Engineer’s Certification

These Specifications for the 200 Year Goldfields Levee Project, Contract #, have been prepared by the following professional engineering companies, with the design responsibility for each as indicated:

*Civil Design of the Yuba River South Levee Improvement Plans, Volume 2*

*Structural Design (Riser Structures) of the Yuba River South Levee Improvement Plans, Volume 2*
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-- End of Section Table of Contents --
1.1 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 actually required under the Contract.

1.2 TYPE OF CONTRACT

This Contract consists of LS and unit price Bid Schedule Items.

1.3 PROJECT DESCRIPTION

1.3.1 Project Description

The 200-year Goldfields Levee Project (GF200YR) will construct a new levee embankment to extend and partially replace the existing Yuba River South Levee (YRSL). The new levee includes approximately 13,910 linear feet (2.6 miles). The new levee will include slurry walls and seepage berms. A description and location of the proposed improvements follow.

The YRSL Work includes the following:

a. Clearing, grubbing, and stripping of the levee foundation and adjacent areas and structure removal as shown on the plans and as specified herein.

b. Levee degrade and levee construction to establish a working surface for cutoff wall construction as noted on the plans and as specified herein.

c. Soil-bentonite cutoff walls ranging in depth from approximately 35-ft to 70-ft using conventional open trench method.

d. Utility modifications as shown on the plans. Utility modifications include installation of new drain pipe crossings, new irrigation culvert crossing, relocation of irrigation canal, and removal and disposal of existing drain pipes.

e. Levee embankment construction with typical 20-ft wide levee crown and 3:1 side slopes.

f. Resurface the levee crown using aggregate base or asphalt paving as shown on the plans.

g. Seepage berm construction.

h. The project typically incorporates a 50-ft wide (20-ft wide along Hammonton-Smartville Road) landside and a 50-ft wide waterside
area that may be used for construction access and staging. Variations from these typical corridors are identified on the Plans.

1.3.2 Location

The GF200YR Project is located in Yuba County, beginning approximately 1,000 feet southwest of the existing YRSL terminus.

1.4 EXISTING FACILITIES

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

1.5 CONTRACTOR'S USE OF THE PREMISES

In addition to requirements presented elsewhere in the Contract documents, the Contractor shall 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.

1.6 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. Performing construction activities as shown or indicated on the Plans.
Contract documents.

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 surveying and construction quality control.

e. 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.

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

g. 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.

1.7 SCHEDULE CONSTRAINTS

The Contractor shall reference the applicable Contract documents for schedule constraints.

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

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

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SECTION 01 11 00.01

MOBILIZATION AND DEMOBILIZATION

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.

1.1.1 Temporary Offices

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

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 STAGING AREAS

Contractor shall coordinate with the Agency for locations of staging, project administration offices, and mixing plants. 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.

1.3.1 Alternative Staging Areas

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 by the Agency prior to use.

1.4 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.
1.4.1 Flooding

The Contractor is to monitor flooding conditions and in the event of potential flooding of the site or at the direction of the Agency, the Contractor shall remove all vehicles and other mobile equipment, fuels and soluble materials within twenty-four (24) hours of notification.

1.4.2 Site Grading

If site grading is performed at staging areas, the site shall be restored to a natural vegetated condition at completion of work in accordance with one of the following:

a. Restored to original grade.

b. Restored in accordance with guidance from the Agency.

1.5 SUBMITTALS

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

SD-09 Contractor'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.

Emergency Levee Reconstruction Plan;

Contractor shall provide the Agency a plan detailing the equipment and methods to be used in case of hydraulic fracture or other levee failure; in which case the levee shall be degraded/rebuilt and/or buttressed as necessary and as reviewed by the Agency.

PART 2 PRODUCTS

2.1 MATERIAL STORAGE

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 41 TEMPORARY CONSTRUCTION FACILITIES or where reviewed by the Agency.

2.1.1 Subcontractors' Storage

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 DRINKING WATER

Provide drinking water for all personnel connected with the work. Transport water in such a manner as to keep it clean and fresh. Serve from single service containers with paper cups or sanitary drinking fountains.

2.3 WATER FOR CONSTRUCTION PURPOSES

Reference Section 01 50 02.00 41 TEMPORARY CONSTRUCTION FACILITIES.

2.4 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.

2.5 ELECTRICAL LIGHT 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.

2.6 SITE CLEANUP AND DISPOSAL OF RUBBISH

Maintain the construction site and building areas in a neat, orderly condition throughout the duration of this Contract. Remove from the site all rubbish, debris, and materials not to be incorporated into the work and all other accumulations that may result from work under this Contract on a weekly basis.

2.7 BARRICADES, RAILING AND PROTECTION

Provide barricades, railing (Type K) temporary fencing, handrails, shoring and other devices required by law and as necessary to protect new construction and materials and to protect all persons on the Job site.

2.8 STORM WATER POLLUTION PREVENTION PLAN

Contractor shall implement the SWPPP in accordance with Section 10-4 of the General Specifications and the Special Provisions.
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   STORM WATER 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   PROJECT ACCESS

Reference Section 01 50 02.00 41 TEMPORARY CONSTRUCTION FACILITIES.

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PART 1 GENERAL

1.1 SUBMITTALS

Submittals shall be submitted in accordance with the appropriate technical provisions of the Project Specifications.

1.2 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 values 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.

1.3 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.

1.4 PAYMENT ITEMS

1.4.1 Mobilization and Demobilization

1.4.1.1 Measurement and Payment

Measurement and payment for mobilization, demobilization, staging areas, temporary construction facilities, and for all other work covered by the Project Specifications and all costs associated therewith shall be included.
in the lump-sum bid item for "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.

1.4.2 Traffic Control

1.4.2.1 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 included in the lump-sum bid item for "TRAFFIC CONTROL"; which payment shall constitute full compensation for all the Work involved in traffic control as shown or specified in the Contract documents, and directed by the Agency.

1.4.3 Storm Water Pollution Control

1.4.3.1 Measurement and Payment

Payment will be made for storm water pollution control including installing and maintaining best management practices in accordance with the owner-provided storm water pollution prevention plan and all costs associated therewith shall be included in the lump-sum bid item for "STORM WATER POLLUTION CONTROL"; which payment shall constitute full compensation for all work involved in storm water pollution control 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.

1.4.4 Project Fencing

1.4.4.1 Measurement

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.

1.4.4.2 Payment

Payment will be made for project fencing as shown or specified in the Contract documents, and as directed by the Agency shall be paid at the Contract unit bid price for "PROJECT FENCING". Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installing and maintaining project fencing for the duration of the project and for the removal and disposal of project fencing. Project fencing includes orange barrier fencing, or silt fencing as noted on the project Storm Water Pollution Prevention Plan.

1.4.5 Clearing and Grubbing

1.4.5.1 Measurement and Payment
Clearing and grubbing, and the disposal of the materials from this operation and all costs associated therewith shall be included in the lump-sum bid item 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 salvaged, demolition of structures not specified elsewhere, trees, stumps, 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".

1.4.6 Demolish and Waste (Existing Structures)

1.4.6.1 Measurement and Payment

Measurement and payment for demolishing and wasting all existing structures and all costs associated therewith shall be included in the lump-sum bid item for "DEMOLISH AND WASTE (EXISTING STRUCTURES)"; which price shall constitute full compensation for providing all labor, equipment, materials and work involved in demolishing and wasting, at an off-site location, the existing structures, awnings, fuel tanks, pumps, fences, silos, tanks, concrete pads, wells, associated appurtenances, all underground piping and all other items as shown or specified on the demolition plan and as directed by the Agency.

1.4.7 Remove and Dispose Existing Asphalt Concrete

1.4.7.1 Measurement

Remove and Dispose Existing Asphalt Concrete will be measured for payment by the square yard. The basis of measurement will be based upon the area measured after the removal of asphalt concrete and/or cement concrete pavements.

1.4.7.2 Payment

Payment will be made for removing and disposing existing asphalt concrete as shown or specified in the contract documents, and as directed by the Agency shall be paid at the Contract unit bid price for "REMOVE AND DISPOSE EXISTING ASPHALT CONCRETE"; which shall include full compensation for all equipment, labor, pavement saw cutting, transportation, materials, hauling excavated materials to and from temporary on-site stockpile locations, hauling to offsite waste sites, dewatering, and incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency. No separate payment will be made for stockpiling or loading material from the stockpile.

1.4.8 Remove and Dispose Existing Aggregate Base

1.4.8.1 Measurement

Remove and Dispose Existing Aggregate Base will be measured for payment by the square yard. The basis of measurement will be based upon the area measured after the removal of aggregate base.
1.4.8.2 Payment

Payment will be made for removing and disposing existing aggregate base shall be paid at the Contract unit bid price for "REMOVE AND DISPOSE EXISTING AGGREGATE BASE"; which shall include full compensation for all equipment, labor, transportation, materials, hauling excavated materials to and from temporary on-site stockpile locations, hauling waste site, dewatering, and incidentals necessary to complete the work as shown or specified in the Contract documents, or as directed by the Agency. No separate payment will be made for stockpiling or loading material from the stockpile.

1.4.9 Remove and Salvage Existing Aggregate Surfacing

1.4.9.1 Measurement

Remove and salvage existing Aggregate Surfacing shall be field measured for payment by the linear foot, to the nearest 1 foot. Measurement shall be based on the dimensions shown in the plans and as directed by the Agency.

1.4.9.2 Payment

Remove and salvage Existing Aggregate Surfacing shall be paid at the contract unit bid price for "REMOVE AND SALVAGE EXISTING AGGREGATE SURFACING". Payment will constitute full compensation for removing existing aggregate surfacing on the levee crown and salvaging existing aggregate surfacing as indicated in these specifications and on the plans including furnishing all labor, stockpiling, transportation to and from stockpile locations, re-spreading on the levee crown as indicated in these specifications, compacting, hauling off-site, and all incidentals necessary to complete the work required as shown on the plans and by these Specifications.

1.4.10 Stripping

1.4.10.1 Measurement

Stripping, removal, stockpile and respread of materials from this operation shall be measured for payment by the cubic yard stripped and quantities will be determined by the average end area method. The basis for measurement will be cross sections of the areas to be stripped taken before and after stripping 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.

1.4.10.2 Payment

Payment for Stripping shall be paid at the Contract unit bid price for "STRIPPING". This price shall constitute full compensation for all equipment, labor, materials and incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency. No separate or direct payment will be made for stockpiling, transportation, loading, unloading, respreading on levee slopes and other areas as directed by the Agency or for dust control of stripped materials. All costs associated therewith shall be included in the unit bid price for "STRIPPING".

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1.4.11 Levee Degrade and Levee Foundation Excavation

1.4.11.1 Measurement

Levee degrade and levee foundation excavation including levee degrade, cutoff trench and inspection trench as shown on the plans will be measured for payment by the cubic yard and quantities will be determined by the average end area method. The basis for measurement will be the actual cross sections of the levee taken after stripping operations and the actual cross sections after levee degrade, cutoff trench and inspection trench excavation to within the specified tolerance. 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. Excavation in excess of the design grades as indicated on the plans, including allowable tolerance, will not be accepted.

1.4.11.2 Payment

Payment for levee degrade and levee foundation excavation shall be paid at the Contract unit bid price for "LEVEE DEGRADE AND LEVEE FOUNDATION EXCAVATION". This price shall constitute full compensation for all equipment, labor, materials, hauling excavated materials to and from stockpile locations or other point of use, and all incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency.

1.4.12 SB Cutoff Wall, Depth Less Than 50 Feet

1.4.12.1 Measurement

Measurement for SB cutoff wall, Depth Less Than 50 Feet shall be based on the area in square feet of wall measured in a vertical plane through the centerline of the cutoff wall as established by the working surface indicated on the Plans, and the bottom of the cutoff wall and vertical lines at each end of the cutoff wall. Measurement shall be based on surveys and measurements taken at the site as directed and reviewed by the Agency. Payment shall be made on the basis of a wall constructed to the depth indicated on the Plans unless installation to a greater depth is directed by the Agency.

1.4.12.2 Payment

Payment for the SB cutoff wall, Depth Less Than 50 Feet shall be paid at the contract unit bid price for "SB CUTOFF WALL DEPTH LESS THAN 50 FEET". Bid price shall include the provision to extend the wall an additional 10 feet in accordance with Specification Section 31 62 41, Paragraph 3.4.2, with no increase in unit bid price. Such price shall constitute full compensation for furnishing all labor, material, equipment, and incidentals and performing all operations necessary to complete the Work specified herein including excavation, stockpiling or spoiling materials generated during the cutoff wall installation, providing backfill materials from excavations and/or the supplemental borrow area and/or obtaining materials from commercial sources for the backfill; mixing, blending, and pumping; temporary cap installation and removal including excavation, removal and backfill of top 1-ft below working platform as shown on the plans, settlement plate installation, settlement plate monitoring and removal;
surveying; quality control and quality acceptance testing; reporting; preparing as-built information; and all other items incidental to the construction and completion of the cutoff wall as shown or specified in the Contract Documents or as directed by the Agency. No separate payment will be made for lead in trenches or materials including bentonite, additives, soil, equipment and mixing, handling and cleaning the slurry, diking around the open trench, and overtime during continuous operations, cleanup, assistance in the collection and maintenance of records and quality control testing; such items being included in the price of the slurry wall construction. Final acceptance of the cutoff wall construction will be based on meeting all the requirements as shown or specified in the Contract Documents or as directed by the Agency.

1.4.13 SB Cutoff Wall, Depth Between 50 and 70 Feet

1.4.13.1 Measurement

Measurement for SB cutoff wall, Depth Between 50 and 70 Feet shall be based on the area in square feet of wall measured in a vertical plane through the centerline of the cutoff wall as established by the working surface indicated on the Plans, and the bottom of the cutoff wall and vertical lines at each end of the cutoff wall. Measurement shall be based on surveys and measurements taken at the site as directed and reviewed by the Agency. Payment shall be made on the basis of a wall constructed to the depth indicated on the Plans unless installation to a greater depth is directed by the Agency.

1.4.13.2 Payment

Payment for the SB cutoff wall, Depth Between 50 and 70 Feet shall be paid at the contract unit bid price for "SB CUTOFF WALL DEPTH BETWEEN 50 AND 70 FEET". Bid price shall include the provision to extend the wall an additional 10 feet in accordance with Specification Section 31 62 41, Paragraph 3.4.2, with no increase in unit bid price. Such price shall constitute full compensation for furnishing all labor, material, equipment, and incidentals and performing all operations necessary to complete the Work specified herein including excavation, stockpiling or spoiling materials generated during the cutoff wall installation, providing backfill materials from excavations and/or the supplemental borrow area and/or obtaining materials from commercial sources for the backfill; mixing, blending, and pumping; temporary cap installation and removal including excavation, removal and backfill of top 1-ft below working platform as shown on the plans, settlement plate installation, settlement plate monitoring and removal; surveying; quality control and quality acceptance testing; reporting; preparing as-built information; and all other items incidental to the construction and completion of the cutoff wall as shown or specified in the Contract Documents or as directed by the Agency. No separate payment will be made for lead in trenches or materials including bentonite, additives, soil, equipment and mixing, handling and cleaning the slurry, diking around the open trench, and overtime during continuous operations, cleanup, assistance in the collection and maintenance of records and quality control testing; such items being included in the price of the slurry wall construction. Final acceptance of the cutoff wall construction will be based on meeting all the requirements as shown or specified in the Contract Documents or as directed by the Agency.
1.4.14   Levee Embankment Fill

1.4.14.1   Measurement

Material specified for levee embankment fill shall 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 excavation operations and the actual cross sections of the embankments constructed within the specified tolerance. 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. Embankments not constructed to design grade and section including allowable tolerance as indicated on the Contractor's compliance survey will not be accepted. Volumes occupied by drainage or irrigation structures will not be included in measurement of embankment for payment.

1.4.14.2   Payment

Payment for levee embankment fill placed as required in levee and ramp embankments as shown or specified in the Contract documents, or as directed by the Agency shall be paid at the Contract unit bid price for "LEVEE EMBANKMENT FILL". Payment shall constitute full compensation for furnishing all plant, labor, equipment and material, and performing all operations necessary for foundation preparation and placing and compacting the material, materials testing, surveying, and moisture control.

1.4.15   Seepage Berm Fill

1.4.15.1   Measurement

Materials specified as seepage berm 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 stripping operations and the actual cross sections constructed within the specified tolerance. 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. Seepage berms not constructed to the design grades and sections including allowable tolerance as indicated on the Contractor's compliance surveys will not be accepted.

1.4.15.2   Payment

Payment for seepage berm platform fill placed as shown on the plans will be made at the contract bid price for "SEEPAGE BERM FILL". Payment shall constitute full compensation for furnishing all plant, labor, equipment, material, and incidentals, and performing all operations necessary to complete the Work including foundation preparation, placing and compacting the material, material testing and moisture control as shown or specified in the Contract Documents, or as directed by the Agency.

1.4.16   Random Fill

1.4.16.1   Measurement
Materials specified as random 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 stripping operations and the actual cross sections constructed within the specified tolerance. 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. Fills not constructed to design grade and section including allowable tolerance as indicated on the Contractor's compliance survey will not be accepted.

1.4.16.2 Payment

Payment for random fill placed as shown on the plans and as directed by the Agency shall be paid at the contract unit bid price for "RANDOM FILL". Payment shall constitute full compensation for furnishing all plant, labor, equipment, material, and incidentals, and performing all operations necessary to complete the Work of foundation preparation and placing and compacting the material, material testing, and moisture control as shown or specified in the Contract documents by the Agency.

1.4.17 Observation Well

1.4.17.1 Measurement

Unit of measure: Each

1.4.17.2 Payment

Payment will be made for costs associated with operations necessary for installation of the observation wells located near the land side levee toe. The work shall include drilling pilot holes, temporary casings, construction of the relief well, which shall include drilling, relief well screen, riser, check valves, gravel pack, structures, manhole, CLSM, ductile iron discharge pipes, flap gates, installation, backfill, pump testing, and any other work and materials required to construct and develop the relief well as shown and specified in the Contract documents. All costs associated therewith shall be included in the bid items for "Observation Well"; which payment shall constitute full compensation for all Work involved in installation of the relief wells as shown or specified in the Contract documents.

1.4.18 Class 2 Aggregate Surfacing

1.4.18.1 Measurement

Class 2 aggregate 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.

1.4.18.2 Payment

Class 2 aggregate surfacing shall be paid at the Contract unit bid price for "CLASS 2 AGGREGATE SURFACING". Payment shall constitute full compensation.
for the construction and completion of the aggregate surfacing 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.

1.4.19  Class 2 Aggregate Base

1.4.19.1  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.

1.4.19.2  Payment

Class 2 aggregate base shall be paid at the Contract unit bid price for "CLASS 2 AGGREGATE BASE". Payment shall constitute full compensation for the construction and completion of the 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.

1.4.20  Asphalt Concrete Paving

1.4.20.1  Measurement

The quantity of asphalt concrete paving completed and accepted as determined by the Agency or Agency’s Representative shall be measured for payment by the ton, to the nearest 1.0 tons.

1.4.20.2  Payment

Quantities of asphalt concrete paving as measured above, shall be paid at the Contract unit bid price for "ASPHALT CONCRETE PAVING". Payment shall constitute full compensation for the construction and completion of the bituminous concrete pavement, including material, paint pavement stripping 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.

1.4.21  Barbed Wire Fence

1.4.21.1  Measurement

Barbed wire 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.

1.4.21.2  Payment

Payment will be made for barbed wire fence as shown or specified in the Contract documents, and as directed by the Agency shall be paid at the Contract unit bid price for "BARBED WIRE FENCE". Payment shall constitute
full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installation.

1.4.22 Concrete Block Barrier

1.4.22.1 Measurement

Concrete Block Barrier 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.

1.4.22.2 Payment

Payment will be made for Concrete Block Barrier as shown or specified in the Contract documents, and as directed by the Agency shall be paid at the Contract unit bid price for "CONCRETE BLOCK BARRIER". Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installation.

1.4.23 Pipe Fence

1.4.23.1 Measurement

Pipe 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.

1.4.23.2 Payment

Payment will be made for pipe fence as shown or specified in the Contract documents, and as directed by the Agency shall be paid at the Contract unit bid price for "PIPE FENCE". Payment shall constitute full compensation for furnishing all supplies, labor, equipment, materials, and for performing all operations necessary for installation.

1.4.24 20’ Pipe Gate

1.4.24.1 Measurement

Unit of Measure: Each

1.4.24.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 20’ pipe gate locations. The work shall include furnishing and installing the pipe gate, excavation, concrete, related labor, equipment, and materials. All costs associated therewith shall be included in the bid item for "20’ PIPE GATE"; which payment shall constitute full compensation for all Work involved in installation of the 20’ pipe gate as shown or specified in the Contract documents.

1.4.25 30’ Pipe Gate

1.4.25.1 Measurement

Unit of Measure: Each
1.4.25.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 30’ pipe gate locations. The work shall include furnishing and installing the pipe gate, excavation, concrete, related labor, equipment, and materials. All costs associated therewith shall be included in the bid item for "30’ PIPE GATE"; which payment shall constitute full compensation for all Work involved in installation of the 30’ pipe gate as shown or specified in the Contract documents.

