contain all necessary materials (except for the lugs). Design termination for installation in low or highly contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.2 Heat Shrinkable Type

Terminator must consist of a uniform cross section heat shrinkable polymeric construction stress relief tubing and environmentally sealed outer covering that is nontracking, resists heavy atmospheric contaminants, ultra violet rays and oxidative decomposition. Provide heat shrinkable sheds or skirts of the same material. Design termination for installation in low or highly contaminated indoor or outdoor locations.

[2.6.3 Separable Insulated Connector Type

IEEE 386. Provide connector with steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Provide connectors of the loadbreak or deadbreak type as indicated, of suitable

construction for the application and the type of cable connected, and that include cable shield adaptors. Provide external clamping points and test points. Do no use separable connectors in manholes/handholes.

[ a. 200 Ampere loadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Short time rating: 10,000 rms symmetrical amperes.
]
[ b. 600 Ampere deadbreak connector ratings: Voltage: [15 kV, 95 kV BIL][25 kV, 125 kV BIL][35 kV, 150 kV BIL]. Short time rating: 25,000 rms symmetrical amperes.[ Connectors must have 200 ampere bushing interface[ for surge arresters][ as indicated].]
]
[ c. Provide[ [one][_____] set[s] of three grounding elbows][ and][ [one][_____] set[s] of three feed-thru inserts]. Deliver [grounding elbows][ and ][feed-thru inserts] to the Contracting Officer.
]
[ d. Install one set of faulted circuit indicators, complying with IEEE 495, on the test points of each set of separable insulated connectors. Indicators must be self powered; with automatic trip with mechanical flag indication upon overcurrent followed by loss of system voltage, and automatic reset upon restoration of system voltage. Indicators must be compact, sealed corrosion resistant construction with provision for hotstick installation and operation.

]]2.7 MEDIUM VOLTAGE CABLE JOINTS

Provide joints (splices) in accordance with IEEE 404 suitable for the rated voltage, insulation level, insulation type, and construction of the cable. Joints must be certified by the manufacturer for waterproof, submersible applications. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint must be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion.

2.7.1 Heat-Shrinkable Joint

Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.

2.7.2 Cold-Shrink Rubber-Type Joint

Joint must be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket must be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice should be packaged three splices per kit, including complete installation instructions.

2.8 TELECOMMUNICATIONS CABLING

Provide telecommunications cabling in accordance with Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

[2.9 LIVE END CAPS

Provide live end caps using a "kit" including a heat-shrinkable tube and a high dielectric strength, polymeric plug overlapping the conductor. Conform to applicable portions of IEEE 48.

]2.10 TAPE

2.10.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

2.10.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 00 00 EARTHWORK.

2.10.3 Fireproofing Tape

Provide tape composed of a flexible, conformable, unsupported intumescent elastomer. Tape must be not less than .030 inch thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, adhesive-free, and must not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.11 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.12 GROUNDING AND BONDING

2.12.1 Driven Ground Rods

Provide [copper-clad steel ground rods conforming to UL 467][solid copper ground rods conforming to UL 467][solid stainless steel ground rods] not less than 3/4 inch in diameter by 10 feet in length. Sectional type rods may be used for rods 20 feet or longer.

2.12.2 Grounding Conductors

Stranded-bare copper conductors must conform to ASTM B8, Class B, soft-drawn unless otherwise indicated. Solid-bare copper conductors must conform to ASTM B1 for sizes No. 8 and smaller. Insulated conductors must be of the same material as phase conductors and green color-coded, except that conductors must be rated no more than 600 volts. Aluminum is not acceptable.

2.13 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE. In addition, provide concrete for encasement of underground ducts with 3000 psi minimum 28-day compressive strength. Concrete associated with electrical work for other than encasement of underground ducts must be 4000 psi minimum 28-day compressive strength unless specified otherwise.

2.14 UNDERGROUND STRUCTURES

Provide precast concrete underground structures or standard type cast-in-place manhole types as indicated, conforming to ASTM C857 and ASTM C478. Top, walls, and bottom must consist of reinforced concrete. Walls and bottom must be of monolithic concrete construction. Locate duct entrances and windows near the corners of structures to facilitate cable racking. Covers must fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings must be free

from warp and blow holes that may impair strength or appearance. Exposed metal must have a smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Install a pulling-in iron in the wall opposite each duct line entrance. Cable racks, including rack arms and insulators, must be adequate to accommodate the cable.

2.14.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.[ Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.][ Concrete block must conform to ASTM C139 and Section 04 20 00, MASONRY.][ Concrete block is not allowed in areas subject to aircraft loading.]

2.14.2 Precast Concrete Structures, Risers and Tops

Precast concrete underground structures may be provided in lieu of cast-in-place subject to the requirements specified below. Precast units must be the product of a manufacturer regularly engaged in the manufacture of precast concrete products, including precast manholes.

2.14.2.1 General

Precast concrete structures must have the same accessories and facilities as required for cast-in-place structures. Likewise, precast structures must have plan area and clear heights not less than those of cast-in-place structures. Concrete materials and methods of construction must be the same as for cast-in-place concrete construction, as modified herein. Slope in floor may be omitted provided precast sections are poured in reinforced steel forms. Concrete for precast work must have a 28-day compressive strength of not less than 4000 psi. Structures may be precast to the design and details indicated for cast-in-place construction, precast monolithically and placed as a unit, or structures may be assembled sections, designed and produced by the manufacturer in accordance with the requirements specified. Structures must be identified with the manufacturer's name embedded in or otherwise permanently attached to an interior wall face.

2.14.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

a. Angle of Internal Friction (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 0.33

d. Ground Water Level = 3 feet below ground elevation

e. Vertical design loads must include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads must consider all types and magnitudes of vehicular (automotive, industrial, or aircraft) traffic to be encountered. The minimum design vertical load must be for H20 highway loading per AASHTO HB-17.

f. Horizontal design loads must include full geostatic and hydrostatic

pressures for the soil parameters, water table, and depth of installation to be encountered. Also, horizontal loads imposed by adjacent structure foundations, and horizontal load components of vertical design loads, including impact, must be considered, along with a pulling-in iron design load of 6000 pounds.

g. Each structural component must be designed for the load combination and positioning resulting in the maximum shear and moment for that particular component.

h. Design must also consider the live loads induced in the handling, installation, and backfilling of the manholes. Provide lifting devices to ensure structural integrity during handling and installation.

2.14.2.3 Construction

Provide a uniform thickness for structure top, bottom, and wall not less than 6 inches. Thin-walled knock-out panels for designed or future duct bank entrances are not permitted. Provide quantity, size, and location of duct bank entrance windows as directed, and cast completely open by the precaster. Size of windows must exceed the nominal duct bank envelope dimensions by at least 12 inches vertically and horizontally to preclude in-field window modifications made necessary by duct bank misalignment. However, the sides of precast windows must be a minimum of 6 inches from the inside surface of adjacent walls, floors, or ceilings. Form the perimeter of precast window openings to have a keyed or inward flared surface to provide a positive interlock with the mating duct bank envelope. Provide welded wire fabric reinforcing through window openings for in-field cutting and flaring into duct bank envelopes. Provide additional reinforcing steel comprised of at least two No. 4 bars around window openings. Provide drain sumps a minimum of 12 inches in diameter and 4 inches deep for precast structures.

2.14.2.4 Joints

Provide tongue-and-groove joints on mating edges of precast components. Shiplap joints are not allowed. Design joints to firmly interlock adjoining components and to provide waterproof junctions and adequate shear transfer. Seal joints watertight using preformed plastic strip conforming to ASTM C990. Install sealing material in strict accordance with the sealant manufacturer's printed instructions. Provide waterproofing at conduit/duct entrances into structures, and where access frame meets the top slab, provide continuous grout seal.

2.14.3 Manhole Frames and Covers

Provide cast iron frames and covers for manholes conforming to CID A-A-60005. Cast the words "ELECTRIC" or "TELECOMMUNICATIONS" in the top face of power and telecommunications manhole covers, respectively.

2.14.4 Handhole Frames and Covers

Frames and covers of steel must be welded by qualified welders in accordance with standard commercial practice. Provide rolled-steel floor plate covers having an approved antislip surface. Hinges must be of [stainless steel with bronze hinge pin] [wrought steel], 5 by 5 inches by approximately 3/16 inch thick, without screw holes, and must be for full surface application by fillet welding. Hinges must have nonremovable pins and five knuckles. The surfaces of plates under hinges must be true after the removal of raised antislip surface, by grinding or other approved method.

[2.14.5 Frames and Covers for Airfield Facilities

Fabricate frames and covers for airfield use of standard commercial grade steel welded by qualified welders in accordance with AWS D1.1/D1.1M. Provide rolled steel floor plate covers having an approved anti-slip surface. Steel frames and covers must be hot dipped galvanized after fabrication.

][2.14.6 Ductile Iron Frames and Covers for Airfield Facilities

At the Contractor's option, ductile iron covers and frames designed for a minimum proof load of 100,000 pounds may be provided in lieu of the steel frames and covers indicated. Covers must be of the same material as the frames (i.e. ductile iron frame with ductile iron cover, galvanized steel frame with galvanized steel cover). Perform proof loading in accordance with CID A-A-60005 and ASTM A48/A48M. Proof loads must be physically stamped into the cover. Provide the Contracting Officer copies of previous proof load test results performed on the same frames and covers as proposed for this contract. Modify the top of the structure to accept the ductile iron structure in lieu of the steel structure indicated. The finished structure must be level and non-rocking, with the top flush with the surrounding pavement.

]2.14.7 Brick for Manhole Collar

Provide sewer and manhole brick conforming to ASTM C32, Grade MS.

2.14.8 Composite/Fiberglass Handholes and Covers

ANSI/SCTE 77. Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass with a design load (Tier rating) appropriate for or greater than the intended use. All covers are required to have the Tier level rating embossed on the surface which must not exceed the design load of the box.

2.15 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

Zinc coat the metal portion of racks and arms after fabrication.

2.15.1 Cable Rack Stanchions

The wall bracket or stanchion must be 4 inches by approximately 1-1/2 inch by 3/16 inch channel steel, or 4 inches by approximately 1 inch glass-reinforced nylon with recessed bolt mounting holes, 48 inches long (minimum) in manholes. Space slots for mounting cable rack arms at 8 inch intervals.