1.4.26 Drainage Ditch

1.4.26.1 Measurement

Unit of measure: Linear Foot

1.4.26.2 Payment

Payment will be made for costs associated with operations necessary for installation of the drainage ditch located on both the land side and water side of the levee toe. The work shall include furnishing all labor, materials, tools, equipment, and incidentals and doing all work necessary to complete the drainage ditch as specified. All costs associated therewith shall be included in the unit bid item for "DRAINAGE DITCH"; which payment shall constitute full compensation for all Work involved in installation of the drainage ditch as shown or specified in the Contract documents.

1.4.27 12 Inch Corrugated Metal Pipe

1.4.27.1 Measurement

Unit of measure: Linear Foot

1.4.27.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 12 Inch corrugated metal pipe located on both the land side and water side of the levee toe. The work shall include furnishing the pipe, installing pipe, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "12 INCH CORRUGATED METAL PIPE"; which payment shall constitute full compensation for all Work involved in installation of pipeline as shown or specified in the Contract documents.

1.4.28 12 Inch Corrugated Metal Pipe Flared End Section

1.4.28.1 Measurement

Unit of measure: Each

1.4.28.2 Payment

Payment will be made for costs associated with operations necessary for installation of the corrugated metal pipe flared end section located on both the land side and water side of the levee toe. The work shall include furnishing and installing the flared end section, excavation, backfill,
related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "12 INCH CORRUGATED METAL PIPE FLARED END SECTION"; which payment shall constitute full compensation for all Work involved in installation of the flared end section as shown or specified in the Contract documents.

1.4.29 18 Inch Corrugated Metal Pipe

1.4.29.1 Measurement

Unit of measure: Linear Foot

1.4.29.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 18 Inch corrugated metal pipe located on both the land side and water side of the levee toe. The work shall include furnishing the pipe, installing pipe, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "18 INCH CORRUGATED METAL PIPE" which payment shall constitute full compensation for all Work involved in installation of pipeline as shown or specified in the Contract documents.

1.4.30 18 Inch Corrugated Metal Pipe Flared End Section

1.4.30.1 Measurement

Unit of measure: Each

1.4.30.2 Payment

Payment will be made for costs associated with operations necessary for installation of the corrugated metal pipe flared end section located on both the land side and water side of the levee toe. The work shall include furnishing and installing the flared end section, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "18 INCH CORRUGATED METAL PIPE FLARED END SECTION"; which payment shall constitute full compensation for all Work involved in installation of the flared end section as shown or specified in the Contract documents.

1.4.31 18 Inch Flap Gate

1.4.31.1 Measurement

Unit of measure: Each

1.4.31.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 18 Inch Flap Gate located on the water side of the levee toe. The work shall include furnishing and installing the flap gate, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "18 INCH FLAP GATE"; which payment shall constitute full compensation for all Work involved in installation of the 18 inch flap gates as shown or specified in the Contract documents.
1.4.32   24 Inch Corrugated Metal Pipe

1.4.32.1   Measurement

Unit of measure: Linear Foot

1.4.32.2   Payment

Payment will be made for costs associated with operations necessary for installation of the 24 Inch corrugated metal pipe located on the land side of the levee toe. The work shall include furnishing the pipe, installing pipe, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "24 INCH CORRUGATED METAL PIPE" which payment shall constitute full compensation for all Work involved in installation of pipeline as shown or specified in the Contract documents.

1.4.33   24 Inch Corrugated Metal Pipe Flared End Section

1.4.33.1   Measurement

Unit of measure: Each

1.4.33.2   Payment

Payment will be made for costs associated with operations necessary for installation of the corrugated metal pipe flared end section located on the land side of the levee toe. The work shall include furnishing and installing the flared end section, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "24 INCH CORRUGATED METAL PIPE FLARED END SECTION"; which payment shall constitute full compensation for all Work involved in installation of the flared end section as shown or specified in the Contract documents.

1.4.34   36 Inch Corrugated Metal Pipe

1.4.34.1   Measurement

Unit of measure: Linear Foot

1.4.34.2   Payment

Payment will be made for costs associated with operations necessary for installation of the 36 Inch corrugated metal pipe located on the land side of the levee toe. The work shall include furnishing the pipe, installing pipe, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "36 INCH CORRUGATED METAL PIPE" which payment shall constitute full compensation for all Work involved in installation of pipeline as shown or specified in the Contract documents.

1.4.35   36 Inch Corrugated Metal Pipe Flared End Section

1.4.35.1   Measurement

Unit of measure: Each
1.4.35.2 Payment

Payment will be made for costs associated with operations necessary for installation of the corrugated metal pipe flared end Section located on the land side of the levee toe. The work shall include furnishing and installing the flared end section, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "36 INCH CORRUGATED METAL PIPE FLARED END SECTION"; which payment shall constitute full compensation for all Work involved in installation of the flared end section as shown or specified in the Contract documents.

1.4.36 Field Inlet

1.4.36.1 Measurement

Unit of measure: Each

1.4.36.2 Payment

Payment will be made for costs associated with operations necessary for installation of the Field Inlet. The work shall include furnishing and installing the Field Inlet, excavation, backfill, related labor, equipment, and materials. All costs associated therewith shall be included in the bid item for "FIELD INLET"; which payment shall constitute full compensation for all Work involved in installation of the concrete drop inlet as shown or specified in the Contract documents.

1.4.37 RD 784 - 36 Inch Pipe - STA 103

1.4.37.1 Measurement

Unit of measure: Lump Sum

1.4.37.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 36 Inch Welded Steel pipe crossing at approximately station 103+78. The work shall include furnishing the pipe, preparation of schedule of values, shop drawings, submittals, field survey cross sections, shoring, gate riser structure, sluice gates, utility identification signs, inlet structure, outfall structure, backfill, CLSM material, dewatering, installing pipe, related labor, equipment, and materials. All costs associated therewith shall be included in the lump-sum bid item for "RD 784 - 36 INCH PIPE - STA 103" which payment shall constitute full compensation for all Work involved in installation of pipe crossing improvements as shown or specified in the Contract documents. The contractor shall provide a schedule of values prior to payment.

1.4.38 36 Inch Flap Gate

1.4.38.1 Measurement

Unit of measure: Each
1.4.38.2 Payment

Payment will be made for costs associated with operations necessary for installation of the 36 Inch Flap Gate located on the land side of the levee toe. The work shall include furnishing and installing the flap gate, related labor, equipment, and materials. All costs associated therewith shall be included in the unit bid item for "36 INCH FLAP GATE"; which payment shall constitute full compensation for all Work involved in installation of the 36 inch flap gates as shown or specified in the Contract documents.

1.4.39 BWD - 5’ x 8’ Concrete Box Culvert – STA 64

1.4.39.1 Measurement

Unit of measure: Lump Sum

1.4.39.2 Payment

Payment will be made for costs associated with operations necessary for installation of 5’ x 8’ Concrete Box Culvert crossing at approximately station 64+95. The work shall include furnishing the box culvert, preparation of schedule of values, shop drawings, submittals, field survey cross sections, shoring, gate riser structure, sluice gates, utility identification signs, excavation, backfill, inlet structure, outfall structure, trash racks, CLSM material, dewatering, installing box culvert, related labor, equipment, and materials. All costs associated therewith shall be included in the lump-sum bid item for "BWD - 5’ X 8’ CONCRETE BOX CULVERT – STA 64" which payment shall constitute full compensation for all Work involved in installation of culvert crossing improvements as shown or specified in the Contract documents. The contractor shall provide a schedule of values prior to payment.

1.4.40 Levee Erosion Control Seeding

1.4.40.1 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.

1.4.40.2 Payment

Erosion control seeding as shown or specified in the Contract documents, and as directed by the Agency, shall be paid at the Contract unit bid price for "LEVEE 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.

1.4.41 Haul and Dispose of Unsuitable Material

1.4.41.1 Measurement

Haul and Dispose of unsuitable material shall be measured for payment by the cubic yard removed to the nearest cubic yard. The basis of measurement will
be based upon the cubic yard volume after the removal of unsuitable material and debris after excavation.

1.4.41.2 Payment

Payment shall be paid for haul and dispose (unsuitable material) at the contract unit bid price for "HAUL AND DISPOSE OF UNSUITABLE MATERIAL"; which shall include full compensation for all equipment, labor, transportation of materials encountered during levee excavation operations, hauling excavated materials and all areas within the limit of construction shown on the Plans, to waste site, and incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency. No separate payment will be made for loading or unloading material.

1.4.42 Brophy Road Detention Basin Stripping

1.4.42.1 Measurement

Stripping, removal, stockpile and respread of materials from this operation shall be measured for payment by the cubic yard stripped and quantities will be determined by the average end area method. The basis for measurement will be cross sections of the areas to be stripped taken before and after stripping 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.

1.4.42.2 Payment

Payment for Stripping shall be paid at the Contract unit bid price for "BROPHY ROAD DETENTION BASIN STRIPPING". This price shall constitute full compensation for all equipment, labor, materials and incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency. No separate or direct payment will be made for stockpiling, transportation, loading, unloading, respreading on levee slopes, basin slopes and other areas as directed by the Agency or for dust control of stripped materials. All costs in connection therewith shall be included in the unit price for "BROPHY ROAD DETENTION BASIN STRIPPING".

1.4.43 Brophy Road Detention Basin Excavation and Hauling

1.4.43.1 Measurement

Brophy Road Detention Basin excavation as shown or specified in the Contract Documents, and as directed by the Agency, shall be measured by use of the average end area method to the nearest cubic yard. The basis of measurement will be a survey of the area after surface layer removal and prior to the excavation and a second survey of the same area after the completion of the excavation. For areas where lines and grades are shown on the Plans, measurement will be limited to those lines and grades. Slides caused by fault of the Contractor, over excavation, and excavation performed for the convenience of the Contractor shall not be measured for payment.

1.4.43.2 Payment

Detention basin excavation shall be paid for at the Contract unit bid price for "BROPHY ROAD DETENTION BASIN EXCAVATION AND HAULING". Payment will constitute full compensation for furnishing all labor, materials, tools,
equipment, and incidentals and doing all work necessary to complete the excavations as specified, including dewatering and water control, blending and moisture-conditioning materials, stripping, clearing and grubbing the stockpile and mixing areas, stockpiling, transporting material to and from stockpile locations and fill locations, construction of field ramps and site access, construction and improvement of haul roads, establishing temporary facilities and controls, water supply, drainage grading, locating utilities, construction of permanent irrigation and drainage facilities at borrow sites as shown on the Plans, and performing quantity surveys.

1.4.44 Brophy Road Detention Basin Erosion Control Seeding

1.4.44.1 Measurement

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

1.4.44.2 Payment

Erosion control seeding at the Brophy Road Detention Basin site as shown on the Contract documents and as directed by the Agency, shall be paid at the contract unit bid price for "BROPHY ROAD DETENTION BASIN 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, which 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.

1.4.45 Detention Basin Causeway Stripping

1.4.45.1 Measurement

Stripping, removal, stockpile and respread of materials from this operation shall be measured for payment by the cubic yard stripped and quantities will be determined by the average end area method. The basis for measurement will be cross sections of the areas to be stripped taken before and after stripping 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.

1.4.45.2 Payment

Payment for detention basin causeway stripping shall be paid at the Contract unit bid price for "DETENTION BASIN CAUSEWAY STRIPPING". This price shall constitute full compensation for all equipment, labor, materials and incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency. No separate or direct payment will be made for stockpiling, transportation, loading, unloading, respreading on levee slopes, basin slopes and other areas as directed by the Agency or for dust control of stripped materials. All costs in connection therewith shall be included in the unit price for "DETENTION BASIN CAUSEWAY STRIPPING".

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1.4.46 Detention Basin Causeway Excavation and Hauling

1.4.46.1 Measurement

Detention Basin Causeway excavation as shown or specified in the Contract Documents, and as directed by the Agency, shall be measured by use of the average end area method to the nearest cubic yard. The basis of measurement will be a survey of the area after surface layer removal and prior to the excavation and a second survey of the same area after the completion of the excavation. For areas where lines and grades are shown on the Plans, measurement will be limited to those lines and grades. Slides caused by fault of the Contractor, over excavation, and excavation performed for the convenience of the Contractor shall not be measured for payment.

1.4.46.2 Payment

Detention basin Causeway excavation and hauling shall be paid at the Contract unit bid price for "DETENTION BASIN CAUSEWAY EXCAVATION AND HAULING". Payment will constitute full compensation for furnishing all labor, materials, tools, equipment, and incidentals and doing all work necessary to complete the excavations as specified, including dewatering and water control, blending and moisture-conditioning materials, stripping, clearing and grubbing the stockpile and mixing areas, stockpiling, transporting material to and from stockpile locations and fill locations, construction of field ramps and site access, construction and improvement of haul roads, establishing temporary facilities and controls, water supply, drainage grading, locating utilities, construction of permanent irrigation and drainage facilities at borrow sites as shown on the Plans, and performing quantity surveys.

1.4.47 Detention Basin Causeway Erosion Control Seeding

1.4.47.1 Measurement

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

1.4.47.2 Payment

Erosion control seeding at the Detention Basin Causeway site as shown on the Contract documents and as directed by the Agency, shall be paid at the contract unit bid price for "DETENTION BASIN CAUSEWAY 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, which 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.

1.4.48 Road 1034 Detention Basin Stripping

1.4.48.1 Measurement

Stripping, removal, stockpile and respread of materials from this operation shall be measured for payment by the cubic yard stripped and quantities will be determined by the average end area method. The basis for measurement will

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be cross sections of the areas to be stripped taken before and after stripping 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.

1.4.48.2 Payment

Payment for Road 1034 detention basin stripping will be made at the Contract unit bid price for "ROAD 1034 DETENTION BASIN STRIPPING". This price shall constitute full compensation for all equipment, labor, materials and incidentals necessary to complete the Work as shown or specified in the Contract documents, or as directed by the Agency. No separate or direct payment will be made for stockpiling, transportation, loading, unloading, respreading on levee slopes, basin slopes and other areas as directed by the Agency or for dust control of stripped materials. All costs in connection therewith shall be included in the unit price for "ROAD 1034 DETENTION BASIN STRIPPING".

1.4.49 Road 1034 Detention Basin Excavation and Hauling

1.4.49.1 Measurement

Road 1034 Detention Basin excavation as shown or specified in the Contract Documents, and as directed by the Agency, shall be measured by use of the average end area method to the nearest cubic yard. The basis of measurement will be a survey of the area after surface layer removal and prior to the excavation and a second survey of the same area after the completion of the excavation. For areas where lines and grades are shown on the Plans, measurement will be limited to those lines and grades. Slides caused by fault of the Contractor, over excavation, and excavation performed for the convenience of the Contractor shall not be measured for payment.

1.4.49.2 Payment

Road 1034 Detention Basin excavation and hauling shall be paid at the Contract unit bid price for "ROAD 1034 DETENTION BASIN EXCAVATION AND HAULING". Payment will constitute full compensation for furnishing all labor, materials, tools, equipment, and incidentals and doing all work necessary to complete the excavations as specified, including dewatering and water control, blending and moisture-conditioning materials, stripping, clearing and grubbing the stockpile and mixing areas, stockpiling, transporting material to and from stockpile locations and fill locations, construction of field ramps and site access, construction and improvement of haul roads, establishing temporary facilities and controls, water supply, drainage grading, locating utilities, construction of permanent irrigation and drainage facilities at borrow sites as shown on the Plans, and performing quantity surveys.

1.4.50 Road 1034 Detention Basin Erosion Control Seeding

1.4.50.1 Measurement

Erosion control seeding at the Road 1034 Detention Basin site as shown or specified in the Contract documents, and as directed by the Agency, shall be measured by the Acre using horizontal area surveys.
1.4.50.2 Payment

Erosion control seeding at the Road 1034 Detention Basin site as shown on the Contract documents and as directed by the Agency, shall be paid at the contract bid price for "ROAD 1034 DETENTION BASIN 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, which 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.

1.4.51 Levee Embankment Fill (From Import) Excavation and Hauling

1.4.51.1 Measurement

Levee embankment fill (from import) excavation and hauling as shown or specified in the Contract Documents, and as directed by the Agency, shall be measured by use of the average end area method to the nearest cubic yard. The basis of measurement will be a survey of the area after surface layer removal and prior to the excavation and a second survey of the same area after the completion of the excavation. For areas where lines and grades are shown on the Plans, measurement will be limited to those lines and grades. Slides caused by fault of the Contractor, over excavation, and excavation performed for the convenience of the Contractor shall not be measured for payment.

1.4.51.2 Payment

Levee embankment fill (from import) excavation and hauling shall be paid at the Contract unit bid price for "LEVEE EMBANKMENT FILL (FROM IMPORT) EXCAVATION AND HAULING". Payment will constitute full compensation for furnishing all labor, materials, tools, equipment, and incidentals and doing all work necessary to complete the excavations as specified, including dewatering and water control, blending and moisture-conditioning materials, stripping, clearing and grubbing the stockpile and mixing areas, stockpiling, transporting material to and from stockpile locations and fill locations, construction of field ramps and site access, construction and improvement of haul roads, establishing temporary facilities and controls, water supply, drainage grading, locating utilities, construction of permanent irrigation and drainage facilities at borrow sites as shown on the Plans, and performing quantity surveys.

1.4.52 Subsurface Drilling, Sampling, and Testing

1.4.52.1 Measurement and Payment

Separate payment will not be made for subsurface drilling, sampling, and testing, and all costs associated therewith shall be included in the various items of work.

1.4.53 Temporary Construction Facilities

1.4.53.1 Measurement and Payment
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".

1.4.54 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.

1.4.55 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.

PART 2 PRODUCTS (NOT APPLICABLE)

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-- End of Section --
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PART 2 PRODUCTS

PART 3 EXECUTION

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SUBMITTAL PROCEDURES

PART 1    GENERAL

1.1    SUBMITTALS

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

1.1.1    Submittal

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

1.1.2    Submittal Descriptions (SD)

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

SD-01 Preconstruction Submittals

Work plans outlining methods of performing various portions of the work.

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

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

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for
Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

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

Preprinted material describing installation of a product, system or material, including special notices and (MSDS) concerning impedances,
hazards and safety precautions.

SD-09 Contractor's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

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.

1.2 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.

1.2.1 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.

1.2.2 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.

1.2.3 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.

1.2.4 Contractor Action Code and Action Code

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

NR - Not Reviewed

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

1.2.5 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.

1.3 PROCEDURES FOR SUBMITTALS

1.3.1 Procedures

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

1.3.2 Reviewing and Certifying

The Contractor shall be responsible for reviewing and certifying that all required submittals are in compliance with Contract requirements. All submittals will be reviewed by the Agency. Agency review may include review by the USACE, DWR and other regulating agencies.
1.3.3 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.

1.3.4 Scheduling

a. The Contractor shall coordinate scheduling, sequencing, preparing, and processing of submittals with performance of Work so that the Work will not be delayed by submittal processing. The Contractor shall allow time for potential requirement to resubmit.

b. Except as specified otherwise, the Contractor shall allow 15 working days for Agency review, beginning with receipt by the Agency. The period of review for each resubmittal is the same as for initial submittal.

1.3.5 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 to 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.

1.3.5.1 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.

1.3.5.2 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.
1.3.5.3 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.

1.3.5.4 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.

1.3.6 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 "No Exception Taken. May Proceed Based on Satisfactory Performance," or "No Exceptions Taken as Noted. May Proceed Based on Satisfactory Performance.", except to the extent that a portion of work must be accomplished as the basis of the submittal.

1.3.7 Agency's Responsibilities

The Agency will:

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.

1.3.8 Actions Possible

Submittals will be returned with one of the following notations:

a. Submittals marked "Not Reviewed" will indicate the submittal has been previously reviewed, is not required, or is not complete. A
submittal marked "Not Reviewed" 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. May Proceed Based on Satisfactory Performance." authorize the Contractor to proceed with the work covered.

c. Submittals marked "No Exceptions Taken as Noted. May Proceed Based on Satisfactory Performance." 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.

1.4 FORMAT OF SUBMITTALS

1.4.1 Transmittal Form

The Contractor shall transmit each submittal, except sample installations and sample panels, to the Agency. Transmit submittals with an accompanying transmittal form prescribed by Agency. 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 1.4.2, "Identifying Submittals." Process the transmittal forms to record actions regarding sample panels and sample installations.

1.4.2 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.
1.4.3 Format for All 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.

1.4.4 Format of All Product Data and 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.

1.4.5 Format of Samples

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

1. Sample of Equipment or Device: Full size.

2. Sample of Materials Less Than 2 by 3 inches: Built up to 8-1/2 by 11 inches.

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

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

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

6. Color Selection Samples: 2 by 4 inches.

7. Sample Panel: 4 by 4 feet.

8. Sample Installation: 100 square feet.

b. Samples Showing Range of Variation: Where variations are unavoidable due to the nature of the materials, submit sets of samples of not less than three (3) units showing extremes and middle of range.

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

d. Recording of Sample Installation: Note and preserve the notation of the area constituting sample installation, but remove the notation at final clean up of the Project.

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

1.4.6 Format of Design Data and 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.

1.4.7 Format of Test Reports and 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.

1.4.8 Format of Preconstruction Submittals and 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.

1.5 QUANTITY OF SUBMITTALS

1.5.1 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.

1.5.2 Number of Copies of Product Data and Manufacturer's Instructions

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

1.5.3 Number of Samples

   a. Submit two (2) samples, or two (2) sets of samples showing the range of variation, of each required item. One (1) approved sample or set of samples will be retained by the Agency and one (1) will be returned to the Contractor.

   b. Submit one (1) sample panel. Include components listed in the technical section or as directed.

   c. Submit one (1) sample installation, where directed.

   d. Submit one (1) sample of non-solid materials.

1.5.4 Number of Copies of Design Data and Certificates

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

1.5.5 Number of Copies of Test Reports and Manufacturer's Field Reports

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

1.5.6 Number of Copies of Operation and Maintenance Data

Submit five (5) copies of O&M data to the Agency for review.

1.5.7 Number of Copies of Preconstruction Submittals and Closeout Submittals

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

1.6 FORWARDING SUBMITTALS

1.6.1 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.

1.6.1.1 O&M Data

The Agency will review O&M data to verify the submittals comply with the Contract requirements; submit data specified for a given item when the item is delivered to the job site.

In the event the Contractor fails to deliver O&M data within the time limits specified, the Agency may withhold from progress payments as noted in the General Provisions.

1.7 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 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."

1.13 AGENCY REVIEWED SUBMITTALS

Upon completion of review of submittals requiring Agency review, the submittals will be marked with "No Exceptions Taken. May Proceed Based on Satisfactory Performance" or "No Exceptions Taken as Noted. May Proceed Based on Satisfactory Performance." 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.

1.14 STAMPS

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

<table>
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<tr>
<th>CONTRACTOR</th>
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<td>(Firm Name)</td>
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<th>Reviewed</th>
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<th>Reviewed with corrections as noted on submittal data and/or attached sheet(s).</th>
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PART 2 PRODUCTS

Not Applicable

December 30, 2019
PART 3  EXECUTION

Not Applicable

-- End of Section --
### SUBMITTAL REGISTER

**Title and Location:** Three Rivers Levee Improvement Authority GF200YR

<table>
<thead>
<tr>
<th>Activity No</th>
<th>Transmittal No</th>
<th>Description</th>
<th>Item Submitted</th>
<th>Contractor: Schedule Dates</th>
<th>Contractor Action</th>
<th>Approving Authority</th>
<th>Action Code</th>
<th>Date Rcd From Contr</th>
<th>Date Rcd From Other Reviewer</th>
<th>Date Rcd From Appr Auth</th>
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<td>Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary Work will be coordinated</td>
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<td>Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, and systems or equipment</td>
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**Three Rivers Levee Improvement Authority GF200YR**

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- Asphalt concrete and material sources
- Asphalt concrete

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 35 26

GENERAL SIGNAGE AND SAFETY REQUIREMENTS

08/09

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PART 3   EXECUTION - NOT USED

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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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements

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

29 CFR 1926 Safety and Health Regulations for Construction

1.2   PROJECT SIGNS

1.2.1   General

The Contractor shall construct and erect Project, safety, and hard hat signs at locations designated by the Agency. The signs shall conform to the figure at the end of this section, see Attachment 1. The signs shall be erected within 15 Work Days after date of commencement of Work under this Contract.

1.2.2   Number of Signs

The Contractor shall furnish the following signs:

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1.2.3   Construction

Signs shall be constructed as detailed on attached figure.

1.2.4   Painting

All exposed surfaces and edges of plywood shall be given one coat of linseed oil and be wiped prior to applying primer. All exposed surfaces of signs and supports shall be given one coat of primer and two finish coats of white paint. All lettering shall be sized as indicated. Width of letter stroke shall be 1/6 of the letter height.
1.2.5 Placement of Signs

Sign placement shall be coordinated with the Agency and signs installed prior to the beginning of Project construction activities.

1.3 BULLETIN BOARD

1.3.1 General

A bulletin board shall be provided in a location approved by the Agency. The bulletin board shall be easily accessible at all times and shall contain wage rates, equal opportunity notice, and other items as directed by the Agency and required by EM 385-1-1.

1.3.2 Maintenance and Disposal

The Contractor shall maintain the bulletin board in good condition throughout the life of the Project. The bulletin board shall remain the property of the Contractor and upon completion of the Project shall be removed from the site.

1.4 GENERAL SAFETY REQUIREMENTS

1.4.1 General

The Project general safety requirements are included in EM 385-1-1 and 29 CFR 1926. The most stringent requirements of the two standards shall govern.

1.4.2 Contractor's Superintendent

The Contractor's superintendent shall take an active role in enforcing the Project general safety requirements by participation in safety conferences, Activity Hazard Analysis, toolbox meetings, walk-through inspections, correction of violations, etc., including that of the subcontractor's work.

1.4.3 Job Hazard Analysis

Based on the construction schedule, the Contractor shall submit an Activity Hazard Analysis of each major phase of Work prior to entering that phase of activity as outlined in Section 01 45 04.00 41. The analysis shall include major or high-risk hazards, as well as commonly recurring deficiencies that might possibly be encountered for that operation. The analysis shall identify the Contractor's Superintendent, who shall take active participation in the Activity Hazard Analysis. Prior to start of construction activities a meeting shall be held with the Contractor, Agency, and affected Subcontractors to review the Activity Hazard Analysis. In addition, job site meetings shall be held to indoctrinate supervisory personnel and workers on details of this analysis.

1.4.4 Violations

If recurring violations and/or gross violations indicate that the safety performance is unsatisfactory, corrective action shall be taken as directed by the Agency, and at the discretion of the Agency additional retention will be withheld from the progress payment until corrective action has been completed.
1.4.5 Fire Prevention

Cutting or welding will be permitted only in areas that are, or have been made, fire safe.

1.4.6 Record-keeping/Reporting Requirements

On all Contract operations, the Contractor shall be responsible for recording and reporting all accident exposure and experience incident to the Work to the appropriate governing agency. As a minimum, these records shall include exposure work-hours and a log of occupational injuries and illnesses using OSHA Form 300 or state equivalent.

1.4.7 Accident Reporting

As part of the requirements for reporting accidents in accordance with EM 385-1-1, the Contractor shall submit at the 50% point and 100% of Project completion, a written summary of worker's compensation claims filed by workers on the Project. The report covering the Contractor claims shall be certified as "correct and true" by the Contractor's compensation insurance carrier. The same certification shall be required for Subcontractor reports.

1.5 SECURITY

The location of Work may be particularly subject to vandalism. Materials left on-site are done so at the Contractors' risk, and if lost, at the Contractor's expense. The Contractor is responsible for security for all the Work. Particularly, the Contractor shall construct and maintain the signs, including but not limited to, those necessary for public safety and traffic control, as specified in these specifications. The Contractor shall replace those signs damaged or destroyed due to vandalism at no additional expense to the Agency.

1.6 SUBMITTALS

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

- SD-01 Preconstruction Submittals
  - Safety Plan
  - Worker's Compensation Claim Summary

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

-- End of Section --
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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

08/10

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1.2   ORDERING INFORMATION

PART 2   PRODUCTS

PART 3   EXECUTION

-- End of Section Table of Contents --
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 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. Documents listed in the specifications with numbers which were not assigned by the standards producing organization should be ordered from the source by title rather than by number.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)
38800 Country Club Drive
Farmington Hills, MI  48331
Ph:   248-848-3700
Fax:  248-848-3701
E-mail: bkstore@concrete.org
Internet:  http://www.concrete.org

ALUMINUM ASSOCIATION (AA)
National Headquarters
1525 Wilson Boulevard, Suite 600
Arlington, VA  22209
Ph:   703-358-2960
Fax:  703-358-2961
Internet:  http://www.aluminum.org

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:  http://www.aashto.org

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)
1303 W. Walnut Hill Lane, Suite 305
Irving, TX  75038-3008
Ph:   972-506-7216

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PART 2   PRODUCTS

Not used

PART 3   EXECUTION

Not used

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 01.10

QUALITY CONTROL SYSTEM (QCS)

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-- End of Section Table of Contents --
1.1 GENERAL

The Agency will use a project tracking software to assist in its monitoring and administration of this Contract. The Contractor shall use a project tracking software to record, maintain, and submit various information throughout the Contract period. Refer to 1.2 "QCS SOFTWARE".

1.1.1 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. 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 QCS SOFTWARE

The Contractor shall use a proprietary or aftermarket quality control system (QCS) software to track the Project.

The Contractor shall submit to the Agency for review a description of the proposed software before delivery. Contractor shall furnish QCS software and all original software manuals to the Agency within 30 calendar days of contract review. The furnished QCS software shall become the property of the Agency and will not be returned to the Contractor. The Agency will compensate the Contractor in conformance with the provisions of General Condition 9-8 "Payment for Changes" for replacement of software that is damaged, lost or stolen after delivery to the Agency.

1.3 ADMINISTRATION

1.3.1 Contractor Information

The QCS software shall contain the Contractor's name, address, telephone numbers, management staff, and other required items.

1.3.1.1 Subcontractor Information

The QCS software shall contain the name, trade, address, phone numbers, and other required information for all Subcontractors.

1.3.2 Correspondence

Contractor correspondence to the Agency shall be identified by use of unique, consecutive serial numbers. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Correspondence initiated by the Contractor's home (main) office shall be prefixed with "H".
"H". Correspondence shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Agency's correspondence to the Contractor will be prefixed with "C".

1.3.1.3 Equipment

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

1.3.2 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.

1.3.2.1 Daily Contractor Quality Control (CQC) Reports.

The QCS software shall include the means to produce Daily CQC Reports. The Contractor may use other formats to record basic QC data. 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.

1.3.2.2 Deficiency Tracking

The Contractor shall use the QCS software to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS software. The Agency's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.3.2.3 Accident/Safety Tracking

The Agency will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Agency's safety comments will be issued to the Contractor.

1.3.2.4 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing.

1.3.3 Submittal Management

The Contractor will provide submittals on ENG Form 4025 or an Agency Approved equivalent. 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. Refer to section 01 33 00.00 41 SUBMITTAL PROCEDURES for required submittals.

1.3.4 Schedule

The Contractor shall develop a construction schedule, in accordance with the General Provisions, Section 7-5 "SCHEDULES".

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1.4 MONTHLY COORDINATION

The Contractor shall update the QCS software each Work Day. The Contractor shall submit to the Agency all QC data with progress payment requests.

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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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 04.00 41

CONTRACTOR QUALITY CONTROL

03/04

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   REFERENCES

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

ASTM INTERNATIONAL (ASTM)


ASTM D3740 (2012a) Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction


ASTM E329 (2011c) Standard Specification for Agencies Engaged in Construction Inspection, Testing or Special Inspection

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2   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.

1.3   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

CQC Plan
PART 2   PRODUCTS

Not used.

PART 3   EXECUTION

3.1   GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract documents. The QCS shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent shall be held responsible for the quality of work on the job and is subject to removal by the Agency for non-compliance with the quality requirements specified in the Contract. The site project superintendent in this context shall be the highest level manager responsible for the overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Agency, and shall be responsible for all construction and construction-related activities at the site.

3.2   QUALITY CONTROL 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

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers or record, consultants, and architect/engineers (AE):

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).

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

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, graduate architect, or a graduate of construction management, with a minimum of 10 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. 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 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Agency for review.

3.5 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:

3.5.1 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. A 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.

3.5.2 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.

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 24 hours in advance of beginning the initial phase. 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.

3.5.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with Contract requirements, until completion of the particular feature of Work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of Work that may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.5.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted 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 a substantial period of inactivity; or if other problems
3.6 TESTS

3.6.1 Testing Procedure

The Contractor shall 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. The Contractor shall 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. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that 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.

e. Record results of all tests taken, both passing and failing tests, shall be recorded on the Daily CQC Report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Agency, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Agency. Final reports shall comply with the minimum requirements of ASTM D3740, ASTM C1077, and ASTM E29, which includes certification by a California Registered Civil Engineer. Distribution of the final copies of each test result shall be made to the Agency within 24 hours after collecting the laboratory test samples or initiating the field test, except when the required test duration exceeds 24 hours. When the test duration exceeds 24 hours, distribution of the final test results shall be made within 24 hours after completion of the test by the Contractor prior to submittal. Test forms submitted to the Agency shall be accurately completed. Incomplete or inaccurate forms will be immediately returned to the Contractor for correction. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.6.2 Testing Laboratories

3.6.2.1 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,
Three Rivers Levee Improvement Authority

200-year Goldfields Levee Project

100% Design

asphalt, and steel shall meet criteria detailed in ASTM D3740, ASTM C1077 and ASTM E329, as applicable and shall comply with ER 1110-1-261; laboratory validation may only be accomplished by audit per Section 6-c-2 of ER 1110-1-261.

3.6.3 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.

3.6.4 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.

3.7 COMPLETION INSPECTION

3.7.1 Punch-Out Inspection

Near the end of the Work, the CQC Manager shall conduct an inspection of the Work. A punch list of items that do not conform to the approved Contract Plans and Specifications shall be prepared and included in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Agency that the facility is ready for the Agency Pre-Final inspection.

3.7.2 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.

3.7.3 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 costs.
3.8 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the Work of Subcontractors and suppliers and shall be 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.

These records shall indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the Work and workmanship comply with the contract. The original plus one copy and electronic files of these records in report form shall be furnished to the Agency daily within 48 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 shall 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 shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.
3.9 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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TEMPORARY CONSTRUCTION FACILITIES

03/04

PART 1 GENERAL

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1.2 AVAILABILITY AND USE OF UTILITY SERVICES
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1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN
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PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

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1.1 GENERAL REQUIREMENTS

1.1.1 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.

If supplemental 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 by the Agency prior to use.

1.1.2 Employee Parking

Contractor employees shall park vehicles, excluding construction equipment, in staging areas. This area shall be within walking distance of the construction site. Contractor employee parking shall not interfere with existing and established roadways, private property and/or agricultural land in the Project area.

1.1.3 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.

1.1.4 Drinking Water

Provide drinking water for all personnel connected with the work. Transport water in such a manner as to keep it clean and fresh. Serve from single service containers with paper cups or sanitary drinking fountains.

1.2 AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1 Water

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

1.2.2 Sanitation

The Contractor shall provide and maintain within the construction trailer plumbed sanitary facilities approved by the Agency. 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.

1.2.3 Telephone

The Contractor shall, at its own expense, make arrangements and procure telephone facilities.

1.2.4 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.

1.3 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1 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.

1.3.2 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. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the Project, the signs shall be removed from the site.

1.4 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.

1.4.1 Haul Roads

The Contractor shall, at its own expense, construct access and on-site 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, although optional, shall be adequate to ensure safe operation at all times. 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 designated by the Agency shall be removed and haul road areas shall be returned to pre-construction condition.

1.4.2 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.

1.4.3 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.

1.5 CONTRACTOR'S TEMPORARY FACILITIES

1.5.1 Administrative Field Office

Contractor shall provide and maintain, at its own expense, administrative field office facilities for its staff.

1.5.2 Security Provisions

Outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment. Security lighting shall be removed upon completion of the Project.

1.6 TEMPORARY PROJECT SAFETY FENCING

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 furnish and erect temporary protective fencing at the work site at the locations identified by the Contract Documents and by the Agency.
Fencing type shall be as noted on the Plans. 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.

1.7 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.

1.8 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.

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.

Pre-Construction Survey of Roads

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

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CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

01/07

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1.3 PLAN
1.4 RECORDS
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  1.5.1 Source Separated Method
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  1.6.2 Recycle
  1.6.3 Waste
1.7 SUBMITTALS

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --
PART 1   GENERAL

1.1   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.

1.2   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.

1.3   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.

1.4 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.

1.5 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:

1.5.1 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.

1.5.2 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.

1.5.3 Other Methods

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

1.6 DISPOSAL

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

1.6.1 Reuse

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. 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.
1.6.2 Recycle

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

1.6.3 Waste

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

1.7 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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CLOSEOUT SUBMITTALS

05/09

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      1.2.1.2  Working Record and Final Record Drawings
      1.2.1.3  Drawing Preparation
      1.2.1.4  Payment
   1.2.2  Record of Equipment and Materials
   1.2.3  Final Approved Shop Drawings
   1.2.4  Construction Contract Specifications
   1.2.5  Real Property Equipment
      1.2.5.1  Schedule
   1.2.6  Test Results
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PART 2  PRODUCTS (NOT USED)

PART 3  EXECUTION (NOT USED)

-- End of Section Table of Contents --
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.

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:

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
<th>Manufacturer and Catalog, and Size</th>
<th>Composition</th>
<th>Where Used</th>
</tr>
</thead>
</table>

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)

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OPERATION AND MAINTENANCE DATA

07/06

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1.3   TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

1.4   SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES
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  1.4.2   Data Package 2
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PART 2   PRODUCTS
PART 3 EXECUTION

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PART 1   GENERAL

1.1   SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Agency personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 00 41 SUBMITTAL PROCEDURES.

1.1.1   Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.1.2   Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 4. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 4. Each facility or pipe crossing shall have a separate O&M package.

1.1.3   Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Engineer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.1.4   Review and Approval

The Engineer shall review the commissioned systems and equipment submittals for completeness and applicability. The Agency shall review that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental
impacts. The Agency shall communicate deficiencies to the Engineer. Upon a successful review of the corrections, the CA shall recommend review and acceptance of these O&M manuals to the Engineer. This work shall be in addition to the normal review procedures for O&M data.

1.2 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.2.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.2.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.2.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.2.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.2.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.2.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.2.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.2.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance
to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.2.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.2.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.2.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.2.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.2.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.2.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies,
subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.3.5  Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.2.4  Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.5  Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.5.1  Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.2.5.2  Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.2.5.3  O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.2.5.4  Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.
1.2.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.2.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.2.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.2.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name, address, and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.3 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).

1.4 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:
1.4.1 Data Package 1
   a. Safety precautions
   b. Cleaning recommendations
   c. Maintenance and repair procedures
   d. Warranty information
   e. Contractor information
   f. Spare parts and supply list

1.4.2 Data Package 2
   a. Safety precautions
   b. Normal operations
   c. Environmental conditions
   d. Lubrication data
   e. Preventive maintenance plan and schedule
   f. Cleaning recommendations
   g. Maintenance and repair procedures
   h. Removal and replacement instructions
   i. Spare parts and supply list
   j. Parts identification
   k. Warranty information
   l. Contractor information

1.4.3 Data Package 3
   a. Safety precautions
   b. Operator prestart
   c. Startup, shutdown, and post-shutdown procedures
   d. Normal operations
   e. Emergency operations
   f. Environmental conditions
   g. Lubrication data
   h. Preventive maintenance plan and schedule
i. Cleaning recommendations
j. Troubleshooting guides and diagnostic techniques
k. Wiring diagrams and control diagrams
l. Maintenance and repair procedures
m. Removal and replacement instructions
n. Spare parts and supply list
o. Product submittal data
p. O&M submittal data
q. Parts identification
r. Warranty information
s. Testing equipment and special tool information
t. Testing and performance data
u. Contractor information

1.4.4 Data Package 4
a. Safety precautions
b. Operator prestart
c. Startup, shutdown, and post-shutdown procedures
d. Normal operations
e. Emergency operations
f. Operator service requirements
g. Environmental conditions
h. Lubrication data
i. Preventive maintenance plan and schedule
j. Cleaning recommendations
k. Troubleshooting guides and diagnostic techniques
l. Wiring diagrams and control diagrams
m. Maintenance and repair procedures
n. Removal and replacement instructions
o. Spare parts and supply list
p. Corrective maintenance man-hours
q. Product submittal data
r. O&M submittal data
s. Parts identification
t. Warranty information
u. Personnel training requirements
v. Testing equipment and special tool information
w. Testing and performance data
x. Contractor information

1.4.5 Data Package 5
a. Safety precautions
b. Operator prestart
c. Start-up, shutdown, and post-shutdown procedures
d. Normal operations
e. Environmental conditions
f. Preventive maintenance plan and schedule
g. Troubleshooting guides and diagnostic techniques
h. Wiring and control diagrams
i. Maintenance and repair procedures
j. Removal and replacement instructions
k. Spare parts and supply list
l. Product submittal data
m. Manufacturer's instructions
n. O&M submittal data
o. Parts identification
p. Testing equipment and special tool information
q. Warranty information
r. Testing and performance data
s. Contractor information

PART 2   PRODUCTS

Not Used

PART 3   EXECUTION

Not Used

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DIVISION 02 - EXISTING CONDITIONS

SECTION 02 32 00

SUBSURFACE DRILLING, SAMPLING, AND TESTING

04/06

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  1.2.4 Auger Borings and Sampling
  1.2.5 Drive Sample Borings and Sampling
  1.2.6 Undisturbed Sample Borings and Sampling
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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 D1452 (2009) Soil Investigation and Sampling by Auger Borings

ASTM D1586 (2011) Penetration Test and Split-Barrel Sampling of Soils

ASTM D1587 (2008) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes

1.2   SYSTEM DESCRIPTION

1.2.1   Available Geotechnical Data

The Agency has performed geotechnical subsurface investigations and laboratory tests relative to the soils located along the project levee and in the borrow areas. This information is provided to the Contractor in electronic format in the Reference section of these specifications.

Any data on subsurface conditions shown in the Plans or specifications may not necessarily be representative of the Project as a whole, since they are based on discrete locations. The water levels shown on the logs of explorations are those measured at the time of drilling. As the water table is related to the river stage and irrigation practices, the water table is expected to fluctuate with the seasons.

It is the Contractor's responsibility to become acquainted and satisfied as to the character, quality, and quantity of surface and subsurface materials to be encountered, by inspecting the site and by evaluating information derived from exploratory work that may have been accomplished by others or included in these Contract Documents.

Any failure to become acquainted with all the available information will not relieve the Contractor from responsibility for properly estimating the difficulty or cost of successfully performing the work.