2.15.2 Rack Arms

Cable rack arms must be steel or malleable iron or glass reinforced nylon and must be of the removable type. Rack arm length must be a minimum of 8 inches and a maximum of 12 inches.

2.15.3 Insulators

Insulators for metal rack arms must be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.16 CABLE TAGS IN MANHOLES

Provide polyethylene tags for each power cable located in manholes. Do not provide handwritten letters. The first position on the power cable tag denotes the voltage. The second through sixth positions on the tag identifies the circuit. The next to last position denotes the phase of the circuit and include the Greek "phi" symbol. The last position denotes the cable size. As an example, a tag could have the following designation: "11.5 NAS 1-8(Phase A)500," denoting that the tagged cable is on the 11.5kV system circuit number NAS 1-8, underground, Phase A, sized at 500 kcmil.

### 2.16.1 Polyethylene Cable Tags

Provide tags of polyethylene having an average tensile strength of 3250 pounds per square inch; and that are 0.08 inch thick (minimum), non-corrosive non-conductive; resistive to acids, alkalis, organic solvents, and salt water; and distortion resistant to 170 degrees F. Provide 0.05 inch (minimum) thick black polyethylene tag holder. Provide a one-piece nylon, self-locking tie at each end of the cable tag, having a minimum loop tensile strength of 175 pounds and black block letters, numbers, and symbols one inch high on a yellow background. Letters, numbers, and symbols must not fall off or change positions regardless of the cable tags' orientation.

## 2.17 MEDIUM VOLTAGE ABOVE GROUND CABLE TERMINATING CABINETS

Cable terminating cabinets must be hook-stick operable, deadfront construction conforming to the requirements of IEEE C37.20.3, Category A. Provide cabinets with [200 A. loadbreak junctions and elbow-type separable loadbreak connectors, cable parking stands, and grounding lugs][600 A. dead-break junctions and elbow-type separable dead-break connectors, cable parking stands, and grounding lugs]. Provide cable terminating equipment in conformance with IEEE 386.

Ratings at 60 Hz must be:

| | |
|---|---|
| Nominal voltage (kV) | [_____] |
| Rated maximum voltage (kV) | [[15][25][35]] |
| Rated continuous current (A) | [[200][600]] |
| One-second short-time current-carrying capacity (kA) | [_____] |
| BIL (kV) | [_____] |

## 2.18 LOW VOLTAGE ABOVE GROUND TERMINATION PEDESTAL

Provide copolymer polypropylene, low voltage above ground termination pedestal manufactured through an injection molding process. Pedestals must resist fertilizers, salt air environments and ultra-violet radiation. Pedestal top must be imprinted with a "WARNING" and "ELECTRIC" identification. Pedestal must contain [three][four] lay-in six port connectors, NEMA C119.4, Class "A", dual rated for aluminum or copper, and capable of terminating conductors ranging from 10 AWG to 500 kcmil. Protect each connector with a clear, hard lexan (plastic) cover. Provide pedestal with rust-free material and stainless steel hardware that is lockable.

## 2.19 PROTECTIVE DEVICES AND COORDINATION

Provide protective devices and coordination as specified in Section 26 05 73 POWER SYSTEM STUDIES.

## 2.20 SOURCE QUALITY CONTROL

### 2.20.1 Arc-Proofing Test for Cable Fireproofing Tape

Manufacturer must test one sample assembly consisting of a straight lead tube 12 inches long with a 2 1/2 inch outside diameter, and a 1/8 inch thick wall, and covered with one-half lap layer of arc and fireproofing tape per manufacturer's instructions. The arc and fireproofing tape must withstand extreme temperature of a high-current fault arc 13,000 degrees K for 70 cycles as determined by using an argon directed plasma jet capable of constantly producing and maintaining an arc temperature of 13,000 degrees K. Temperature (13,000 degrees K) of the ignited arc between the cathode and anode must be obtained from a dc power source of 305 (plus or minus 5) amperes and 20 (plus or minus 1) volts. Direct the arc toward the sample assembly accurately positioned 5 (plus or minus 1) millimeters downstream in the plasma from the anode orifice by fixed flow rate of argon gas (0.18 g per second). Test each sample assembly at three unrelated points. Start time for tests must be taken from recorded peak current when the specimen is exposed to the full test temperature. Surface heat on the specimen prior to that time must be minimal. The end point is established when the plasma or conductive arc penetrates the protective tape and strikes the lead tube. Submittals for arc-proofing tape must indicate that the test has been performed and passed by the manufacturer.

### 2.20.2 Medium Voltage Cable Qualification and Production Tests

Results of AEIC CS8 qualification and production tests as applicable for each type of medium voltage cable.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Install equipment and devices in accordance with the manufacturer's published instructions and with the requirements and recommendations of NFPA 70[ and IEEE C2][ and CALPUC G.O.128] as applicable. In addition to these requirements, install telecommunications in accordance with TIA-758 and RUS Bull 1751F-644.[ Treat soil a minimum 12 inches on each side of the installed cable for the entire length in accordance with Section 31 31 16.13 CHEMICAL TERMITE CONTROL.]