1.2.2   Additional Geotechnical Data

The Contractor shall provide at its own expense whatever additional subsurface investigation is required along the levee or in borrow areas to further define the nature of the materials, and obtain samples of material for testing or trial mixes, so that the work can be properly planned and
executed. This is to be accomplished by means of sonic borings, auger borings, drive sample borings, undisturbed sample borings, or test pits. Any drilling in the levee embankment shall not use drilling fluid unless casing is provided through the embankment, except as authorized by CVFPB and USACE. The work shall be executed as specified herein and copies of all boring logs, test pit logs, and laboratory test results shall be provided to the Agency to be made part of the project record.

1.2.2.1 Pre-bid Subsurface Investigation

The prospective bidders may perform subsurface investigations at their own expense prior to the date bids are received to expand the site characterization and subsurface conditions data, but only after receiving the necessary clearance from the Agency and rights-of-entry from property owners. All work shall be performed in accordance with applicable laws and regulations. Results of subsurface exploration performed by bidders, including soil classification logs and laboratory data, shall be submitted to the Agency following bid opening to become part of the Project record.

1.2.3 Sonic Drilling and Sampling

Sonic drilling methods entail drilling boreholes using high frequency vibration to continuously advance a core barrel. Samples are collected as a continuous core.

1.2.4 Auger Borings and Sampling

An auger boring is any boring made in unconsolidated soils with a conventional manually or power-driven earth auger for the purpose of obtaining samples of subsurface materials. Auger boring and sampling shall be performed in accordance with ASTM D1452, or as directed by the Agency.

1.2.5 Drive Sample Borings and Sampling

A drive sample boring is a boring made through unconsolidated or partly consolidated sediments or decomposed rock by means of a mechanically driven sampler. The purpose of these borings is to obtain knowledge of the composition, the thickness, the depth, the sequence, the structure, and the pertinent physical properties of foundation or borrow materials. Standard Penetration Tests (SPT) shall be performed in accordance with ASTM D1586.

1.2.6 Undisturbed Sample Borings and Sampling

An undisturbed sample boring is a boring made to obtain soil samples which, when tested, will show properties as close to the in situ (in place) properties as any sample which can be obtained. All undisturbed sampling shall be accomplished in accordance with ASTM D1587, or as directed by the Agency.

1.2.7 Test Pit Excavation and Sampling

A test pit is any excavation in soil, hardpan, decomposed rock, or other unconsolidated or partially consolidated overburden materials which has an open cross-sectional area large enough to permit efficient excavation and shoring/lining, engineering and geological inspection and photographing of the subsurface soils. All test pits shall be excavated, dewatered (if necessary), shored/lined and protected from surface water drainage and backfilled in accordance with all applicable Federal and State safety regulations.
1.3 SUBMITTALS

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

SD-02 Drawings

Drilling and Test Pit Log

The Contractor shall submit complete, legible copies of DRILLING LOG, TEST PIT LOGS, and records to the Agency within 2 days after a hole or test pit is completed.

SD-03 Permits/Certifications

Permits, Certifications, and Licenses

Copies of all permits, certifications, and licenses prior to starting work.

Schedule of Drilling, Sampling, and Testing

Prior to starting work, the Contractor shall submit a plan for drilling, sampling, testing, and safety. The plan shall include, but shall not be limited to, the proposed method of drilling and sampling including a description of the equipment and sampling tools that will be used, a listing of any subcontractors to include a description of how the subcontractors will be used and a description of all methods and procedures that will be utilized to insure a safe operation and to protect the environment. This submittal shall also include a statement of the prior experience, in the type of work described in these specifications, of the person or persons designated to perform the work specified herein. No work shall be performed until this plan has been reviewed and no deviation from the reviewed plan will be permitted without prior review by the Agency.

1.4 CARE AND DELIVERY OF SAMPLES

1.4.1 General

The Contractor shall be solely responsible for preserving all samples in good condition.

1.4.2 Undisturbed Samples

Every precaution shall be taken to avoid damage to samples as a result of careless handling and undue delay in shipping. Samples shall be shipped in containers and shall be of sufficient durability to protect the samples from any damage during shipment. The sample tubes shall be well packed in vermiculite or other equal material reviewed by the Agency to protect the samples against vibration. The Contractor shall avoid exposing sealed and crated samples to precipitation, direct sunlight, freezing and temperatures in excess of 100 degrees F. In general, no undisturbed samples shall remain on the site of sampling for more than one week before shipment. Samples shall be stored and shipped with the tube in a vertical position in order to prevent consolidation, segregation, and change in moisture content.
PART 2 PRODUCTS

2.1 CONTAINERS

The Contractor shall furnish jars, tubes, and boxes for the storage and shipment of samples.

2.1.1 Sample Jars

Sample jars shall be 1 pint capacity, wide-mouth glass jars with moisture-tight screw tops. Alternatively, samples may be taken using a one-gallon zip-top plastic bag.

2.1.2 Shipping Boxes

Boxes for shipping sample jars shall be corrugated cardboard boxes that have the capacity to hold no more than 12 sample jars and the strength to contain and protect the jars and their contents under ordinary handling and environmental conditions.

2.1.3 Tubes and Crates

Undisturbed samples shall be shipped in thin walled Shelby tubes packed in crates.

2.2 LABELS

2.2.1 Sample Jar Labels

A printed or type-written, fade resistant and waterproof label shall be affixed to the outside of each jar and shall contain the following information:

PROJECT __________________________ LOCATION __________________________
(Such as Table Rock Dam) (Such as Borrow Area B)

HOLE NO. __________________________ STATION __________________________

JAR NO. _________ of _________ JARS

TOP ELEV. OF HOLE ________________ DEPTH OF SAMPLE ________________

DESCRIPTION OF MATERIAL ____________________________________________
(Such as Moist, silty, medium sand)
2.2.2 Shipping Box Labels

Each box of jar samples shall be identified with weatherproof and wear-proof labels indicating the following:

PROJECT: _____
LOCATION: _____
JAR SAMPLES FROM HOLE OR HOLES: _____

2.2.3 Core Box Labels

Core boxes shall be identified with stenciled labels. The information on this label shall contain the following:

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>[______]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOLE NO.</td>
<td>[______]</td>
</tr>
<tr>
<td>BOX NO.</td>
<td>[______]</td>
</tr>
<tr>
<td>TOTAL NUMBER OF BOXES FOR THE HOLE</td>
<td>[______]</td>
</tr>
</tbody>
</table>

PART 3 EXECUTION

3.1 SUBSURFACE DRILLING MOBILIZATION AND DEMOBILIZATION

3.1.1 Mobilization

Mobilization shall consist of the delivery to the site of all exploration equipment, plant, equipment, materials and supplies to be furnished by the Contractor, the complete assembly in satisfactory working order of all such plant and equipment at the jobsite and the satisfactory storage at the site of all such materials and supplies.

3.1.2 Demobilization

Demobilization shall consist of the removal from the site of all exploration equipment plant, equipment, materials and supplies after completion of the work and also includes, at the direction of the Agency, the cleanup and removal of all scrap, waste backfill material, waste drilling fluid, soil contaminated with engine/hydraulic oil, backfilling all sumps or excavations resulting from the operations and, in general, returning the site as close to its original condition as possible.

3.2 EQUIPMENT AND SUPPLIES

3.2.1 Auger Boring and Sampling

The equipment to be furnished by the Contractor for making auger borings shall include, but not be limited to, standard continuous flight augers and/or standard cup-type earth augers, similar or equal to the Iwan Auger and not less than 4 inches in diameter unless otherwise approved. The augers shall be completely equipped with all the accessories necessary for boring and sampling.
3.2.2 Drive Sample Boring and Sampling

Equipment to be furnished by the Contractor for making drive sample borings shall include, but not be limited to, standard 2-inch OD split barrel drive samplers and power-driven drilling machinery of a type or types reviewed by the Agency, complete with a drive-hammer of 140-pound weight and all other accessories for taking samples of all types of soils or decomposed rock at the locations and to the depths required. The drive shoe for the split barrel samplers shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. Supplies shall include, but not be limited to, all casing, drill stem, drill bits, drill fluid and additives, pumps, and power necessary to accomplish the required boring and sampling.

3.2.3 Undisturbed Sample Boring and Sampling

Equipment to be furnished by the Contractor for making undisturbed sample borings shall include, but not be limited to, power-driven drilling machinery of an approved type or types complete with the special devices and accessories enumerated and described hereinafter. Drilling machinery shall be of the hydraulic feed type. Supplies shall include, but not be limited to, all samplers, casing, drill stem, drill bits, drill fluid and additives, pumps, and power necessary to accomplish the required boring and sampling. Drill casing, if used, shall be of such minimum inside diameter as to allow use of the selected sampler.

a. Sands and Cohesive Soils: The sampling device used to sample fine to medium grain sands and cohesive soils shall be a fixed or stationary piston type that uses a 3-inch diameter thin wall Shelby tube.

b. Stiff and Dense Soils: The sampling device for obtaining samples of stiff and dense soils shall be similar or equal to a Denison double tube, swivel head core barrel, or a Pitcher sampler and must be reviewed by the Agency prior to use.

3.2.4 Test Pit Excavation and Sampling

Selection of the test pit excavation, shoring/lining and dewatering (if necessary) methods and equipment shall be at the Contractor’s discretion but must be reviewed by the Agency. The Contractor shall also furnish all materials required for shoring/lining to comply with all applicable safety regulations.

3.3 IDENTIFYING SAMPLES

Sample jars, shipping boxes, and labels shall comply with PART 2, paragraphs SAMPLE JARS, SHIPPING BOXES, and LABELS, respectively. In addition, a moisture proof label containing the project name, hole number and sample number shall be placed inside the jar or this information can be written using a waterproof pen or scribed on the jar lid. The Contractor shall take all precautions required to insure that the shipping boxes are not subjected to rough handling or damaging environmental conditions. A copy of the boring log for the portion of the boring that the samples came from shall be enclosed in the shipping box.

3.4 AUGER AND SONIC BORING AND SAMPLING

Samples shall be labeled in accordance with paragraph IDENTIFYING SAMPLES. Samples shall be obtained for each change of material type noted during
drilling and at maximum vertical intervals of 5 feet. In order to retain the natural moisture content of the material to the fullest extent possible, all samples shall be of sufficient volume to completely fill the sample jars and the samples shall be placed in the sample jars as soon as possible after they are taken from the hole. All sample jars shall be labeled.

3.5 DRIVE SAMPLE BORING AND SAMPLING

Samples shall be labeled in accordance with paragraph IDENTIFYING SAMPLES. Drive sample borings drilled through overburden materials shall be suitably cased to permit obtaining drive samples of the size or sizes specified or as directed. Samples shall be taken either continuously or at maximum vertical intervals of 5 feet or at all changes in material type noted during drilling. The sampler shall be driven with the force of the 140 pound drive hammer under a free fall of 30 inches. To minimize the compacting effect of casing driving when casing is used to stabilize a boring, the bottom of the casing shall be kept as high above the soil sampling zone as conditions permit. If hollow stem auger is used as a casing and/or to advance the boring, a plug assembly must be used to keep soil from entering the inside of the auger. Above the water table, samples shall be obtained from a dry hole. Below the water table, water shall be maintained within the hole at or above the groundwater level. Where information on the natural water content of soils above the water table is not needed and when reviewed by the Agency, boreholes may be drilled without casing by using a suitable drilling fluid to prevent collapse of sidewalls. When a drilling fluid is used, soil sampling shall be done by such means that will prevent inclusion of drilling fluid in the samples. The samples shall be placed in sample jars as soon as possible after they are taken from the hole and, when possible, the volume of the sample shall be large enough to completely fill the sample jar in order that the natural moisture content of the material may be retained to the fullest extent possible. All samples shall be labeled.

3.6 UNDISTURBED SAMPLE BORING AND SAMPLING

In general, labeling of undisturbed samples shall conform to paragraph IDENTIFYING SAMPLES. Particular care shall be taken to indicate the top and bottom of each sample tube. Tubes and crates for undisturbed samples shall be labeled "DO NOT JAR OR VIBRATE" and "HANDLE, HAUL, AND SHIP IN A VERTICAL POSITION".

3.6.1 Procedure

The procedure for Undisturbed Sample Boring and Sampling shall be the same as outlined in paragraph DRIVE SAMPLE BORING AND SAMPLING, except that the sampling device shall be advanced downward by one continuous, smooth drive using the drill rig's hydraulic feed system. The hydraulic down pressure shall be read and recorded at 6 inch intervals during each sample drive. The sampling device for stiff and dense soils shall be advanced by continuous rotation of the outer cutting barrel in conjunction with use of drill fluid circulation. Driving of any undisturbed sampling device by means such as a drop hammer will not be permitted.

3.6.2 Sealing

Both ends of the soil sample tube/liner obtained with a Denison barrel, or its equivalent, shall be cleaned out to remove all drill fluid contaminated and/or disturbed soil or to a minimum distance of 2 inches from the ends of
the tube/liner. Any material removed that is not contaminated with drill fluid shall be placed in a sample jar and labeled in accordance with paragraph IDENTIFYING SAMPLES. The cleaned out ends of the sample liner tube shall then be sealed with microcrystalline wax. A metal or wooden disk, having a diameter just slightly smaller than the inside diameter of the liner tube shall be inserted into the wax to a distance of 1/4-inch from the end of the soil sample. The wax plugs shall be flush with the ends of the tube and a final seal consisting of a metal cap or tape shall be placed over the ends of the tube.

3.7 TEST PIT EXCAVATION AND SAMPLING

3.7.1 Excavation

The test pits shall be excavated to depths and dimensions needed to permit soil classification and sampling of potential borrow material for physical property and compaction testing. Before excavating pits, the Contractor shall thoroughly familiarize himself with work site, with all available subsurface data, particularly groundwater conditions, and with environmental mapping of the area. Regardless of the method of excavation employed, the pits shall be excavated, dewatered and shored/lined in conformance with all applicable safety regulations.

3.8 BACKFILLING

3.8.1 Drill Holes

Unless otherwise noted in these specifications or directed by the Agency, all drill holes shall be backfilled and abandoned in accordance with all Federal, State, and local laws, regulations and ordinances. The Contractor shall preserve all holes in good condition until final measurement and until the records and samples have been accepted. As a minimum, all holes shall be grouted from the bottom of the hole to within 2 feet of the ground surface using a grout mixture of six to eight gallons of water per sack (94 pounds) of portland cement. All grout shall be pumped through a tremie pipe that is inserted to the bottom of the boring to ensure that the grout fills the full extent of the hole. The remaining ungrouted top 2 feet of the hole shall be backfilled with local soil and tamped. All backfilling operations shall be performed in the presence of the Agency and, if required by regulation, Federal, State, and local officials.

3.8.2 Test Pits

The Contractor shall backfill all test pits with local soil compacted to original densities as directed by the Agency.

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DEMOLITION AND DECONSTRUCTION

10/06

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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 SOCIETY OF SAFETY ENGINEERS (ANSI/ASSE)

ANSI/ASSE A10.6 (2006) Safety Requirements for Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011) Safety and Health Requirements Manual

1.2   GENERAL REQUIREMENTS

The Contractor shall not begin demolition until authorization is received from the Agency. Remove rubbish and debris from the Project site and do not allow accumulations. Rubbish and debris shall be removed from the Project site daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in approved stockpile areas. In the interest of occupational safety and health, the Work shall be performed in accordance with EM 385-1-1. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT. Contractor shall comply with all other applicable provisions of the GENERAL PROVISIONS and SPECIAL PROVISIONS including but not limited to contaminated or hazardous material or environments and sanitary regulations.

1.3   SUBMITTALS

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

SD-01 Preconstruction Submittals

Work Plan

The procedures proposed for the accomplishment of the Work. The procedures shall provide for safe conduct of the Work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property that is to remain undisturbed, coordination with other Work in progress, and timely disconnection of utility services. Lateral
bracing and shoring work plan shall include shoring plans and calculations reviewed and stamped by a Civil or Structural Engineer registered in the State of California. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

Demolition Plan

Submit proposed salvage, demolition and removal procedures to Agency for review before construction activities are started.

SD-18 Records Closeout Submittals

Receipts

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the Contract safety requirements shall conform with ANSI/ASSE A10.6. Obtain necessary permits required for the demolition of structures and utility termination from the appropriate agencies.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris to adjacent properties and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Sweep pavements as often as necessary to control the spread of debris.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal Work, use traffic barricades. Notify the Agency prior to beginning such Work.

1.6.2 Existing Work

Before beginning any demolition Work, the Contractor shall survey the site, take photos, and examine the Plans and Specifications to determine the extent of the Work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Agency or adjacent landowners; any damaged items shall be repaired or replaced as reviewed by the Agency at no cost to the Agency. The Contractor shall coordinate the Work of this section with all other Work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural and geotechnical elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this Contract. Do not overload structural elements or pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. All sheeting, shoring, bracing, and supports shall be designed and stamped by a Civil or Structural Engineer registered in the State of California.
1.6.3 Trees

In addition to other protective measures required by the General Specifications and the Special Provisions, trees within the Project site that might be damaged by the Contractor's activities, and that are to remain in place, shall be protected by temporary protective fencing or temporary security fencing. Any tree not designated for demolition that is removed under this Contract shall be replaced in kind.

1.6.4 Facilities

The Contractor shall protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Agency. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition Work.

1.6.5 Protection of Personnel

During the demolition Work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.7 BURNING

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

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Damaged items that are to be relocated shall be repaired or replaced with new undamaged items.

1.9 REQUIRED DATA

The Demolition Plan shall include; procedures for careful removal and disposition of materials specified to be salvaged, coordination with other Work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation, and the sequence of operations.

1.10 USE OF EXPLOSIVES

Use of explosives will not be permitted.
PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

Remove existing utilities associated with structures to be removed as indicated on the Plans and terminate in a manner conforming to the nationally recognized code covering the specific utility and reviewed by the Agency. Where structures are designated for demolition, coordinate with and request service termination from appropriate utility companies prior to demolition of structure and associated utilities. The extent of utility removal shall be as noted on the Plans. Coordinate removal of meters and related equipment in accordance with the instructions of the Agency. When utility lines are encountered that are not indicated on the Plans, the Agency shall be notified for direction prior to performing further work in the area containing utilities.

Protect in place all power poles and overhead and underground utility lines, unless otherwise indicated on the Plans. The Contractor shall obtain Agency approval prior to demolition of existing utilities. The Contractor will be held responsible for any damage or interruption of service to underground or overhead utilities to remain.

3.1.2 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated on the Plans to existing adjacent grade. Provide neat sawcuts at limits of pavement removal as indicated or at limits of proposed right-of-way.

3.1.3 Concrete

Sawcut concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.4 Patching

Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish.

3.1.5 Fencing and Gates

Remove fencing, gates and posts within proposed right-of-way lines as shown on the Plans. Terminate fencing to remain with end post to match existing fence posts. Replace fencing and gates as shown on Plans.
3.1.6 Structures

Structures noted to be removed shall be wholly and completely demolished, including all above ground features. Materials to be salvaged shall be stored in accordance with this Specification.

3.1.7 Wells

Existing wells not to be used as a source for water during construction shall be abandoned per local, State, and Federal requirements.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor and shall be removed from the Project. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon review by the Agency of the Contractor's demolition and removal procedures, and authorization by the Agency to begin demolition. The Agency will not be responsible for the condition or loss of, or damage to, such property after Contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated by the Agency to be reused or relocated to prevent damage, and reinstall as the Work progresses.

3.2.3 Salvaged Materials and Equipment

Remove materials and equipment that are indicated by the Agency to be removed by the Contractor and that are to remain the property of the Agency, and deliver to a storage site as directed by the Agency.

The Contractor shall inventory and salvage items and material to the maximum extent practicable.

Material salvaged by the Contractor shall be stored as approved by the Agency and shall be removed from the project site before completion of the Contract. Material salvaged by the Contractor shall not be sold on the site.

Salvaged items to remain the property of the Agency shall be removed in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage shall be repaired or replaced to match existing items. Containers shall be properly identified as to contents.

3.2.4 Debris

Debris and rubbish shall be removed from excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.
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CONCRETE REINFORCING

08/10

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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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318  (2011; Errata 1 2011; Errata 2 2012; Errata 3-4 2013) Building Code Requirements for Structural Concrete and Commentary


AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M  (2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)


ASTM A370  (2012a) Standard Test Methods and Definitions for Mechanical Testing of Steel Products


ASTM A706/A706M  (2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

December 30, 2019
1.2 SUBMITTALS

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

SD-02 Shop Drawings
Reinforcement

SD-03 Product Data
Welding
Butt-Splices
Material;

SD-04 Samples
Epoxy-Coated Bars

SD-06 Test Reports
Material
Tests, Inspections, and Verifications

SD-07 Certificates
Reinforcing Steel
Qualification of Steel Bar Butt-Splicers

1.3 QUALITY ASSURANCE

1.3.1 Welding Qualifications

Welders shall be qualified in accordance with AWS D1.4/D1.4M. Qualification test shall be performed at the worksite and notify the Engineer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4/D1.4M. Submit a list of qualified welders names.
1.3.2 Qualification of Steel Bar Butt-Splacers

Qualification of steel bar butt-splicers shall be certified to have satisfactorily completed a course of instruction in the proposed method of butt-splicing or have satisfactorily performed such work within the preceding year. Submit certificates on the Qualifications of Steel Bar Butt-Splacers prior to commencing butt-splicing.

1.3.3 Qualification of Butt-Splicing Procedure

As a condition of reviewal of the butt-splicing procedure, make three test butt-splices of steel bars of each size to be spliced using the proposed butt-splicing method, in the presence of the Engineer. These test butt-splices and unspliced bars of the same size shall be tension tested to destruction with stress-strain curves plotted for each test. Test results shall show that the butt-splices meet the specified strength and deformation requirements in order for the splicing procedure to be approved.

1.4 DELIVERY, STORAGE, AND HANDLING

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A675/A675M, Grade 80. Steel pipe conforming to ASTM A53/A53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A184/A184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A615/A615M, ASTM A706/A706M, or ASTM A1035/A1035M grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A82/A82M. In highly corrosive environments or when directed by the Engineer, reinforcing steel shall conform to ASTM A767/A767M, ASTM A775/A775M, ASTM A1035/A1035M or ASTM A934/A934M as appropriate. If Grade 40 bars are unavailable the Contractor may substitute Grade 50 or Grade 60 bars of the same size and spacing as indicated for Grade 40 bars when authorized.

Submit certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

2.3.1 Epoxy-Coated Bars

Epoxy-coated steel bars shall comply with the requirements of ASTM A775/A775M, including written certifications for coating material and coated bars, sample of coating material, and 1.5 pounds of patching material.
2.4 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire. Ties for epoxy-coated bars shall be vinyl-coated or epoxy-coated. Ties for zinc-coated bars shall be zinc-coated.

2.5 SUPPORTS

Bar supports shall comply with the requirements of ACI SP-66. Supports for bars in concrete with formed surfaces exposed to view or to be painted shall be plastic-coated wire, stainless steel or precast concrete supports. Precast concrete supports shall be wedged-shaped, not larger than 3-1/2 by 3-1/2 inches, of thickness equal to that indicated for concrete cover and have an embedded hooked tie-wire for anchorage. Bar supports used in precast concrete with formed surfaces exposed to view shall be the same quality, texture and color as the finish surfaces.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests, specified and required by applicable standards, by an approved laboratory and certified to demonstrate that the materials are in conformance with the specifications. Tests, inspections, and verifications shall be performed and certified at the Contractor's expense. Submit certified tests reports of reinforcement steel showing that the steel complies with the applicable specifications for each steel shipment and identified with specific lots prior to placement. Submit three copies of the heat analyses for each lot of steel furnished certifying that the steel conforms to the heat analyses.

2.6.1 Reinforcement Steel Tests

Mechanical testing of steel shall be in accordance with ASTM A370 except as otherwise specified or required by the material specifications. Tension tests shall be performed on full cross-section specimens using a gage length that spans the extremities of specimens with welds or sleeves included. Chemical analyses of steel heats shall show the percentages of carbon, phosphorous, manganese, sulphur and silicon present in the steel. The frequency of testing shall be on twenty (20) percent of material unless directed by engineer.

2.6.2 Radiographic Examination of Welds

Radiographic examination of welds shall be in accordance with ASTM E94 and shall be performed and evaluated by an approved testing agency adequately equipped to perform such services. Radiographs of welds and evaluations of the radiographs submitted for reviewal shall become the property of the Agency.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement steel and accessories shall be fabricated and placed as specified and shown and approved shop drawings. Fabrication and placement details of steel and accessories not specified or shown shall be in accordance with ACI SP-66 and ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Zinc-Coated and epoxy-coated bars shall be mill-bent prior to
coating. All steel shall be bent cold unless authorized. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms. Submit detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be reviewed before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4/D1.4M. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line. Twenty (20) percent of all joints shall be tested. The joints tested shall be determined by the engineer.

3.1.3 Placing Tolerances

3.1.3.1 Spacing

The spacing between adjacent bars and the distance between layers of bars may not vary from the indicated position by more than one bar diameter nor more than 1 inch.

3.1.3.2 Concrete Cover

The minimum concrete cover of main reinforcement steel bars shall be as shown. The allowable variation for minimum cover shall be as follows:

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<tr>
<th>MINIMUM COVER (inch)</th>
<th>VARIATION (inch)</th>
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<tr>
<td>MINIMUM COVER (inch)</td>
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<td>3/4</td>
<td>plus 1/8</td>
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3.1.4 Splicing

Splices in steel bars shall be made only as required. Bars may be spliced at alternate or additional locations at no additional cost to the Agency subject to reviewal.

3.1.4.1 Lap Splices

Lap splices shall be used only for bars smaller than size 14. Lapped bars may be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than 1/5 the required length of lap or 6 inches.

3.1.4.2 Butt-Splices

Use butt-splices only for splicing size 14 and 18 bars and for splicing #11 bars to larger bars except where otherwise shown or authorized. Make butt-splices by a method which develops splices suitable for tension, compression and stress reversal applications. Welded butt-splices shall be full penetration butt welds. Butt-splices shall develop 90 percent of the specified minimum ultimate tensile strength of the smallest bar of each splice. Bars shall be cleaned of all oil, grease, dirt, rust, scale and other foreign substances and shall be flame dried before splicing. Adequate jigs and clamps or other devices shall be provided to support, align and hold the longitudinal centerline of the bars to be butt-spliced in a straight line. Submit proposed procedure for butt-splicing steel bars prior to making the test butt-splices for qualification of the procedure. Properties and analyses of steel bars and splicing materials shall be included in the submitted procedure. Physical properties of splicing sleeves shall include length, inside and outside diameters, and inside surface details. Butt-splices shall be as follows:

a. Thermit Welded Butt Splices - Bars to be thermit welded shall be restricted to steel shown by heat analysis to have a sulfur content not exceeding 0.05 percent. The ends of bars to be thermit welded shall be cut square and smooth. Flame cutting will be permitted provided grinding is employed to remove the resulting scale and to square and smooth the cut ends to a condition equivalent to a saw cut. No shearing will be permitted. Bars shall be cleaned and flame dried before splicing. The joint shall be properly aligned in the mold with a gap opening in accordance with the manufacturer's recommendations. Charging and firing shall conform to the manufacturer's
recommendations. The end of bars and the welded mold shall be preheated before welding to a temperature of not less than 100 degrees F and the mold shall be left in place for at least 15 minutes after ignition. Risers shall be broken or burned off after removing the mold. Tension splices shall be staggered longitudinally a minimum of 5 feet so that no more than half of the bars are spliced at any one section or as otherwise indicated.

b. Mechanical Butt-Splices - Mechanical butt-splices shall be an approved exothermic, threaded coupling, swaged sleeve or other positive connecting type. Bars to be spliced by a mechanical butt-splicing process may be sawed, sheared or flame cut provided the ends of sheared bars are reshaped after shearing and all slag is removed from the ends of flame cut bars by chipping and wire brushing prior to splicing. Surfaces to be enclosed within a splice sleeve or coupling shall be cleaned by wire brushing or other approved method prior to splicing. Splices shall be made using manufacturer's standard jigs, clamps, ignition devices and other required accessories. In addition to the strength requirements specified paragraph BUTT-SPLICES the additional deformation of number 14 and smaller bars due to slippage or other movement within the splice sleeve shall not exceed 0.015 inches (unit strain 0.0015 inches/inch) beyond the elongation of an unspliced bar based upon a 10 inch gage length spanning the extremities of the sleeve at a stress of 30,000 psi. The additional deformation of number 18 bars shall not exceed 0.03 inches (unit strain 0.003 inches/inch) beyond the elongation of an unspliced bar based upon a 10 inch gage length spanning the extremities of the sleeve at a stress of 30,000 psi. The amount of the additional deformation shall be determined from the stress-strain curves of the unspliced and spliced bars tested as required paragraph QUALIFICATION OF BUTT-SPLICING PROCEDURE for qualification of the butt-splicing procedure. Tension splices of number 14 or smaller bar shall be staggered longitudinally a minimum of 5 feet or as otherwise indicated so that no more than half of the bars are spliced at any one section. Tension splices of number 18 bars shall be staggered longitudinally a minimum of 5 feet so that no more than 1/3 of the bars are spliced at any one section.

3.2 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.3 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with UFC 3-310-04.

3.4 FIELD TESTS AND INSPECTIONS

3.4.1 Identification of Splices

Establish and maintain an approved method of identification of all field butt-splices which will indicate the splicer and the number assigned each splice made by the splicer.
3.4.2 Examining, Testing, and Correcting

Perform the following during the butt-splicing operations as specified and as directed. The Engineer reserves the right to perform QA testing in accordance with Title 23 on all or none of the QC testing listed below:

a. Visual Examination - All welded splices shall be visually examined for the presence of cracks, undercuts, inadequate size and other visible defects. Respliced connections resulting from correction of visual defects may be radiographically examined at the option of the Engineer as specified in paragraph SUPPLEMENTAL EXAMINATION. Exothermic mechanical butt-splices shall be visually examined to determine if the filler metal is clearly visible at the tap holes and completely fills the sleeves at both ends except for spaces of not more than 3/8 inch occupied by packing. All inspections shall be performed by a American Welding Society Certified Welding Inspector (AWS-CWI).

b. Tension Tests - Tensions tests to 90 percent of the minimum specified ultimate tensile strength of the spliced bars or to destruction shall be performed on one test specimen made in the field for every 25 splices made. Test specimens shall be made by the splicers engaged in the work, using the approved splicing procedure and the same size bars placed in the same relative position, and under the same conditions as those in the groups represented by the specimens. Stress-strain curves shall be furnished for each butt-splice tested.

c. Radiographic Examination - Not less than one of each 25 welded splices selected at random by the Engineer shall be examined radiographically and evaluated for defects. The greatest dimension of any porosity (gas pocket or similar void) or fusion-type defect (slag inclusion, incomplete fusion or similar generally elongated defect in weld fusion) shall not exceed 1/4 inch. The minimum clearance between edges of porosity or fusion-type defects shall not be less than 1 inch. All inspections shall be performed by a certified ASNT NDT.

d. Correction of Deficiencies - No splice shall be embedded in concrete until satisfactory results of visual examination and the required tests or examinations have been obtained. All splices having visible defects or represented by test specimens which do not satisfy the tests or examinations shall be removed. If any of the tension test specimens fail to meet the strength requirements or deformation limitations two production splices from the same lot represented by the test specimens which failed shall be cut out and tension tested. If both of the retests pass the strength requirements and deformation limitations all of the splices in the lot will be accepted. If one or both of the retests fail to meet the strength requirements or deformation limitations all of the splices in the lot will be rejected. All costs of removal, testing and resplicing of the additional production splices shall be borne by the Contractor. The bars of rejected splices shall be cut off outside the splice zone of weld metal, filler metal contact, coupling or sleeve. The cut ends shall be finished as specified and the joints shall be respliced and reinspected at no additional cost.

e. Supplemental Examination - The Engineer may require additional or supplemental radiographic examination and/or tension test of any completed splice.

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-- End of Section Table of Contents --
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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 117  (2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary


ACI 301  (2010; Errata 2011) Specifications for Structural Concrete


ACI 315  (1999) Details and Detailing of Concrete Reinforcement

ACI 318  (2011; Errata 1 2011; Errata 2 2012; Errata 3-4 2013) Building Code Requirements for Structural Concrete and Commentary

ACI/MCP-4  (2013) Manual of Concrete Practice Part 4

AMERICAN WELDING SOCIETY (AWS)


AWS D1.4/D1.4M  (2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)


and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A706/A706M (2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement


ASTM C138/C138M (2013) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete


<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM C618</td>
<td>(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete</td>
</tr>
<tr>
<td>ASTM C827/C827M</td>
<td>(2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures</td>
</tr>
<tr>
<td>ASTM D698</td>
<td>(2012) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 ft-lbf/kW-hr))</td>
</tr>
</tbody>
</table>

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1.2 RELATED SECTIONS

Section 32 31 26 FENCES, GATES AND BOLLARDS.

1.3 SUBMITTALS

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

SD-01 Preconstruction Submittals

Equipment List

Construction Equipment Lists shall be submitted by the Contractor prior to construction in accordance with the paragraph entitled, "General Information," of this section.

Shop Drawings

SD-04 Samples

Waterstop Samples

Three samples of each type of waterstop, 6-inch long, shall be submitted.

SD-05 Design Data

Concrete mix design

Mix design data for each class of Ready-Mix Concrete shall be submitted at least 15 calendar days prior to start of specified work.

Formwork

Formwork shall be designed in accordance with ACI 347R for anticipated loads, lateral pressure and stresses and shall be submitted at least 15 calendar days prior to start of work.
SD-06 Test Reports

Test reports for welding electrodes shall be in accordance with AWS A5.1/A5.1M.

Reports for concrete shall be in accordance with the paragraph entitled, "Quality-Control Testing During Construction," of this section. Test reports of the chemical requirements of reinforcing bars shall also be submitted.

Chemical Composition
Mechanical Usability
Soundness
Slump
Air Entrainment
Compressive Strength
Concrete Temperature

SD-07 Certificates

Steel Bar

Mill certificates shall be submitted for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Certificates for concrete shall be in accordance with the paragraph entitled, "Classification and Quality of Concrete," of this section. Certificates shall contain project name and number, date, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as specified for each material, and test results. Certificates for Welder Qualifications shall be in accordance with the paragraph entitled, "Qualifications for Welding Works" of this section.

Reinforcing Steel

Concrete Design Mixes

Concrete Aggregates

SD-11 Closeout Submittals

Records of Communication shall be submitted in accordance with paragraph entitled, "General Information" of this section.

1.4 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Concrete testing shall be performed by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency shall meet the requirements of ASTM E329 and ASTM C1077.
1.5 QUALIFICATIONS FOR WELDING WORK

Welding procedures shall be in accordance with AWS D1.4/D1.4M. Welder qualifications shall be verified in accordance with AWS D1.4/D1.4M or under an equivalent qualification test approved in advance. Welders shall be permitted to do only the type of welding for which each is specifically qualified.

1.6 CONCRETE SAMPLING AND TESTING

Testing by the Contractor shall include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Quality control testing during construction shall be performed by the Contractor.

Concrete aggregate materials proposed for use in the work shall be sampled and tested in accordance with ASTM C33/C33M.

Portland cement shall be sampled and tested in accordance with ASTM C150/C150M.

Air-entraining admixtures shall be sampled and tested in accordance with ASTM C233/C233M.

1.7 CONCRETE DESIGN MIXES

Mix proportions for each concrete class shall be determined and tested as follows:

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>TEST METHOD</th>
<th>NUMBER OF TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity absorption of fine aggregate</td>
<td>ASTM C128</td>
<td>As required for the concrete aggregate for each trial mix</td>
</tr>
<tr>
<td>Specific gravity and absorption of coarse aggregate</td>
<td>ASTM C127</td>
<td></td>
</tr>
<tr>
<td>Gradation of fine and coarse aggregates</td>
<td>ASTM C117 and ASTM C136</td>
<td></td>
</tr>
<tr>
<td>Moisture content of both fine and coarse aggregates</td>
<td>ASTM C70 and ASTM C566</td>
<td></td>
</tr>
<tr>
<td>Dry-rodded unit weight of coarse aggregate</td>
<td>ASTM C29/C29M</td>
<td></td>
</tr>
<tr>
<td>Trial mixes using at least three different water/cement ratios, minimum allowable cement content, maximum allowable slump; both with</td>
<td>ACI 211.1</td>
<td>As required to determine the concrete mix having the properties specified for each concrete class</td>
</tr>
</tbody>
</table>
and without air entrainment

Making and curing concrete specimens in the laboratory

Sampling fresh concrete in the laboratory

Slump

Air content

Yield

Compressive strength

Proportions of concrete mixtures shall be determined in accordance with ACI/MCP 205 and Method 1 of ACI 301, Section 3.8.2.1. Separate curves shall be prepared for air-entrained and nonair-entrained concretes.

1.8 DELIVERY AND STORAGE OF MATERIALS

Packaged materials shall be delivered to the project site in their original, unopened package or container bearing label clearly identifying manufacturer's name, brand name, material, weight or volume, and other pertinent information. Packaged materials shall be stored in their original, unbroken package or container in a weathertight and dry place until ready for use in the work.

Unpackaged aggregates shall be stored to avoid excessive segregation, contamination with other materials or other size aggregates, or freezing.

Reinforcement and other metal items shall be protected from corrosion and shall be kept free from ice, grease, and other coatings that would destroy or reduce bond. Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

1.9 SHOP DRAWINGS

Fabrication drawings for concrete formwork for reinforcement materials, column forms, wall forms, floor forms, ceiling forms, and for special construction shall indicate concrete pressure calculations with both live and dead loads, along with material types. All design calculations shall be in accordance with ACI/MCP 205 and ACI 301, Chapter 4.

1.10 GENERAL INFORMATION

Construction Equipment Lists of major components used during this phase of work shall be submitted.

Records of Historical Data shall be recorded in the presence of the
Construction Manager showing the condition of structures and other facilities indicating existing conditions of site prior to work start.

Letters of record expressing communication between the Contractor and Agency shall be provided after the contract completion.

**PART 2  PRODUCTS**

**2.1  CONCRETE MATERIALS**

**2.1.1  Concrete Aggregates**

Fine and coarse aggregates shall conform to ASTM C33/C33M.

Concrete aggregate for architectural concrete shall be obtained from a single source. All aggregates shall not be alkali-silica reactive or alkali-carbonate reactive.

**2.1.2  Portland Cement**

Cement shall conform to ASTM C150/C150M, Type I, IA, II, or IIA. One brand and type of cement shall be used for formed concrete having exposed-to-view finished surfaces. Cement type shall conform to ACI 318, Table 4.3.1. Unless supported by testing, cement shall be Type II or IIA.

**2.1.3  Admixtures**

**2.1.3.1  Air-Entraining Admixtures**

Air-entraining admixtures shall conform to ASTM C260. Admixtures containing chlorides shall not be used.

**2.1.3.2  Water-Reducing Admixtures**

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C494/C494M. Admixtures containing chlorides shall not be used.

**2.1.3.3  Pozzolan**

Fly ash or other pozzolans used as admixtures shall conform to ASTM C618, Class C or Class F with 4 percent maximum loss on ignition and 20 percent maximum cement replacement by weight. When pozzolans are used to mitigate the effect of sulfate containing soils, they shall be a type that has demonstrated such ability by test or by service record.

**2.1.4  Water**

Water shall be potable and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete or reinforcement.

**2.2  READY-MIX CONCRETE**

Concrete shall meet the requirements of ASTM C94/C94M.

Concrete mix shall account for hot and cold weather protection in accordance with subparagraph "Weather Limitations and Protection."

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Ready-mixed concrete manufacturer shall provide duplicate delivery tickets with each load of concrete delivered. Delivery tickets shall provide the following information in addition to that required by ASTM C94/C94M:

- Type and brand cement.
- Cement content in 94-pound bags per cubic yard of concrete.
- Maximum size of aggregate.
- Amount and brand name of admixtures.
- Total water content expressed by water/cement ratio.
- Concrete temperature.
- Amount of ice added or description of other cooling methods for hot weather protection.

2.3 FORM FACING MATERIALS

2.3.1 Concrete Form Plywood (Standard Rough)

Plywood shall conform to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.3.2 Overlaid Concrete Form Plywood (Standard Smooth)

Plywood shall conform to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.3.3 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

2.3.4 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

2.4 REINFORCEMENT MATERIALS

2.4.1 Reinforcing Bars

Reinforcing bars shall conform to ASTM A615/A615M and Supplemental S1, Grade 60, ACI/MCP 305 and ACI 318, Section 3.5.3.2. Welded reinforcing bars shall conform to ASTM A706/A706M.
2.4.2 Supports for Reinforcement

Supports shall include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Supports shall be wire bar type conforming to ACI/MCP-4 and ACI 318.

Legs of supports in contact with formwork shall be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.4.3 Wire Ties

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.4.4 Supports

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 10MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

2.4.5 Welded Wire Fabric

Welded wire fabric shall conform to ASTM A185/A185M. When directed by the Agency for special applications, welded wire fabric shall conform to ASTM A884/A884M.

2.5 JOINT MATERIALS

2.5.1 Dumbbell Waterstops

Waterstop shall be extruded polyvinyl chloride, dumbbell shape conforming to CRD-C-572.

2.5.2 Hydrophilic Water Stops

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D412 as follows: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F shall be 3 to 1 minimum.

2.5.3 Preformed Joint Filler Strips

Filler strips shall be nonextruding and resilient nonbituminous type conforming to ASTM D1752, Type I or II.
2.5.4 Joint Sealant Compound

Compound shall be cold-applied, two-component, elastomeric polymer type conforming to Federal Specification (FS) SS-S-200.

2.6 CONCRETE CURING MATERIALS

2.6.1 Absorptive Cover

Cover for curing concrete shall be burlap cloth made from jute or kenaf, weighing 9 ounces plus or minus 5 percent per square yard when clean and dry, conforming to ASTM C171, Class 3; or cover may be cotton mats as approved.

2.6.2 Moisture-Retaining Cover

Cover for curing concrete shall be waterproof paper conforming to ASTM C171, regular or white, or polyethylene sheeting conforming to ASTM C171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap shall conform to ASTM C171, Class 3, and polyethylene film shall conform to ASTM C171. When tested for water retention in accordance with ASTM C 156, weight of water lost 72 hours after application of moisture retaining covering material shall not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.6.3 Water

Water shall be potable and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deterrent to concrete of reinforcement.