## 3.2 CABLE INSPECTION

Inspect each cable reel for correct storage positions, signs of physical damage, and broken end seals prior to installation. If end seal is broken, remove moisture from cable prior to installation in accordance with the cable manufacturer's recommendations.

## [3.3 CABLE INSTALLATION PLAN AND PROCEDURE

Obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature limits for installation, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, maximum allowable pulling tension, and maximum allowable sidewall bearing pressure. [Prepare a

checklist of significant requirements ][Perform pulling calculations and prepare a pulling plan ]and submit along with the manufacturer's instructions in accordance with SUBMITTALS. Install cable strictly in accordance with the cable manufacturer's recommendations and the approved installation plan.

[ Calculations and pulling plan must include:

a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.

b. List of cable installation equipment.

c. Lubricant manufacturer's application instructions.

d. Procedure for resealing cable ends to prevent moisture from entering cable.

e. Cable pulling tension calculations of all cable pulls.

f. Cable percentage conduit fill.

g. Cable sidewall bearing pressure.

h. Cable minimum bend radius and minimum diameter of pulling wheels used.

i. Cable jam ratio.

j. Maximum allowable pulling tension on each different type and size of conductor.

k. Maximum allowable pulling tension on pulling device.

]]3.4 UNDERGROUND FEEDERS SUPPLYING BUILDINGS

Terminate underground feeders supplying building at a point 5 feet outside the building and projections thereof, except that conductors must be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide [PVC, Type EPC-40][IMC][RGS] conduit from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

[ Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

]3.5 UNDERGROUND STRUCTURE CONSTRUCTION

Provide standard type cast-in-place construction as specified herein and as indicated, or precast construction as specified herein. Horizontal concrete surfaces of floors must have a smooth trowel finish. Cure concrete by applying two coats of white pigmented membrane forming-curing compound in strict accordance with the manufacturer's printed instructions, except that precast concrete may be steam cured. Curing compound must conform to ASTM C309. Locate duct entrances and windows in the center of end walls (shorter) and near the corners of sidewalls (longer) to facilitate cable racking and splicing. Covers for underground structures must fit the frames without undue play. Form steel and iron to shape and size with sharp lines and angles. Castings must be free from warp and blow holes that may impair strength or appearance. Exposed metal must have a

smooth finish and sharp lines and arises. Provide necessary lugs, rabbets, and brackets. Set pulling-in irons and other built-in items in place before depositing concrete. Manhole locations, as indicated, are approximate. Coordinate exact manhole locations with other utilities and finished grading and paving.

### 3.5.1 Cast-In-Place Concrete Structures

[Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.] [Provide concrete block conforming to ASTM C139 and Section 04 20 00 MASONRY.] [Concrete block is not allowed in areas subject to aircraft loading.]

### 3.5.2 Precast Concrete Construction

Set commercial precast structures on 6 inches of level, 90 percent compacted granular fill, 3/4 inch to 1 inch size, extending 12 inches beyond the structure on each side. Compact granular fill by a minimum of four passes with a plate type vibrator. Installation must additionally conform to the manufacturer's instructions.

### 3.5.3 Pulling-In Irons

Provide steel bars bent as indicated, and cast in the walls and floors. Alternatively, pipe sleeves may be precast into the walls and floors where required to accept U-bolts or other types of pulling-in devices possessing the strengths and clearances stated herein. The final installation of pulling-in devices must be made permanent. Cover and seal exterior projections of thru-wall type pulling-in devices with an appropriate protective coating. In the floor, locate the irons a minimum of 6 inches from the edge of the sump, and in the walls, locate the irons within 6 inches of the projected center of the duct bank pattern or precast window in the opposite wall. However, the pulling-in iron must not be located within 6 inches of an adjacent interior surface, or duct or precast window located within the same wall as the iron. If a pulling-in iron cannot be located directly opposite the corresponding duct bank or precast window due to this clearance limitation, locate the iron directly above or below the projected center of the duct bank pattern or precast window the minimum distance required to preserve the 6 inch clearance previously stated. In the case of directly opposing precast windows, pulling-in irons consisting of a 3 foot length of No. 5 reinforcing bar, formed into a hairpin, may be cast-in-place within the precast windows simultaneously with the end of the corresponding duct bank envelope. Irons installed in this manner must be positioned directly in line with, or when not possible, directly above or below the projected center of the duct bank pattern entering the opposite wall, while maintaining a minimum clear distance of 3 inches from any edge of the cast-in-place duct bank envelope or any individual duct. Pulling-in irons must have a clear projection into the structure of approximately 4 inches and must be designed to withstand a minimum pulling-in load of 6000 pounds. Hot-dip galvanize irons after fabrication.