2.6.4 Membrane-Forming Curing Compound

Compound shall be liquid type conforming to ASTM C309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.7 CLASSIFICATION AND QUALITY OF CONCRETE

2.7.1 Concrete Classes and Usage

Concrete classes, compressive strength, requirements for air entrainment, and usage shall be as follows unless indicated otherwise. Concrete mix shall also conform to ACI 318, Table 4.3.1.
<table>
<thead>
<tr>
<th>CONCRETE CLASS</th>
<th>MIN. 28-DAY COMPRESSIVE STRENGTH (POUNDS PER SQ. IN.)</th>
<th>REQUIREMENT FOR AIR ENTRAINMENT</th>
<th>USAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5A</td>
<td>2,500</td>
<td>Air-entrained</td>
<td>For concrete not re-inforced and exposed to freezing and thawing</td>
</tr>
<tr>
<td>2.5N</td>
<td>2,500</td>
<td>Nonair-entrained</td>
<td>For concrete not re-inforced and not exposed to freezing and thawing</td>
</tr>
<tr>
<td>3A</td>
<td>3,000</td>
<td>Air-entrained</td>
<td>For foundation concrete work exposed to freezing and thawing or subjected to hydraulic pressure, such as foundation walls, grade beams, pits, tunnels. For exterior concrete slabs, such as steps, platforms, walks</td>
</tr>
<tr>
<td>3N</td>
<td>3,000</td>
<td>Nonair-entrained</td>
<td>For foundation concrete work not exposed to freezing and thawing or subjected to hydraulic pressure, such as footings, pile caps, foundation mats. For interior slabs on ground to be covered with resilient flooring</td>
</tr>
<tr>
<td>4A</td>
<td>4,000</td>
<td>Air-entrained</td>
<td>For structural concrete work exposed to freezing and thawing, unless otherwise indicated or specified, such as exterior columns and spandrels</td>
</tr>
<tr>
<td>4N</td>
<td>4,000</td>
<td>Nonair-entrained</td>
<td>For structural concrete work not exposed to freezing and thawing such as interior columns, beams, supported slabs and other structural members for interior slabs on ground subjected to foot traffic</td>
</tr>
</tbody>
</table>
### 2.7.2 Limits for Concrete Proportions

Limits for maximum water/cement ratio and minimum cement content for each concrete class shall be as follows. Water/cement ratio shall also conform to ACI 318, Table 4.3.1.

<table>
<thead>
<tr>
<th>CONCRETE CLASS</th>
<th>MAX. WATER/CEMENT RATIO</th>
<th>MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5A</td>
<td>0.58</td>
<td>4.75</td>
</tr>
<tr>
<td>2.5N</td>
<td>0.62</td>
<td>4.75</td>
</tr>
<tr>
<td>3A</td>
<td>0.50</td>
<td>5.25</td>
</tr>
<tr>
<td>3N</td>
<td>0.54</td>
<td>5.25</td>
</tr>
<tr>
<td>4A</td>
<td>0.46</td>
<td>6.0</td>
</tr>
<tr>
<td>4N</td>
<td>0.48</td>
<td>6.0</td>
</tr>
<tr>
<td>5A</td>
<td>0.41</td>
<td>6.5</td>
</tr>
<tr>
<td>5N</td>
<td>0.44</td>
<td>6.5</td>
</tr>
</tbody>
</table>

* Weight of water to weight of cement in pounds in one cubic yard of concrete.

### 2.7.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, shall be as follows. Water/cement ratio shall also conform to ACI 318, Table 4.3.1.

<table>
<thead>
<tr>
<th>MAXIMUM SIZE OF AGGREGATE</th>
<th>ASTM C 33 SIZE NUMBER</th>
<th>TYPE OF CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inches</td>
<td>357</td>
<td>Nonreinforced footings and other flat work having a depth of not less than 6 inches, and nonreinforced walls and other formed sections having a dimension between forms of not less than 10 inches</td>
</tr>
<tr>
<td>1-1/2 inches</td>
<td>467</td>
<td>Monolithic slabs on ground, concrete fill, and other flat-work having a depth of not less than 6 inches</td>
</tr>
</tbody>
</table>
than 5 inches and a clear
distance between reinforcing
bars of not less than 2 inches

1 inch       67  Reinforced walls, columns,
girders, beams, and other
formed sections having a dimen-
sion between forms of not less
than 6 inches and clear
distance between reinforcing
bars or reinforcing bar and
face of form of not less than
2-1/2 inch

3/4 inch     67  Monolithic concrete slabs and
other flatwork having a depth
of not less than 2-1/2 inches
and a clear distance between
reinforcing bars of not less
than 1 inch

1/2 inch     7   Concrete joist construction,
beams, reinforced walls, and
other formed work having a
clear distance between rein-
forcing bars and face of form
of less than 2 inch

3/8 inch     8   Nonreinforced slabs and other
flatwork having a depth of less
than 2-1/2 inches

Maximum size of aggregate may be that required for most critical type of
construction using that concrete class.

Gradation of aggregates shall be as specified for separate floor topping.

2.7.4  Slump

Slump for concrete at time and in location of placement shall be as follows:

<table>
<thead>
<tr>
<th>TYPE OF CONSTRUCTION</th>
<th>SLUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footings, unreinforced walls</td>
<td>Not less than 1 inch nor more than 3 inches</td>
</tr>
<tr>
<td>Columns, beams, reinforced walls,</td>
<td>Not less than 1 inch nor more than 4 inches</td>
</tr>
<tr>
<td>monolithic slabs</td>
<td></td>
</tr>
<tr>
<td>Ramps and other sloping surfaces</td>
<td>Not less than 1 inch nor more than 3 inches</td>
</tr>
</tbody>
</table>

2.7.5  Total Air Content

Air content of exposed concrete and interior concrete shall be in
accordance with ASTM C260/C260M and/or as follows:

<table>
<thead>
<tr>
<th>LIMITS</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

December 30, 2019
Concrete exposed to freezing and thawing or subjected to hydraulic pressure shall be air-entrained by addition of approved air-entraining admixture to concrete mix.

2.8 GROUT

2.8.1 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout shall be nonmetallic, shrinkage resistant. Grout compressive strength shall be 5,000 psi minimum at 7 days.

PART 3 EXECUTION

3.1 FORMWORK

3.1.1 General

Forms shall be constructed to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms shall be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.1.2 Design and Construction of Formwork

Form work design and construction shall conform to ACI 301, Chapter 4.

Forms shall be tight to prevent leakage of cement paste during concrete placing.

Form facing materials shall be supported by structural members spaced close to prevent deflection of form facing material. Forms placed in successive units for continuous surfaces shall be fitted to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, formwork shall be cambered for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Exposed joints, edges, and external corners shall be chamfered a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Shores and struts shall be provided with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Adjustment shall be obtained with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, trussed supports shall be provided.

Temporary openings shall be provided in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate
cleaning.

Forms shall be readily removable without impact, shock, or damage to concrete.

3.1.3 Forms for Standard Rough Form Finish

Rough form finish shall be given concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish shall be the specified concrete form plywood or other approved form facing material that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Horizontal joints shall be level and vertical joints shall be plumb.

3.1.4 Forms for Standard Smooth Form Finish

Smooth form finish shall be given concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish shall be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that will produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales shall not exceed 0.0025 times the span.

Arrangement of form facing sheets shall be orderly and symmetrical, and sheets shall be in sizes as large as practical.

Panels shall be arranged to make a symmetrical pattern of joints. Horizontal and vertical joints shall be solidly backed and butted tight to prevent leakage and fins.

3.1.5 Form Ties

Ties shall be factory fabricated metal, adjustable in length, removable or snap-off type that will not allow form deflection or will not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts shall be at least 1-1/2 inches back from concrete surface. Form ties shall be free of devices that will leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.1.6 Tolerances for Form Construction

Formwork shall be constructed to ensure that after removal of forms and prior to patching and finishing of formed surfaces, concrete surfaces shall be in accordance with tolerances specified in ACI 117.
3.1.7 Preparation of Form Surfaces

Contact surfaces of forms shall be coated with form-coating compound before reinforcement is placed. Form-coating compound shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Excess form-coating compound shall not be allowed to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete will be placed. Thinning of form-coating compound shall be made with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.1.8 Removal of Forms

Formwork that does not support weight of concrete, such as sides of beams, walls, columns, and similar vertical parts of the work, may be removed 24 hours after placing concrete, provided concrete is sufficiently hard not to be damaged from form-removal operations.

Formwork that supports weight of concrete, such as beam soffits, slabs, and similar horizontal parts of the work, shall remain in place at least until concrete has attained design minimum laboratory compressive strength at 28 days for applicable concrete class specified.

Form facing material may be removed before concrete has attained its required 28-day compressive strength but in no case less than 6 days after placing concrete, provided shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports. Shores and other vertical supports shall remain in place until concrete has attained its required 28-day compressive strength.

Results of control tests will be used as evidence that concrete has attained sufficient strength to permit removal of supporting forms. Test specimens shall be removed from molds at the end of 24 hours and stored in the structure as near points of sampling as possible; shall receive same protection from elements during curing as is given those portions of the structure which they represent; and shall not be removed from the structure for transmittal to the laboratory prior to expiration of three-fourths of proposed period before removal of forms. Supporting forms of shoring shall not be removed until strength of control-test specimens has attained a value of at least 1,500 psi for columns and 2,000 psi for other work. Contractor shall ensure that newly unsupported portions of the structure are not subjected to heavy construction or material loading.

Tie-rod clamps to be removed from wall shall be loosened 24 hours after concrete is placed; form ties, except for a sufficient number to hold forms in place, may be removed at that time. Ties wholly withdrawn from wall shall be pulled toward inside face.

When formwork is removed during concrete curing period, exposed concrete shall be cured as specified.

3.1.9 Re-Use of Forms

Surfaces of forms that are to be re-used shall be cleaned and repaired,
except that split, frayed, or delaminated form facing material shall not be re-used. Contact surfaces of re-used forms shall be coated as specified.

3.2 REINFORCEMENT FABRICATION AND INSTALLATION

3.2.1 General

Details of reinforcement shall be in accordance with ACI 315 and ACI 318, and as specified. Bars shall not be bent after embedment in concrete.

3.2.2 Fabrication

Reinforcing bars shall be shop fabricated to conform to shapes and dimensions indicated for reinforcement, and as follows:

Fabrication tolerances shall be in accordance with ACI/MCP 205, ACI 315 and ACI 318, and ACI 117.

Hooks and bends shall be in accordance with ACI 315 and ACI 318.

Reinforcement shall be bent cold to shapes as indicated. Bending shall be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly shall not be permitted. Bending shall be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends shall be in accordance with ACI 315 and ACI 318.

Reinforcing bars shall be delivered bundled, tagged, and marked. Tags shall be metal with bar size, length, mark, and other information pressed in by machine. Marks shall correspond with those used on the placing Plans.

Reinforcement which has any of the following defects shall not be used:

Bar lengths, depths, and bends beyond specified fabrication tolerances

Bends or kinks not indicated on Plans or approved shop drawings

Bars with reduced cross-section due to rusting or other cause

Defective reinforcement shall be replaced with new reinforcement having required shape, form, and cross-section area.

3.2.3 Placing Reinforcement

Reinforcement shall be placed in accordance with ACI 315 and ACI 318.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, bars or welded wire fabric shall be supported on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion will be less than 1 inch from concrete surfaces that will be exposed to view or will be painted shall be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units shall be wedge shaped, not larger than 4 by 4 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Precast units shall
have cast-in galvanized tie wire hooked for anchorage and shall blend with concrete surfaces after finishing is completed.

Contractor shall cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor shall notify the Agency so that conflicts may be reconciled before placing concrete. Anchors and embedded items shall be positioned and supported with appropriate accessories.

Epoxy-coated reinforcing bars shall be handled carefully to prevent damage to the coating. Plastic-coated tie wire shall be used and supports shall be of a type to prevent damage to the reinforcing bars.

Reinforcement shall be supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Supports for reinforcing bars shall be sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with ACI 315 and ACI 318. Supports shall not be used to support runways for concrete conveying equipment and similar construction loads.

Supports on ground and similar surfaces shall be equipped with sand-plates.

Welded wire fabric shall be supported as required for reinforcing bars.

Reinforcements shall be secured to supports by means of tie wire. Wire shall be black, soft iron wire, not less than 16 gage.

With the exception of temperature reinforcement, which shall be tied to main steel approximately 24 inches on center, reinforcement shall be accurately placed, securely tied at intersections with 18-gage annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Wire-tie ends shall point away from the form. Unless otherwise indicated, numbers, type, and spacing of supports shall conform to ACI/MCP 305 and ACI 318.

Bending of reinforcing bars partially embedded in concrete will be permitted only as specified in ACI/MCP 305 and ACI 318.

3.2.4 Spacing of Reinforcing Bars

Spacing shall be as indicated. If not indicated, spacing shall be in accordance with ACI 318.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement shall be subject to reviewal.

3.2.5 Splices in Reinforcement

Splices shall be as indicated on the approved Plans.

3.2.6 Concrete Protection for Reinforcement

Concrete protection shall be in accordance with the ACI 318 and ACI/MCP-4.
3.2.7 Welded Wire Fabric Placement

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 JOINTS

3.3.1 Construction Joints

Joints not indicated shall be made and located so as not to impair strength and appearance of the structure and shall be as approved. Construction joints shall be located as follows:

In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; or where required to conform to detail.

Near midpoint of spans for supported slabs, beams. Transfer of shear through construction joints in beams shall be made by use of inclined reinforcement.

In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet.

Joints in water retaining structures, including but not limited to: vaults, distribution boxes, headwalls, outfalls, and flumes shall have waterstops at all joints. Contractor shall coordinate and provide manufacturer's recommended cover for hydrophilic waterstops.

Joints shall be perpendicular to main reinforcement. Reinforcement shall be continued across construction joints, unless indicated otherwise.

3.3.2 Isolation Joints in Slabs on Ground

Joints shall be provided at points of contact between slabs on ground and vertical surfaces, such as foundation walls and elsewhere as indicated.

3.3.3 Control Joints in Slabs on Ground

Joints shall be provided to form panels with 1.5 to maximum aspect ratio, unless indicated otherwise. For slabs without deformed steel reinforcement, joints shall be spaced at no more than 36 times the slab thickness unless indicated otherwise.

Joints shall be offset and shall be continuous to construction joints or edge of slab. "L" and "T" shaped panels shall be avoided.

Joints shall be 1/8-inch wide by 1/5 to 1/4 of slab depth and shall be in fresh concrete by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface, or by cutting the concrete with a saw immediately after the concrete has set, but no later than 8 hours after initial finishing. After concrete has cured for at least 7 days, the Contractor shall remove any inserts and clean
groove of foreign matter and loose particles.

3.3.4 Sealing Joints in Slabs on Ground

Isolation and control joints, where indicated, shall be sealed with joint sealing compound after concrete curing period. Excess material shall be removed as soon after sealing as possible.

3.4 INSTALLATION OF ANCHORAGE DEVICES

3.4.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, cast-in-place concrete shall be set and built in as part of the work of this section, using setting Plans, instructions, and directions for work to be attached thereto.

3.4.2 Placing Anchorage Devices

Anchorage devices and embedded items shall be positioned accurately and supported against displacement. Openings in anchorage devices such as slots and threaded holes shall be filled with an approved, removable material to prevent entry of concrete into openings.

3.5 PREPARATIONS FOR CONCRETE PLACING

3.5.1 General

Surfaces against which concrete is to be placed shall be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Standing water shall be removed without washing over freshly deposited concrete. Flow of water shall be diverted through side drains provided for such purpose.

3.5.2 Weather Limitations and Protection

Concrete shall not be placed in cold weather, hot weather, during rain, sleet, nor snow, unless protection is provided.

Arrangements shall be made before start of concrete placing for protection. Protection materials shall be stored at project site for use in event of unforeseen weather changes that may occur after start of concrete placing operations.

Cold weather is defined as a period when the temperature of the atmosphere is less than 40 degrees F, and other conditions listed in ACI 306.1.

Hot weather is defined as one or any combination of the following conditions that tends to impair the quality of freshly mixed of hardened concrete by accelerating the rate of moisture loss and rate of cement hydration, or otherwise causing detrimental results: ambient temperature above 80 degrees F; high concrete temperature above 90 degrees F; and other conditions listed in ACI 305R.

Protection shall be provided during cold weather and hot weather in accordance with ACI 301, ACI 305R, and ACI 306.1.
During inclement weather, protection material shall be watertight to prevent entry of rain, sleet, or snow onto surfaces to receive concrete and into fresh concrete.

Submit appropriate protection measures 15 days in advance of the first concrete placement anticipated to require protection. The Contractor is responsible for executing all measures necessary to result in acceptable concrete, including but not limited to the protection measures submitted.

3.5.2.1 Concrete Temperature During Conveying and Placing

Temperature of concrete during conveying and placing shall comply with subparagraph "Temperature of Concrete During Curing". Make all necessary arrangements in advance of concrete mixing, conveying and placement for maintaining required concrete temperatures in compliance with ACI 301.

For cold weather conditions, take all advance measures necessary to maintain required temperatures, including but not limited to: heating of aggregates, heating of mix water, heating of mixing environment, provision of heated enclosures, maintaining temperature of surfaces and reinforcement in contact with concrete, slump control, and protection against freezing, and accelerating admixtures.

For hot weather conditions, take all advance measures necessary to maintain required temperatures, including but not limited to: cooling of aggregates, cooling of mix water, incorporation of ice during mixing, approved alteration of proportioning in the mix design, incorporating the use of pozzolans, incorporating the use of retardant admixtures, and preparation or cooling of the surfaces and reinforcement in contact with concrete.

3.5.3 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, subgrade surface shall be moisture conditioned to the satisfaction of the Agency, with water as required to eliminate suction at the time concrete is deposited. Where reviewed by the Agency's geotechnical engineer and when subgrade material is porous, subgrade surface shall be sealed by covering surface with specified water barrier subgrade cover.

3.5.4 Subgrade Under Slabs on Ground

Before construction of slabs on ground, underground work on pipes and conduits shall have been completed and reviewed.

Previously constructed subgrade or fill shall be cleaned of foreign materials and shall be inspected by the Agency for adequate compaction and surface tolerances as specified.

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. The compaction requirement shall meet or exceed the requirements in Section 31 00 00 Earthwork 3.7.2 "Compaction of Fill" for structural backfill and utility trench backfill. The relative compaction shall be no less than ninety seven (97) percent in accordance with ASTM D698. The moisture content after compaction shall be within the limits of 3 percentage points above optimum to 1 percentage point below optimum moisture content as determined by ASTM D698.
Finished surface of subgrade or fill under exterior slabs on ground shall be not more than 0.02-foot above or 0.10-foot below elevation indicated.

Subgrade or fill surface under exterior slabs on ground shall be prepared and moisture conditioned as specified for subgrade under foundations and footings.

3.5.5 Formwork

Formwork shall be complete and reviewed. Debris and foreign material shall be removed from interior of forms before start of concrete placing.

3.5.6 Edge Forms and Screed Strips for Slabs

Edge forms or bulkheads and intermediate screed strips for slabs shall be set to obtain indicated elevations and contours in finished slab surface and shall be strong to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Concrete surface shall be aligned to elevation of screed strips by use of strike-off templates or reviewed compacting-type screeds.

3.5.7 Reinforcement and Other Embedded Items

Reinforcement, joint materials, and other embedded materials shall be secured in position, inspected, and reviewed before start of concrete placing.

3.6 DRILLED PIERS

Excavation for drilled piers shall be performed by boring or augering and shall not disturb adjacent soil. Contractor shall take necessary measures to avoid soil caving into pier excavation, including temporary casing.

3.7 CONCRETE CONVEYING

3.7.1 Transfer of Concrete At Project Site

Concrete shall be handled from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.

3.7.2 Mechanical Equipment for Conveying Concrete

Equipment shall ensure a continuous flow of concrete at delivery end and shall be as reviewed. Runways for wheeled concrete-conveying equipment shall be provided from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment shall be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.8 CONCRETE PLACING

3.8.1 General Placing Requirements

Concrete shall be deposited continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a
section cannot be placed continuously, construction joints shall be provided as specified. Concrete placing shall be performed at such a rate that concrete which is being integrated with fresh concrete is still plastic. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to procedures which will cause segregation.

Concrete to receive other construction shall be screeded to proper level to avoid excessive skimming or grouting.

Concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials shall not be used. Use of retempered concrete will not be permitted. Rejected concrete shall be removed from the site.

Comply with subparagraph "Weather Limitations and Protection" for hot and cold weather placement

3.8.2 Placing Concrete in Forms

Concrete placed in forms shall be deposited in horizontal layers not exceeding 24 inches.

Temporary spreaders in forms shall be removed when concrete placing has reached elevation of spreaders.

Concrete placed in forms shall be consolidated by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Vibrators shall be designed to operate with vibratory element submerged in concrete and shall maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Vibrating equipment shall be adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement shall not be permitted. Vibrators shall not be used to transport concrete inside forms. Vibrators shall be inserted and withdrawn vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Vibrator shall not be inserted into lower courses of concrete that have begun to set. At each insertion, duration of vibration shall be limited to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Placing of concrete in supporting elements shall not be started until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.3 Placing Concrete Slabs

Concrete for slabs shall be placed and consolidated in a continuous operation, within the limits of reviewed construction joints until placing of panel or section is completed.

During concrete placing operations, concrete shall be consolidated by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground shall be consolidated by mechanical vibrators as specified. Concrete in remainder of slabs shall be consolidated by vibrating bridge screeds, roller pipe screeds, or other approved method. Consolidation operations shall be limited to time necessary to obtain consolidation of
concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated shall be as dry as practical and surfaces thereof shall not be manipulated prior to finishing operations. Concrete shall be brought to correct level with a straightedge and struck-off. Bull floats or darbies shall be used to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface shall not be permitted.

Finish of slabs shall be as specified.

3.8.4 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, shall be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Surfaces shall be roughened in a manner that will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Bonding of fresh concrete that has set shall be obtained as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete shall be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, and other structural members; and at joints in work designed to contain liquids; the roughened and cleaned surface of set concrete shall be dampened but not saturated and covered with a cement grout coating.

Cement grout shall consist of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Cement grout shall be applied with a stiff broom or brush to a minimum thickness of 1/16 inch. Fresh concrete shall be deposited before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Such bonding material shall be applied to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 FINISHING OF FORMED SURFACES

3.9.1 Repairing and Patching Defective Areas

Immediately after removal of forms, defective areas shall be repaired and patched with cement mortar.

Honeycomb, rock pockets, voids over 1/2 inch in diameter, and holes left by tie rods and bolts shall be cut out to solid concrete, but in no case to a depth of less than 1 inch. Edges of cuts shall be perpendicular to surface of concrete. Before placing cement mortar, area to be patched at least 6 inches adjacent thereto shall be cleaned, dampened with water, and brush coated with neat portland cement grout. Cement mortar for patching shall consist of one part standard portland cement to two parts fine aggregate passing No. 16 mesh sieve and as little water as necessary for handling and placing. Where concrete surface will be exposed to view, portland cement portion of cement mortar shall be a blend of white and standard portland
cement so that when dry, cement mortar will match surrounding concrete in color. Cement mortar shall be compacted in place and struck off slightly higher than the surrounding surface. Holes extending through concrete shall be filled by means of a plunger type gun or other suitable device from unexposed face, using a stop held at exposed face to ensure complete filling.

3.9.2 Standard Rough Form Finish

Finish shall be the concrete surface having texture imparted by form facing material used, defective areas repaired and patched as specified, and fins and other projections exceeding 1/4 inch in height rubbed down with wood blocks.

3.9.3 Standard Smooth Finish

Finish shall be as-cast concrete surface as obtained with form facing material for standard smooth finish. Defective areas shall be repaired and patched as specified; and all fins and other projections on surface shall be removed.

3.9.4 Grout Finish

Finish shall be standard, smooth coated with grout as specified.

Finish shall be given to interior and exterior concrete vertical surfaces that are to be exposed to view.

Surface of concrete shall be wetted, and grout shall be applied immediately to wetted surfaces. Grout shall be spread over surface with clean burlap pads or sponge-rubber floats to fill pits, air bubbles, and surface holes. Excess grout shall be removed by scraping, then rubbing surface with clean burlap to remove visible grout film. Grout shall be kept damp by means of fog spray during setting period. Finish shall be completed the day it is started, and limits of a finished area shall be made at natural breaks in finished surface.

3.9.5 Related Unformed Surfaces

Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck off smooth after concrete is placed and shall be finished to a texture matching that of adjacent formed surfaces. Final surface treatment on formed surfaces shall continue uniformly across adjacent unformed surfaces.

3.10 CURING AND PROTECTION

3.10.1 General

Freshly placed concrete shall be protected from premature drying and cold or hot temperature and shall be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete. Immediately after placing concrete, surfaces shall be protected against moisture loss for not less than 7 days, regardless of curing method used.

Initial curing shall start as soon as free water has disappeared from surface of concrete after placing.
Finishing shall be timed such that finishing is complete when concrete reaches final set.

Final curing shall coincide with the completion of finishing and shall immediately follow initial curing and before concrete has dried. Final curing shall continue until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Rapid drying at end of final curing period shall be prevented by controlled gradual termination of wet or moist curing measures.

3.10.2 Curing Methods

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

For hot weather concrete, moist curing shall be used for a period of not less than 72 hours beginning at initial set. Subsequent curing shall be accomplished by moist curing, by moisture retaining cover curing, or by membrane curing.

3.10.2.1 Moist Curing

Moist curing shall be accomplished by any of the following methods. Provide for ample water and disposal of the runoff.

a. Keeping surface of concrete continuously wet by covering with water

b. Continuous water spraying

c. Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover continuously wet by water spraying or intermittent hosing. Absorptive cover shall be placed to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

3.10.2.2 Moisture-Retaining Cover Curing:

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Cover shall be placed directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Cover shall be weighted to prevent displacement; tears or holes appearing during curing period shall be immediately repaired by patching with pressure-sensitive, waterproof tape or other approved method.

3.10.2.3 Membrane Curing

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Curing compound shall be applied uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Second coat shall be applied in a direction at right angles to direction of first coat. Total coverage for two coats shall be not more than 200 square feet per gallon of curing compound.
Concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by method and at rate specified. Continuity of coating shall be maintained for entire curing period and damage to coating during this period shall be repaired immediately.

Membrane-curing compounds shall not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.10.3 Curing Formed Surfaces

Curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces shall be accomplished by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, final curing of formed surfaces shall be accomplished by any of the curing methods specified above, as applicable.

3.10.4 Curing Unformed Surfaces

Unless otherwise specified, curing of unformed surfaces shall be accomplished by any of curing methods specified above, as applicable.

Final curing of concrete surfaces to receive liquid floor hardener of finish flooring shall be accomplished by moisture-retaining cover curing.

3.10.5 Temperature of Concrete During Curing

Comply with subparagraph "Weather Limitations and Protection."

Protection measures may be removed when the surface temperature of the concrete is within 20 degrees F of ambient temperature but not less than 7 days from initial set.

Cold Weather Protection:

When temperature of atmosphere is 40 degrees F and below, temperature of concrete shall be maintained at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. Arrangements shall be made before start of concrete placing for one or more of the following methods to preserve moisture in the concrete: heating, covering, insulation, application of steam, and housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

Hot weather protection:

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which will cause too rapid drying of concrete, arrangements shall be made before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period. Temperature of concrete as delivered shall not exceed 90 degrees F.

Changes in temperature of concrete shall be uniform and shall not exceed 5
degrees F in any 1 hour nor 50 degrees F in any 24-hour period.

3.10.6 Protection from Mechanical Injury

During curing period, concrete shall be protected from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.10.7 Protection After Curing

Finished concrete surfaces shall be protected from damage by construction operations.

3.11 QUALITY-CONTROL TESTING DURING CONSTRUCTION

Concrete shall be sampled and tested for quality control by the Contractor during the placement of the concrete as follows:

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>TEST METHOD</th>
<th>NUMBER OF TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling fresh concrete</td>
<td>ASTM C172 except modified for slump per ASTM C94/C94M</td>
<td>As required for each test</td>
</tr>
<tr>
<td>Slump test</td>
<td>ASTM C143/C143M</td>
<td>One for each concrete load at point of discharge and one for each set of compressive strength tests</td>
</tr>
<tr>
<td>Air content by pressure method</td>
<td>ASTM C231/C231M</td>
<td>One set for each 150 cubic yards or fraction thereof of each concrete class placed in any one day; two specimens tested at 7 days, three specimens tested at 28 days</td>
</tr>
<tr>
<td>Compression test specimens</td>
<td>ASTM C31/C31M</td>
<td>One set of six standard cylinders for each compressive strength test</td>
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<tr>
<td>Concrete temperature</td>
<td></td>
<td>Hourly when air temperature is 40 degrees F or below and 80 degrees F or above; each time a set of compression test specimens is made</td>
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</tbody>
</table>

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Test reports for concrete for Chemical Composition, Mechanical Usability and Soundness shall be submitted by the Contractor meeting all design Specifications as required by referenced standards within this section.

3.12 INSPECTION AND ACCEPTANCE PROVISIONS

The Agency will determine acceptance or rejection of concrete.

3.12.1 Agency Inspection and Testing

The Agency's Inspection and Testing Firm will provide inspections as follows.

Continuous Inspection shall be defined as the full-time observation of work requiring inspection by the Agency's Inspection and Testing Firm's representative who is present in the area where the work is being performed. The Agency reserves the right to test none or all testing required by the contractor.

Periodic Inspection shall be defined as the part-time or intermittent observation of work requiring inspection by the Agency's Inspection and Testing Firm's representative who is present in the area where the work has been or is being performed and at the completion of the work.

<table>
<thead>
<tr>
<th>Verification and Inspection</th>
<th>Continuous</th>
<th>Periodic</th>
<th>Referenced Standard</th>
</tr>
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<td>Inspection of reinforcing</td>
<td>X</td>
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<td>ACI 318: 3.5, 7.1, 7.7</td>
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<tr>
<td>7.7 steel placement, including embedded anchorages</td>
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<tr>
<td>Inspection of reinforcing</td>
<td>X</td>
<td></td>
<td>AWS D1.4 ACI 318: 3.5.2</td>
</tr>
<tr>
<td>3.5.2 steel welding, verification of weldability of reinforcing steel other than ASTM A706</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Inspect formwork for shape, location and dimensions of the concrete member being formed</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verifying the use of the required design mix</td>
<td>X</td>
<td>ACI 318: Ch. 4, 5.2-5.4</td>
<td></td>
</tr>
<tr>
<td>At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine temperature of the concrete</td>
<td>X</td>
<td>ACI 318: 5.9, 5.10</td>
<td></td>
</tr>
<tr>
<td>Inspection of concrete placement</td>
<td>X</td>
<td>ACI 318:</td>
<td></td>
</tr>
</tbody>
</table>
3.12.2 Evaluation of Compressive Strength Tests

Concrete quality control test will be evaluated as specified.

Compressive strength tests will be considered satisfactory if the average of all sets of five consecutive compressive strength tests equal or exceed the 28-day design compressive strength, and if no individual compressive strength test (average of two cylinders) falls below the required 28-day design compressive strength by more than 500 pounds per square inch.

If compressive strength tests fail to meet minimum requirements specified, concrete represented by such tests will be considered deficient in strength and subject to provisions specified.

3.12.3 Strength of Concrete Structure

Strength of concrete structure in place will be considered deficient if it fails to comply with requirements which control strength of structure, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength.

3.12.4 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet Specification requirements, cores drilled from hardened concrete for compressive strength determination shall be made in accordance with ASTM C42/C42M, and as follows:

At least three representative cores shall be taken from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Agency.

Cores shall be tested after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent will be more than superficially wet under service.

Cores shall be air dried, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and shall be tested dry if concrete they represent will be dry under service conditions.

Strength of cores from each member or area will be considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Agency. If the results of
core-boring tests indicate that the concrete as placed does not conform to the Plans and Specification, the cost of such tests and restoration required shall be borne by the Contractor.

Core holes shall be filled solid with patching mortar and finished to match adjacent concrete surfaces.

Concrete work that is found inadequate by core tests shall be corrected in a manner reviewed by the Agency.

3.12.5 Rejection of Installation of Concrete

Contractor is responsible for all costs related to correcting or replacing concrete work deemed unacceptable by the Agency.

Concrete structure, slab, lining, foundation, footing, wall, or other cast-in-place concrete elements will be considered deficient if any of the following conditions are present:

Inadequate Strength.

Excessive cracking due to poor workmanship, deficient placement and curing practices, deficient hot or cold weather protection, or any practice related to the work not meeting this specification.

Concrete not meeting required dimensions, elevations, control points, surface flatness, or levelness.

Deficient concrete finish, honeycombs, voids, or poor consolidation.

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  1.2.2 Custom-Made Precast Units
  1.2.3 Proprietary Precast Units
  1.2.4 Joints and Sealants
  1.2.5 Concrete Mix Design
    1.2.5.1 Concrete Mix Proportions
    1.2.5.2 Concrete Strength
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SECTION 03 40 00.00 10
PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION
08/06

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 CONCRETE INSTITUTE INTERNATIONAL (ACI)


ACI 211.2 (1998; R 2004) Standard Practice for Selecting Proportions for Structural Lightweight Concrete


ACI 318 (2011; Errata 1 2011; Errata 2 2012; Errata 3-4 2013) Building Code Requirements for Structural Concrete and Commentary

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)


ACPA QPC (2005; Ver 3.0) QCast Plant Certification Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

AWS D1.4/D1.4M (2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)


December 30, 2019
<table>
<thead>
<tr>
<th>Standard Specification</th>
<th>Description</th>
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<tr>
<td>ASTM A706/A706M</td>
<td>(2009b) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement</td>
</tr>
<tr>
<td>ASTM A775/A775M</td>
<td>(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars</td>
</tr>
<tr>
<td>ASTM C1244</td>
<td>(2011) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill</td>
</tr>
<tr>
<td>ASTM C138/C138M</td>
<td>(2013) Standard Test Method for Density (&quot;Unit Weight&quot;), Yield, and Air Content (Gravimetric) of Concrete</td>
</tr>
</tbody>
</table>
Hydraulic-Cement Concrete


ASTM C618 (2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C877 (2008) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

ASTM C891 (2011) Installation of Underground Precast Concrete Utility Structures


CSA STANDARDS (CSA)


NATIONAL PRECAST CONCRETE ASSOCIATION (NPCA)


1.2 SYSTEM DESCRIPTION

Furnish precast concrete units designed and fabricated by an experienced and acceptable precast concrete manufacturer who has been, for at least 3 years, regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings. Coordinate precast work with the work of other trades.

1.2.1 Standard Precast Units

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards ACI 318, ASTM, ACPA 01-102, Chapter 7-Design for Sulfide Control. Design shall also consider stresses induced during handling, shipping and installation as to avoid product cracking or other handling damage. Indicate design loads for precast concrete units on the shop drawings. Submit drawings for standard precast concrete units furnished by the precast concrete producer for review by the Engineer. These drawings shall demonstrate that the applicable industry design standards have been met. Include installation and construction information on shop drawings. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings. Submit cut sheets, for standard precast concrete units, showing conformance to project drawings and requirements, and to applicable industry design standards listed in this specification.
1.2.2 Custom-Made Precast Units

Submit design calculations for custom-made precast units, prepared and sealed by a registered professional engineer, for review prior to fabrication. Include in the calculations the analysis of units for lifting stresses and the sizing of lifting devices. Submit drawings furnished by the precast concrete producer for review by the Engineer. Show on these drawings complete design, installation, and construction information in such detail as to enable the Engineer to determine the adequacy of the proposed units for the intended purpose. Include details of steel reinforcement size and placement as well as supporting design calculations, if appropriate. Produce precast concrete units in accordance with the approved drawings.

1.2.3 Proprietary Precast Units

Products manufactured under franchise arrangements shall conform to all the requirements specified by the franchiser. Items not included in the franchise specification, but included in this specification, shall conform to the requirements in this specification. Submit standard plans or informative literature, for proprietary precast concrete units. Make available supporting calculations and design details upon request. Provide sufficient information as to demonstrate that such products will perform the intended task.

1.2.4 Joints and Sealants

Provide joints and sealants between adjacent units of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

1.2.5 Concrete Mix Design

1.2.5.1 Concrete Mix Proportions

Base selection of proportions for concrete on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. Develop the concrete proportions using the same type and brand of cement, the same type and brand of pozzolan, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Do not use calcium chloride in precast concrete containing reinforcing steel or other embedded metal items. At a minimum of thirty days prior to precast concrete unit manufacturing, the precast concrete producer will submit a mix design and proportions for each strength and type of concrete that will be used. Furnish a complete list of materials, including quantity, type, brand and applicable data sheets for all mix design constituents as well as applicable reference specifications. The use of self-consolidating concrete is permitted, provided that mix design proportions and constituents meet the requirements of this specification.

1.2.5.2 Concrete Strength

Provide precast concrete units with a 28-day compressive strength (f'c) of 5,000 psi.

1.2.5.3 Water-to-Cement Ratio

Furnish concrete, that will be exposed to freezing and thawing, containing...
entrained air and with water-cement ratios of 0.45 or less. Furnish concrete which will not be exposed to freezing, but which is required to be watertight, with a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or seawater. Furnish reinforced concrete exposed to deicer salts, brackish water or seawater with a water-cement ratio of 0.40 or less for corrosion protection.

1.2.5.4 Air Content

The air content of concrete that will be exposed to freezing conditions shall be within the limits given below.

<table>
<thead>
<tr>
<th>NOMINAL MAXIMUM</th>
<th>AIR CONTENT %</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGGREGATE SIZE</td>
<td>SEVERE EXPOSURE</td>
</tr>
<tr>
<td>10 mm (3/8 inch)</td>
<td>6.0 to 9.0</td>
</tr>
<tr>
<td>13 mm (1/2 inch)</td>
<td>5.5 to 8.5</td>
</tr>
<tr>
<td>19 mm (3/4 inch)</td>
<td>4.5 to 7.5</td>
</tr>
<tr>
<td>25 mm (1.0 inch)</td>
<td>4.5 to 7.5</td>
</tr>
<tr>
<td>38 mm (1.5 inch)</td>
<td>4.5 to 7.0</td>
</tr>
</tbody>
</table>

Note: For specified compressive strengths greater than 5000 psi, air content may be reduced 1 percent.

1.2.5.5 Corrosion Control for Sanitary Sewer Systems

Follow design recommendations outlined in Chapter 7 of ACPA 01-102 or the ACPA 01-110 when hydrogen sulfide is indicated as a potential problem.

1.3 SUBMITTALS

All submittals are the responsibility of the precast concrete producer. Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals
Quality Control Procedures

SD-02 Shop Drawings
Standard Precast Units; EN
Custom-Made Precast Units; EN

SD-03 Product Data
Standard Precast Units
Proprietary Precast Units
Embedded Items
Accessories

SD-05 Design Data
Design Calculations; EN
Concrete Mix Proportions; EN
SD-06 Test Reports
   Test Reports; EN
SD-07 Certificates

Quality Control Procedures

1.4 QUALITY ASSURANCE

Demonstrate adherence to the standards set forth in NPCA QC Manual and/or ACPA QPC. Meet requirements written in the subparagraphs below.

1.4.1 NPCA and ACPA Plant Certification

The precast concrete producer shall be certified by the National Precast Concrete Association's and/or the American Concrete Pipe Association's Plant Certification Program prior to and during production of the products for this project.

1.4.2 Qualifications, Quality Control and Inspection

1.4.2.1 Qualifications

Select a precast concrete producer that has been in the business of producing precast concrete units similar to those specified for a minimum of 3 years. The precast concrete producer shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis.

1.4.2.2 Quality Control Procedures

Submit quality control procedures established by the precast manufacturer in accordance with NPCA QC Manual and/or ACPA QPC. Show that the following QC tests are performed as required and in accordance with the ASTM standards indicated.

   a. Slump: Perform a slump test for each 150 cu yd of concrete produced, or once a day, whichever comes first. Perform slump tests in accordance with ASTM C143/C143M.

   b. Temperature: Measure the temperature of fresh concrete when slump or air content tests are made and when compressive test specimens are made in accordance with ASTM C1064/C1064M.

   c. Compressive Strength: Make at least four compressive strength specimens for each 150 cubic yards of concrete of each mix in accordance with the following Standards: ASTM C31/C31M, ASTM C192/C192M, ASTM C39/C39M.

   d. Air Content: Perform tests for air content on air-entrained, wet-cast concrete for each 150 cu yd of concrete, but not less often than once each day when air-entrained concrete is used. Determine the air content in accordance with either ASTM C231/C231M or ASTM C173/C173M for normal weight aggregates and ASTM C173/C173M for lightweight aggregates.

   e. Unit Weight: Perform tests for unit weight a minimum of once per
week to verify the yield of batch mixes. Perform unit weight tests for each 100 cu yd of lightweight concrete in accordance with ASTM C138/C138M.

Submit test reports as follows:

a. Copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

b. Copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Clearly detail in the specifications special tests for precast concrete or cast-in items.

c. Sufficient documentation, when the use of self-consolidating concrete (SCC) is proposed, showing a minimum of 30-days production track records demonstrating that SCC is appropriate for casting of the product.

d. Copies of in-plant QA/QC inspection reports, upon the request of the Engineer.

1.4.2.3 Inspection

The Engineer may place an inspector in the plant when the units covered by this specification are being manufactured. The burden of payment for plant inspection will be clearly detailed in the specification. The precast concrete producer shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Agency’s right to enforce contractual provisions after units are transported or erected.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver precast units to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite, all precast concrete units will be inspected by the Engineer for quality and final acceptance.

1.5.2 Storage

Store units off the ground or in a manner that will minimize potential damage.

1.5.3 Handling

Handle, transport, and store products in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Perform lifting with methods or devices intended for this purpose as indicated on shop drawings.
PART 2   PRODUCTS

2.1   MATERIALS

Except as otherwise specified in the following paragraphs, conform material to Section 03 30 00 00 10 CAST-IN-PLACE CONCRETE and Section 03 20 00 00 10 CONCRETE REINFORCING.

2.1.1   Cement

Furnish cement conforming to ASTM C150/C150M, Type I, II, III or V. Furnish blended cements that conform to ASTM C595/C595M.

2.1.2   Silica Fume

Provide silica fume conforming to ASTM C1240. Provide available alkalies conforming to the optimal limit given in Table 2 of ASTM C1240. Silica fume may be furnished as a dry, densified material or as a slurry. When necessary, coordinate the services of a technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.1.3   Fly Ash and Pozzolans

Fly ash is required as a supplementary cementitious material (SCM) conforming to ASTM C618, Class C or F with 4 percent maximum loss on ignition and 35 percent maximum cement replacement by weight.