### 3.5.4 Cable Racks, Arms and Insulators

Cable racks, arms and insulators must be sufficient to accommodate the cables. Space racks in power manholes not more than 3 feet apart, and provide each manhole wall with a minimum of two racks. Space racks in signal manholes not more than 16 1/2 inches apart with the end rack being no further than 12 inches from the adjacent wall. Methods of anchoring cable racks are as follows:

a. Provide a 5/8 inch diameter by 5 inch long anchor bolt with 3 inch foot cast in structure wall with 2 inch protrusion of threaded portion of bolt into structure. Provide 5/8 inch steel square head nut on each anchor bolt. Coat threads of anchor bolts with suitable coating immediately prior to installing nuts.

b. Provide concrete channel insert with a minimum load rating of 800 pounds per foot. Insert channel must be steel of the same length as "vertical rack channel;" and cast flush in structure wall. Provide 5/8 inch steel nuts in channel insert to receive 5/8 inch diameter by 3 inch long steel, square head anchor bolts.

c. Provide concrete "spot insert" at each anchor bolt location, cast flush in structure wall. Each insert must have minimum 800 pound load rating. Provide 5/8 inch diameter by 3 inch long steel, square head anchor bolt at each anchor point. Coat threads of anchor bolts with suitable coating immediately prior to installing bolts.

### 3.5.5 Field Painting

Clean cast-iron frames and covers not buried in concrete or masonry of mortar, rust, grease, dirt and other deleterious materials, and coat with bituminous paint.

## [3.6 DIRECT BURIAL CABLE SYSTEM

Direct-bury cables in the earth below the frostline [as indicated][to the requirements of NFPA 70 and IEEE C2, whichever is more stringent].

### 3.6.1 Trenching

Excavate trenches for direct-burial cables to provide a minimum cable cover of 24 inches below finished grade for power conductors operated at 600 volts or less, and 30 inches below finished grade for over 600 volts in accordance with IEEE C2. When rock is encountered, remove to a depth of at least 3 inches below the cable and fill the space with sand or clean earth free from particles larger than 1/4 inch. Bottoms of trenches must be smooth and free of stones and sharp objects. Where materials in bottoms of trenches are other than sand, a 75 mm 3 inch layer of sand must be laid first and compacted to approximate densities of surrounding firm soil. Trenches must be not less than [6][8] inches wide, and must be in straight lines between cable markers.[ Do not use cable plows.] Bends in trenches must have a radius [of not less than 36 inches][consistent with the cable manufacturer's published minimum cable bending radius for the cable installed].

### 3.6.2 Cable Installation

Unreel cables along the sides of or in trenches and carefully place on sand or earth bottoms. Pulling cables into direct-burial trenches from a fixed reel position is not permitted, except as required to pull cables through conduits under paving or railroad tracks.

Where two or more cables are laid parallel in the same trench, space cables laterally at not less than 3 inches apart, except that communication cable must be separated from power cable by a minimum distance of 12 inches.

Where direct-burial cables cross under roads or other paving exceeding5 feet in width, install such cables in[ concrete-encased] ducts. Where direct-burial cables cross under railroad tracks, install such cables in [reinforced concrete-encased ducts][ducts installed through rigid

galvanized steel sleeves]. Extend ducts at least 5 feet beyond each edge of any paving and at least 5 feet beyond each side of any railroad tracks. Cables may be pulled into duct from a fixed reel where suitable rollers are provided in the trench. Where direct burial cable transitions to duct-enclosed cable, center direct-burial cables in duct entrances, and a waterproof nonhardening mastic compound must be used to facilitate such centering. If paving or railroad tracks are in place where cables are to be installed, coated rigid steel conduits driven under the paving or railroad tracks may be used in lieu of concrete-encased ducts. Prevent damage to conduit coatings by providing ferrous pipe jackets or by predrilling. Where cuts are made in any paving, restore the paving and subbase to their original condition. Where cable is placed in duct(e.g. under paved areas, roads, or railroads), slope ducts to drain.

### 3.6.3 Splicing

Provide cables in one piece without splices between connections except where the distance exceeds the lengths in which cables are manufactured.[ Where splices are required, provide splices designed and rated for direct burial.][ Where splices are required, install splices only in maintenance manholes/handholes or cabinets/pedestals.]

### 3.6.4 Bends

Bends in cables must have an inner radius not less than those specified in NFPA 70 for the type of cable, or manufacturer's recommendation.

### 3.6.5 Horizontal Slack

Leave approximately 3 feet of horizontal slack in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought above ground. Where cable is brought above ground, leave additional slack to make necessary connections.[ Enclose splices in lead-sheathed or armored cables in split-type cast-iron splice boxes; after completion of the connection, fill with insulating filler compound and tightly clamp the box.]

### 3.6.6 Identification Slabs[ or Markers]

Provide a slab at each change of direction of cable, over the ends of ducts or conduits which are installed under paved areas and roadways[, over the ends of ducts or conduits stubbed out for future use][, and over each splice]. Identification slabs must be concrete, approximately 20 inches square by 6 inches thick, set flat in the ground so that top surface projects not less than 3/4 inch, nor more than 1 1/4 inches above ground. Concrete must have a compressive strength of not less than 3000 psi and have a smooth troweled finish on exposed surface. Inscribe an identifying legend such as "electric cable," "telephone cable," "splice," or other applicable designation on the top surface of the slab before concrete hardens. Inscribe circuit identification symbols on slabs as indicated. Letters or figures must be approximately 2 inches high and grooves must be approximately 1/4 inch in width and depth. Install slabs so that the side nearest the inscription on top includes an arrow indicating the side nearest the cable. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

]3.7 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.7.1 Requirements

Run conduit in straight lines except where a change of direction is necessary. Provide numbers and sizes of ducts as indicated. Provide a 4/0 AWG bare copper grounding conductor [below][above] medium-voltage distribution duct banks. Bond bare copper grounding conductor to ground rings (loops) in all manholes and to ground rings (loops) at all equipment slabs (pads). Route grounding conductor into manholes with the duct bank (sleeving is not required). Ducts must have a continuous slope downward toward underground structures and away from buildings, laid with a minimum slope of [3][4] inches per 100 feet. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Terminate all PVC conduit end points in utility holes, switching cabinets, transform handholes and buildings with end bells. The bell end of the conduits that enter manholes and handholes must be flush with the wall.

Perform changes in ductbank direction as follows:

a. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable.

b. The minimum manufactured bend radius must be 18 inches for ducts of less than 3 inch diameter, and 36 inches for ducts 3 inches or greater in diameter.

c. As an exception to the bend radius required above, provide field manufactured longsweep bends having a minimum radius of 25 feet for a change of direction of more than 5 degrees, either horizontally or vertically, using a combination of curved and straight sections. Maximum manufactured curved sections allowed for use in field manufactured longsweep bend: 30 degrees.

3.7.2 Treatment

Keep ducts clean of concrete, dirt, or foreign substances during construction. Make field cuts requiring tapers with proper tools and match factory tapers. Use a coupling recommended by the duct manufacturer whenever an existing duct is connected to a duct of different material or shape. Store ducts to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Thoroughly clean ducts before being laid. Store plastic ducts on a flat surface and protected from the direct rays of the sun.

3.7.3 Conduit Cleaning

As each conduit run is completed, for conduit sizes 3 inches and larger, draw a flexible testing mandrel approximately 12 inches long with a diameter less than the inside diameter of the conduit through the conduit. After which, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs. For conduit sizes less than 3 inches, draw a stiff bristle brush through until conduit is clear of particles of earth, sand and gravel; then immediately install conduit plugs.

3.7.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be

disturbed, and under roads and railroad tracks, must be zinc-coated, rigid steel, jacked into place. Where ducts are jacked under existing pavement, install rigid steel conduit because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks must be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers.[ Hydraulic jet method must not be used.]

[3.7.5 Galvanized Conduit Concrete Penetrations

Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations must be PVC coated and extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

]3.7.6 Multiple Conduits

Separate multiple conduits by a minimum distance of 3 inches[, except that light and power conduits must be separated from control, signal, and telephone conduits by a minimum distance of [12] inches]. Stagger the joints of the conduits by rows (horizontally) and layers (vertically) to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly must consist of base spacers, intermediate spacers, ties, and locking device on top to provide a completely enclosed and locked-in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

3.7.7 Conduit Plugs and Pull Rope

Provide new conduit indicated as being unused or empty with plugs on each end. Plugs must contain a weephole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

3.7.8 Conduit and Duct Without Concrete Encasement

Depths to top of the conduit must be not less than 24 inches below finished grade. Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover must be sand compacted as previously specified. The rest of the excavation must be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.7.8.1 Encasement Under Roads and Structures

Under roads, paved areas, and railroad tracks, install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts. Extend concrete encasement at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks. Depths to top of the concrete envelope must be not less than 24 inches below finished grade[, and under railroad tracks not less than 50 inches below the top of the rails].

[3.7.8.2 Directional Boring

HDPE conduits must be installed below the frostline and as specified herein.

[For distribution voltages greater than 1000 volts and less than 34,500 volts, depths to the top of the conduit must not be less than 48 inches in pavement-covered areas and not less than 120 inches in non-pavement-covered areas.][ For distribution voltages less than 1000 volts, depths to the top of the conduit must not be less than 48 inches in pavement- or non-pavement-covered areas.][ For branch circuit wiring less than 600 volts, depths to the top of the conduit must not be less than 24 inches in pavement- or non-pavement-covered areas.]

]3.7.9 Duct Encased in Concrete

Construct underground duct lines of individual conduits encased in concrete. Depths to top of the concrete envelope must be not less than 18 inches below finished grade[, except under roads and pavement, concrete envelope must be not less than 24 inches below finished grade][, and under railroad tracks not less than 50 inches below the top of the rails]. Do not mix different kinds of conduit in any one duct bank. Concrete encasement surrounding the bank must be rectangular in cross-section and provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 3 inches. Before pouring concrete, anchor duct bank assemblies, prevent floating during concrete pouring by driving reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly.[ Provide steel reinforcing in the concrete envelope as indicated.][ Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.]

3.7.9.1 Connections to Manholes

Duct bank envelopes connecting to underground structures must be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section must be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure must be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.7.9.2 Connections to Existing Underground Structures

For duct bank connections to existing structures, break the structure wall out to the dimensions required and preserve steel in the structure wall. Cut steel and [extend into][bend out to tie into the reinforcing of] the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

3.7.9.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and [extend into][bend out to tie into the reinforcing of] the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.

3.7.9.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.[ Remove existing cables which constitute interference with the work.][ Abandon in place those no longer used ducts and cables which do not interfere with the work.]

3.7.9.5 Partially Completed Duct Banks

During construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, and, and dirt from entering ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 2 feet back into the envelope and a minimum of 2 feet beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately one foot apart. Restrain reinforcing assembly from moving during concrete pouring.

[3.7.9.6 Removal of Ducts

Where duct lines are removed from existing underground structures, close the openings to waterproof the structure. Chip out the wall opening to provide a key for the new section of wall.

]3.7.10 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.8 CABLE PULLING

[Test existing duct lines with a mandrel and thoroughly swab out to remove foreign material before pulling cables. ]Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with[ tape][ or][ wire] shield must have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.8.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.9 CABLES IN UNDERGROUND STRUCTURES

Do not install cables utilizing the shortest path between penetrations, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators. Support cable splices in underground structures by racks on each side of the

splice. Locate splices to prevent cyclic bending in the spliced sheath. Install cables at middle and bottom of cable racks, leaving top space open for future cables, except as otherwise indicated for existing installations. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

### 3.9.1 Cable Tag Installation

Install cable tags in each manhole as specified, including each splice. Tag wire and cable provided by this contract. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes.

## 3.10 CONDUCTORS INSTALLED IN PARALLEL

Group conductors such that each conduit of a parallel run contains one Phase A conductor, one Phase B conductor, one Phase C conductor, and one neutral conductor.

## 3.11 LOW VOLTAGE CABLE SPLICING AND TERMINATING

Make terminations and splices with materials and methods as indicated or specified herein and as designated by the written instructions of the manufacturer. Do not allow the cables to be moved until after the splicing material has completely set.[ Make splices in underground distribution systems only in accessible locations such as manholes, handholes, or aboveground termination pedestals.]

### [3.11.1 Terminating Aluminum Conductors

a. Use particular care in making up joints and terminations. Remove surface oxides by cleaning with a wire brush or emery cloth. Apply joint compound to conductors, and use UL-listed solid aluminum connectors for connecting aluminum conductors. When connecting aluminum to copper conductors, use connectors specifically designed for this purpose.

b. Terminate aluminum conductors to copper bus either by: (1) in line splicing a copper pigtail to the aluminum conductor (copper pigtail must have a ampacity at least that of the aluminum conductor); or (2) using a circumferential compression type, aluminum bodied terminal lug UL listed for AL/CU and steel Belleville spring washers, flat washers, bolts, and nuts. Belleville spring washers must be cadmium-plated hardened steel. Install the Belleville spring washers with the crown up toward the nut or bolt head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville. Tighten nuts sufficient to flatten Belleville and leave in that position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

c. Terminate aluminum conductors to aluminum bus by using all-aluminum nuts, bolts, washers, and lugs. Wire brush and apply inhibiting compound to conductor prior to inserting in lug. Lubricate hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).

## ]3.12 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

## 3.13 MEDIUM VOLTAGE CABLE JOINTS

Provide power cable joints (splices) suitable for continuous immersion in water. Make joints only in accessible locations in manholes or handholes by using materials and methods in accordance with the written instructions of the joint kit manufacturer.

### 3.13.1 Joints in Shielded Cables

Cover the joined area with metallic tape, or material like the original cable shield and connect it to the cable shield on each side of the splice. Provide a bare copper ground connection brought out in a watertight manner and grounded to the manhole grounding loop as part of the splice installation. Ground conductors, connections, and rods must be as specified elsewhere in this section. Wire must be trained to the sides of the enclosure to prevent interference with the working area.

### [3.13.2 Joints in Armored Cables

Enclose armored cable joints in compound-filled, cast-iron or alloy splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

## ]3.14 CABLE END CAPS

Cable ends must be sealed at all times with coated heat shrinkable end caps. Cables ends must be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps must remain in place until the cable is spliced or terminated. Sealing compounds and tape are not acceptable substitutes for heat shrinkable end caps. Cable which is not sealed in the specified manner at all times will be rejected.

## [3.15 LIVE END CAPS

Provide live end caps for single conductor medium voltage cables where indicated.

## ]3.16 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

### 3.16.1 Fireproofing Tape

Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Install tape in accordance with manufacturer's instructions.

### [3.16.2 Tape-Wrap

Tape-wrap metallic-sheathed or metallic armored cables without a nonmetallic protective covering over the sheath or armor prior to application of fireproofing. Wrap must be in the form of two tightly applied half-lapped layers of a pressure-sensitive 10 mil thick plastic tape, and must extend not less than one inch into the duct. Even out irregularities of the cable, such as at splices, with insulation putty before applying tape.

]3.17 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding [25][_____] ohms.

3.17.1 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus[ 6 inches][ 12 inches], installed to provide an earth ground of the appropriate value for the particular equipment being grounded.
If the specified ground resistance is not met, provide an additional ground rod in accordance with the requirements of NFPA 70 (placed not less than 6 feet from the first rod). Should the resultant (combined) resistance exceed the specified resistance, measured not less than 48 hours after rainfall, notify the Contracting Officer immediately.

3.17.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies must be as recommended by the manufacturer. An embossing die code or other standard method must provide visible indication that a connector has been adequately compressed on the ground wire.

3.17.3 Grounding Conductors

Provide bare grounding conductors, except where installed in conduit with associated phase conductors. Ground cable sheaths, cable shields, conduit, and equipment with No. 6 AWG. Ground other noncurrent-carrying metal parts and equipment frames of metal-enclosed equipment. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.[ Provide direct connections to the grounding conductor with 600 v insulated, full-size conductor for each grounded neutral of each feeder circuit, which is spliced within the manhole.]

3.17.4 Ground Cable Crossing Expansion Joints

Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.17.5 Manhole Grounding

Loop a 4/0 AWG grounding conductor around the interior perimeter, approximately 12 inches above finished floor. Secure the conductor to the manhole walls at intervals not exceeding 36 inches. Connect the conductor to the manhole grounding electrode with 4/0 AWG conductor. Connect all incoming 4/0 grounding conductors to the ground loop adjacent to the point of entry into the manhole. Bond the ground loop to all cable shields, metal cable racks, and other metal equipment with a minimum 6 AWG conductor.

[3.17.6 Fence Grounding

[Provide grounding for fences as indicated.][Provide grounding for fences with a ground rod at each fixed gate post and at each corner post.] Drive ground rods until the top is 12 inches below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 12 inches of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence. Bond each gate section to its gatepost by a 1/8 by one inch flexible braided copper strap and ground post clamps. Clamps must be of the anti-electrolysis type.

][3.17.7 Metal Splice Case Grounding

Ground metal splice cases for medium-voltage direct-burial cable by connection to a driven ground rod located within 2 feet of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

]3.18 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

3.18.1 Reconditioning of Surfaces

3.18.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct [or direct burial cable]. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding, and provide topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching.[ Provide work in accordance with Section 32 92 19 SEEDING and Section 32 93 00 EXTERIOR PLANTS.]

3.18.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists [, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.][ Make repairs as specified in Section [32 13 13.06 PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES][_____].]

3.19 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.19.1 Concrete Slabs (Pads) for Equipment

Unless otherwise indicated, the slab must be at least 8 inches thick, reinforced with a 6 by 6 - W2.9 by W2.9 mesh, placed uniformly 4 inches from the top of the slab. Place slab on a 6 inch thick, well-compacted gravel base. Top of concrete slab must be approximately 4 inches above finished grade with gradual slope for drainage. Edges above grade must have 1/2 inch chamfer. Slab must be of adequate size to project at least 8

inches beyond the equipment.

Stub up conduits, with bushings, 2 inches into cable wells in the concrete pad. Coordinate dimensions of cable wells with transformer cable training areas.

[3.19.2 Sealing

When the installation is complete, seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals must be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

]3.20 FIELD QUALITY CONTROL

3.20.1 Performance of Field Acceptance Checks and Tests

Perform in accordance with the manufacturer's recommendations, and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.20.1.1 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) Visually inspect jacket and insulation condition.

(7) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform acceptance test on new cables before the new cables are connected to existing cables and placed into service, including terminations and joints. Perform maintenance test on complete cable system after the new cables are connected to existing cables and placed into service, including existing cable, terminations, and joints. Tests must be very low frequency (VLF) alternating voltage withstand tests in accordance with IEEE 400.2. VLF test frequency must be 0.05 Hz minimum for a duration of 60 minutes using a sinusoidal waveform. Test voltages must be as follows:

| CABLE RATING AC TEST VOLTAGE for ACCEPTANCE TESTING | |
|---|---|
| 5 kV | 10kV rms(peak) |
| 8 kV | 13kV rms(peak) |

| CABLE RATING AC TEST VOLTAGE for ACCEPTANCE TESTING | |
|---|---|
| 15 kV | 20kV rms(peak) |
| 25 kV | 31kV rms(peak) |
| 35 kV | 44kV rms(peak) |

| CABLE RATING AC TEST VOLTAGE for MAINTENANCE TESTING | |
|---|---|
| 5 kV | 7kV rms(peak) |
| 8 kV | 10kV rms(peak) |
| 15 kV | 16kV rms(peak) |
| 25 kV | 23kV rms(peak) |
| 35 kV | 33kV rms(peak) |

3.20.1.2 Low Voltage Cables, 600-Volt

Perform tests after installation of cable, splices and terminations and before terminating to equipment or splicing to existing circuits.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Verify tightness of accessible bolted electrical connections.

(4) Inspect compression-applied connectors for correct cable match and indentation.

(5) Visually inspect jacket and insulation condition.

(6) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 1000 volts dc for one minute.

(2) Perform continuity tests to insure correct cable connection.

3.20.1.3 Grounding System

a. Visual and mechanical inspection

Inspect ground system for compliance with contract plans and specifications.

b. Electrical tests

Perform ground-impedance measurements utilizing the fall-of-potential method in accordance with IEEE 81. On systems consisting of interconnected ground rods, perform tests after interconnections are complete. On systems consisting of a single ground rod perform tests before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Use a portable ground resistance tester in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument must be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground rod or grounding systems under test. Provide site diagram indicating location of test probes with associated distances, and provide a plot of resistance vs. distance.

3.20.2 Follow-Up Verification

Upon completion of acceptance checks and tests, show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer must be given 5 working days advance notice of the dates and times of checking and testing.

.... -- End of Section --