2.1.4   Ground Granulated Blast-Furnace Slag

Ground granulated blast furnace slag is used as a supplementary cementitious material conforming to ASTM C989/C989M, Grade 120 with between 25 to 50 percent maximum cement replacement by weight.

2.1.5   Water

Furnish water potable or free of deleterious substances in amounts harmful to concrete or embedded metals.

2.1.6   Aggregates

2.1.6.1   Selection

Furnish aggregates conforming to ASTM C33/C33M. Provide aggregates not containing any substance, which may be deleteriously reactive with the alkalies in the cement.

2.1.6.2   Aggregates for Lightweight Concrete

ASTM C330

2.1.7   Admixtures

2.1.7.1   Air-Entraining

ASTM C260/C260M
2.1.7.2 Accelerating, Retarding, Water Reducing Moderate to High

ASTM C494/C494M

2.1.7.3 Pigments

Non-fading and lime-resistant

2.1.8 Reinforcement

2.1.8.1 Reinforcing Bars

a. Deformed Billet-steel: ASTM A615/A615M
b. Deformed Low-alloy steel: ASTM A706/A706M

2.1.8.2 Reinforcing Wire

a. Plain Wire: ASTM A82/A82M
b. Deformed Wire: ASTM A496/A496M

2.1.8.3 Welded Wire Fabric

a. Plain Wire: ASTM A185/A185M
b. Deformed Wire: ASTM A497/A497M

2.1.8.4 Epoxy Coated Reinforcement

a. Reinforcing Bars: ASTM A775/A775M
b. Wires and Fabric: ASTM A884/A884M

2.1.8.5 Galvanized Reinforcement

Provide galvanized reinforcement conforming to ASTM A767/A767M.

2.1.9 Synthetic Fiber Reinforcement

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 2 inch.

2.1.10 Inserts and Embedded Metal

All items embedded in concrete shall be of the type required for the intended task, and meet the following standards.

a. Structural Steel Plates, Angles, etc.: ASTM A36/A36M
b. Hot-dipped Galvanized: ASTM A153/A153M
   c. Proprietary Items: In accordance with manufacturers published literature

2.1.11 Accessories

Submit proper installation instructions and relevant product data for items including, but not limited to, sealants, gaskets, connectors, steps, cable racks and other items installed before or after delivery.


b. External Sealing Bands for Noncircular Sewer, Storm Drain and
Culvert Pipe: ASTM C877.

c. Preformed Flexible Joint Sealants for Concrete Pipe, Manholes, and Manufactured Box Sections: ASTM C990.
d. Elastomeric Joint Sealants: ASTM C920

2.1.12 Pipe Entry Connectors

Pipe entry connectors shall conform to ASTM C923 or ASTM C1478.

2.1.13 Grout

Nonshrink Grout shall conform to ASTM C1107/C1107M. Cementitious grout shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method.

PART 3 EXECUTION

3.1 FABRICATION AND PLACEMENT

Perform fabrication in accordance with NPCA QC Manual and/or ACPA QPC unless specified otherwise.

3.1.1 Forms

Use forms, for manufacturing precast concrete products, of the type and design consistent with industry standards and practices. They should be capable of consistently providing uniform products and dimensions. Construct forms so that the forces and vibrations to which the forms will be subjected can cause no product damage. Clean forms of concrete build-up after each use. Apply form release agents according to the manufacturers recommendations and do not allow to build up on the form casting surfaces.

3.1.2 Reinforcement

Follow applicable ASTM Standard or ACI 318 for placement and splicing. Fabricate cages of reinforcement either by tying the bars, wires or welded wire fabric into rigid assemblies or by welding, where permissible, in accordance with AWS D1.4/D1.4M. Position reinforcing as specified by the design and so that the concrete cover conforms to requirements. The tolerance on concrete cover shall be one-third of that specified but not more than 1/2 inch. Provide concrete cover not less than 1/2 inch. Take positive means to assure that the reinforcement does not move significantly during the casting operations.

3.1.3 Embedded Items

Position embedded items at locations specified in the design documents. Perform welding in accordance with AWS D1.1/D1.1M when necessary. Hold rigidly in place inserts, plates, weldments, lifting devices and other items to be imbedded in precast concrete products so that they do not move significantly during casting operations. Submit product data sheets and proper installation instruction for anchors, lifting inserts and other devices. Clearly indicate the products dimensions and safe working load.
3.1.4 Synthetic Fiber Reinforced Concrete

Add fiber reinforcement to the concrete mix in accordance with the applicable sections of ASTM C1116/C1116M and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

3.2 CONCRETE

3.2.1 Concrete Mixing

Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

3.2.2 Concrete Placing

Deposit concrete into forms as near to its final location as practical. Keep the free fall of the concrete to a minimum. Consolidate concrete in such a manner that segregation of the concrete is minimized and honeycombed areas are kept to a minimum. Use vibrators to consolidate concrete with frequencies and amplitudes sufficient to produce well consolidated concrete.

3.2.2.1 Cold Weather Concreting

Perform cold weather concreting in accordance with ACI 306.1.

a. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather.

b. Free from frost all concrete materials and all reinforcement, forms, fillers, and ground with which concrete is to come in contact.

c. Do not use frozen materials or materials containing ice.

d. In cold weather the temperature of concrete at the time of placing shall not be below 45 degrees F. Discard concrete that freezes before its compressive strength reaches 500 psi.

3.2.2.2 Hot Weather Concreting

Recommendations for hot weather concreting are given in detail in ACI 305R. During hot weather, give proper attention to constituents, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure. The temperature of concrete at the time of placing shall not exceed 90 degrees F.

3.2.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing.

3.2.3.1 Curing by Moisture Retention

Prevent moisture evaporation from exposed surfaces until adequate strength for stripping is reached by one of the following methods:

a. Cover with polyethylene sheets a minimum of 6 mils thick in accordance with ASTM C171.
b. Cover with burlap or other absorptive material and keep continually moist.

c. Use of a membrane-curing compound applied at a rate not to exceed 200 square ft/gallon, or in accordance with manufacturers' recommendations according to ASTM C309.

3.2.3.2 Curing with Heat and Moisture

Do not subject concrete to steam or hot air until after the concrete has attained its initial set. Apply steam, if used, within a suitable enclosure, which permits free circulation of the steam in accordance with CSA A23.4. If hot air is used for curing, take precautions to prevent moisture loss from the concrete. The temperature of the concrete shall not be permitted to exceed 150 degrees F. These requirements do not apply to products cured with steam under pressure in an autoclave.

3.2.4 Surface Finish

Finish unformed surfaces of wet-cast precast concrete products as specified. If no finishing procedure is specified, finish such surfaces using a strike-off to level the concrete with the top of the form.

3.2.4.1 Formed Non-Architectural Surfaces

Cast surfaces against approved forms following industry practices in cleaning forms, designing concrete mixes, placing and curing concrete. Normal color variations, form joint marks, small surface holes caused by air bubbles, and minor chips and spalls will be accepted but no major imperfections, honeycombs or other major defects will be permitted.

3.2.4.2 Unformed Surfaces

Finish unformed surfaces with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be accepted but no major imperfections, honeycombs, or other major defects shall be permitted.

3.2.4.3 Special Finishes

Troweled, broom or other finishes shall be according to the requirements of project documents and performed in accordance with industry standards or supplier specifications. Submit finishes for reviewal when required by the project documents. The sample finishes shall be reviewed prior to the start of production.

3.2.5 Stripping Products from Forms

Do not remove products from the forms until the concrete reaches the compressive strength for stripping required by the design. If no such requirement exists, products may be removed from the forms after the final set of concrete provided that stripping damage is minimal.

3.2.6 Patching and Repair

No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.
3.2.6.1 Repairing Minor Defects
Defects that will not impair the functional use or expected life of a precast concrete product may be repaired by any method that does not impair the product.

3.2.6.2 Repairing Honeycombed Areas
When honeycombed areas are to be repaired, remove all loose material and cut back the areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Use proprietary repair materials in accordance with the manufacturer's instructions. If a proprietary repair material is not used, saturate the area with water. Immediately prior to repair, the area should be damp, but free of excess water. Apply a cement-sand grout or an approved bonding agent to the chipped surfaces, followed immediately by consolidating an appropriate repair material into the cavity.

3.2.6.3 Repairing Major Defects
Evaluate, by qualified personnel, defects in precast concrete products which impair the functional use or the expected life of products to determine if repairs are feasible and, if so, to establish the repair procedure.

3.2.7 Shipping Products
Do not ship products until they are at least 5 days old, unless it can be shown that the concrete strength has reached at least 75 percent of the specified 28-day strength, or that damage will not result, impairing the performance of the product.

3.3 INSTALLATION
3.3.1 Site Access
It is the Contractor's responsibility to provide adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete products.

3.3.2 General Requirements
a. Install precast concrete products to the lines and grades shown in the contract documents or otherwise specified.

b. Lift products by suitable lifting devices at points provided by the precast concrete producer.

c. Install products in accordance with the precast concrete producer's instructions. In the absence of such instructions, install underground utility structures in accordance with ASTM C891. Install pipe and manhole sections in accordance with the procedures outlined by the American Concrete Pipe Association.

d. Field modifications to the product will relieve the precast producer of liability even if such modifications result in the failure of the product.
3.3.3 Water Tightness

Where water tightness is a necessary performance characteristic of the precast concrete product's end use, watertight joints, connectors and inserts should be used to ensure the integrity of the entire system.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Tests

When water tightness testing is required for an underground product, use one of the following methods:

3.4.2 Vacuum Testing

Prior to backfill vacuum test system according to ASTM C1244.

3.4.3 Water Testing

Perform water testing according to the contract documents and precast concrete producer's recommendations.

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DIVISION 03 - CONCRETE

SECTION 03 52 01

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

03/10

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-- End of Section Table of Contents --
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 C940 (2010a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory


1.2   SUMMARY

This section specifies ready-mix Controlled Low Strength Material for the following applications:
1. Encasement of pipe crossings through the levee embankment.

1.3 RELATED SECTIONS

Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

Storm Drainage, Irrigation, Gravity, Section 33 40 00

1.4 DEFINITIONS

A. Ready-mix Controlled Low Strength Material is used for utility pipe back fill, and is also known as controlled density fill or flowable fill. Controlled Low Strength Material differs from Portland cement concrete as it contains a low cementitious content to reduce strength development for possible future removal. Chemical admixtures may also be used in Controlled Low Strength Material to modify performance properties of strength, flow, set and permeability. Pumpable mixes are available.

B. Controlled Low Strength Material shall be may be either machine tool or hand tool excavatable at minimum compressive strength of 50 psi and maximum compressive strength of 300 psi (1.5 MPa) maximum at 28 days.

1.5 SUBMITTALS

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

SD-05 Design Data
Mix design for the Controlled Low Strength Material
Pipe Bracing
Submit design of proposed pipe bracing system to prevent pipe floatation during installation of Controlled Low Strength Material. Provide buoyancy calculations and bracing requirements of the resisting members.

1.6 QUALITY ASSURANCE

1.6.1 Manufacturer

Controlled Low Strength Material shall be manufactured by a ready-mix concrete producer with a minimum of 1 year experience in the production of similar products.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver and handle in strict compliance with manufacturer's recommendations. Protect from damage due to weather, excessive temperatures, and construction operations.

1.8 PROJECT CONDITIONS

Perform work only when existing and forecasted weather conditions are

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within the limits established by the manufacturer of the materials and products used.

PART 2   PRODUCTS

2.1   MANUFACTURER

2.1.1   Controlled Low Strength Material

Provide Controlled Low Strength Material manufactured by a ready-mix concrete producer experienced in the design and control of flowable mixtures. Manufacturer shall provide mixtures meeting performance properties specified herein.

2.1.2   Stable-Air Generator Admixture

Provide Stable-Air Generator admixture DaraFill by Grace Construction Products, or Agency reviewed equal, for Controlled Low Strength Material meeting specified requirements.

2.2   MATERIALS

2.2.1   Portland Cement

Portland Cement: ASTM C150/C150M.

2.2.2   Aggregate

Provide material meeting the requirements of ASTM C33/C33M.

2.2.3   Other Admixtures

Provide material meeting the requirements of ASTM C494/C494M.

2.2.4   Pozzolanic Materials

Fly ash meeting ASTM C618 requirements is allowable.

2.2.5   Water

Water shall be potable and free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete or reinforcement.

2.3   CONTROLLED LOW STRENGTH MATERIAL MIXTURE

2.3.1   Mix Design

Mix design shall produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place.

2.3.2   Mix Compressive Strength

Provide mix with compressive strength of minimum 30 psi and maximum 300 psi according to ASTM D4832 at 28 days after placement.
2.3.3 Mix Permeability

Provide mix with maximum permeability of $1 \times 10^{-6}$ cm/sec at fourteen (14) days after placement.

2.3.4 Final Bleeding

Controlled Low Strength Material shall have minimal subsidence and bleed water which is measured as a Final Bleeding of less than 2.0 percent (retains 98.0 percent of original height after placement, approximately 1/4 inch per foot of depth) per ASTM C940.

2.3.5 Fresh Unit Weight

The fresh unit weight shall be 90 - 110 lbs/ft³ (1600 - 1760 kg/m³), except where specified, and in the absence of strength data the cementitious content shall be a maximum of 150 lbs/cy (90 kg/m³).

2.3.6 Control Density Fill

Control Density Fill shall have an in-place yield of 98% of design yield.

PART 3 EXECUTION

3.1 EXAMINATION

Examine conditions of substrates and other conditions under which work is to be performed and notify Agency, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 APPLICATION OF CONTROL DENSITY FILL

A. Secure pipe to be encased in Controlled Low Strength Material to prevent displacement during placement. The percentage reduction in hydrostatic pressure achieved with the use of a Stable Air Generator may be used to calculate anchorage requirements.

B. The pipe shall be braced as recommended by the pipe manufacturer to prevent floatation when placing the Controlled Low Strength Material.

C. Place Controlled Low Strength Material in separate lifts as recommended by the pipe manufacturer to prevent the pipe from floating during installation.

3.3 PROTECTION

Protect Controlled Low Strength Material from traffic until sufficient strength has been achieved for further construction or traffic operations.

3.4 QUALITY-CONTROL TESTING DURING CONSTRUCTION

Concrete shall be sampled and tested for quality control by the Contractor during the placement of the concrete as follows:

<table>
<thead>
<tr>
<th>REQUIREMENT</th>
<th>TEST METHOD</th>
<th>NUMBER OF TESTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling fresh</td>
<td>ASTM C172</td>
<td>As required</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete</td>
<td>except modified for slump per ASTM C94/C94M</td>
</tr>
<tr>
<td>Slump test</td>
<td>ASTM C143/C143M One for each concrete load at point of discharge and one for each set of compressive strength tests</td>
</tr>
<tr>
<td>Air content by pressure method</td>
<td>ASTM C231/C231M One for each set of compressive strength tests</td>
</tr>
<tr>
<td>Compression test specimens</td>
<td>ASTM D5971 One set of six standard cylinders for each compressive strength test</td>
</tr>
<tr>
<td>Concrete temperature</td>
<td>Hourly when air temperature is 40 degrees F or below and 80 degrees F or above; each time a set of compression test specimens is made</td>
</tr>
<tr>
<td>Compressive strength test</td>
<td>ASTM D4832 One set for each 50 cubic yards or fraction thereof of placed in any one day; two specimens tested at 7 days, three specimens tested at 28 days and one specimen retained in reserve for testing if required</td>
</tr>
<tr>
<td>Permeability test</td>
<td>ASTM D5084 One set for each 50 cubic yards or fraction thereof of placed in any one day</td>
</tr>
</tbody>
</table>

Test reports for concrete for Chemical Composition, Mechanical Usability and Soundness shall be submitted by the Contractor meeting all design Specifications as required by referenced standards within this section.

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WELDING

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SECTION 05 05 23

WELDING

11/08

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 SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A (2011; Text Correction 2013) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

AMERICAN WELDING SOCIETY (AWS)


AWS A3.0M/A3.0 (2010) Standard Welding Terms and Definitions

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel


AWS D1.4/D1.4M (2011) Structural Welding Code - Reinforcing Steel


ASTM INTERNATIONAL (ASTM)


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1.2 DEFINITIONS

Definitions of welding terms are in accordance with AWS A3.0M/A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class) indicate the project's class(es) of weld joints.

1.2.1 Class 1 Weld Joints

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

1.2.2 Class 2 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

1.2.3 Class 3 Weld Joints

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

1.2.4 Class 4 Weld Joints

This covers weld joints applicable to welding reinforcing steel to primary structural members.

1.2.5 Class 5 Weld Joints

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

1.2.6 Class 6 Weld Joints

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

1.3 SYSTEM DESCRIPTION

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Engineer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.
1.3.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor’s welding production and inspection personnel and appropriate Agency personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.4 SUBMITTALS

Agency approval is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-03 Product Data
- Welding Procedure Qualifications; EN
- Welder, Welding Operator, and Tacker Qualification
- Inspector Qualification
- Previous Qualifications
- Pre-qualified Procedures

SD-06 Test Reports
- Quality Control
  - Nondestructive Examination; EN

SD-07 Certificates
- Certified Welding Procedure Specifications (WPS)
- Certified Brazing Procedure Specifications (BPS)
- Certified Procedure Qualification Records (PQR)
- Certified Welder Performance Qualifications (WPQ)
- Certified Brazer Performance Qualifications (BPQ)

1.5 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of
AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

1.5.1 General Requirements

To perform this work, the contractor shall provide a full time welding inspector whenever there is welding to be performed. The welding inspector shall have prior inspection experience on the type of welding be performed (i.e. pipe welding inspection) and shall be a CWI in accordance with the provisions of AWS QC1.

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

(2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

(3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

(1) Submit for review to the Engineer two copies of Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) within fifteen calendar days after receipt of Notice to Proceed.

(2) Cranes: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.1/D14.1M.

(3) Submit for review to the Engineer two copies of Certified Welder Performance Qualifications (WPQ) and Certified Brazer Performance Qualifications (BPQ) within fifteen calendar days prior to any employee welding on the project material.

(4) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.5.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor’s approved quality control organization.

b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.

1.5.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test results, including those of test welds that failed to meet the requirements, with the welding procedure.

1.5.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.5.5.1 Previous Personnel Qualifications

At the discretion of the Engineer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.

b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.

c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.

d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests.
Keep the certification current, on file, and furnish 3 copies.

1.5.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.

b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.

c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.

d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

1.5.6 Inspector Qualification

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.5.7 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe welding practices and safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.
PART 3  EXECUTION

3.1  WELDING OPERATIONS

3.1.1  Requirements

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

3.1.2  Identification

Identify all welds in one of the following ways:

a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.

b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Engineer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

3.2  QUALITY CONTROL

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual and radiographic, ultrasonic, and dye penetrant inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M, ASTM E165/E165M, ASTM E709, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," are acceptable. Submit a quality assurance plan and records of tests and inspections.

3.3  STANDARDS OF ACCEPTANCE

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection ultrasonic, or dye penetrant methods. The minimum extent of nondestructive testing shall be random 10 percent of welds or joints, as indicated on the drawings.

3.3.1  Nondestructive Examination

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Agency reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

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3.3.2 Destructive Tests

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 AGENCY INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Agency will perform inspection and testing for acceptance to the extent determined by the Engineer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Agency if the welds are satisfactory. The work may be performed by the Agency's own forces or under a separate contract for inspection and testing. The Agency reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

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STRUCTURAL STEEL
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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 INSTITUTE OF STEEL CONSTRUCTION (AISC)
AISC 201 (2006) AISC Certification Program for Structural Steel Fabricators
AISC 326 (2009) Detailing for Steel Construction

AMERICAN WATER WORKS ASSOCIATION (AWWA)
AWWA C200 (2012) Steel Water Pipe - 6 In. (150 mm) and Larger
AWWA C300 (2011) Reinforced Concrete Pressure Pipe, Steel-Cylinder Type

AMERICAN WELDING SOCIETY (AWS)
AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)
ASME B46.1 (2009) Surface Texture, Surface Roughness, Waviness and Lay

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<table>
<thead>
<tr>
<th>ASTM Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A193/A193M</td>
<td>(2012a) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications</td>
</tr>
<tr>
<td>ASTM A500/A500M</td>
<td>(2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes</td>
</tr>
</tbody>
</table>
Structural Steel


ASTM C827/C827M (2010) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures


ASTM F436 (2011) Hardened Steel Washers

ASTM F844 (2007a) Washers, Steel, Plain (Flat), Unhardened for General Use

ASTM F959 (2013) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2000; E 2004) Shop, Field, and Maintenance Painting of Steel

SSPC PS 13.01 (1982; E 2004) Epoxy Polyamide Painting System

SSPC Paint 25 (1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

SSPC SP 3 (1982; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning
1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including galvanizing, complete and ready for use. The stairways in the positive closure structure, steel pipe welding, and any other steel work are covered by this section. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 360 and AISC 341 except as modified in this contract.

1.3 SUBMITTALS

Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Pins and rollers

AISC Quality Certification

Overhead, top running crane rail beam

Welding procedures and qualifications; EN

1.4 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified Category Std fabrication plant.

1.5 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with AISC 341.

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit fabrication drawings for reviewal prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with
OSHA 29 CFR 1926.756(c)(1) shall be shown on the shop drawings, reviewed by the structural engineer of record. Use AWS A2.4 standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.6.2  Certifications

1.6.2.1  Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance requirements, area out of tolerance and proposed corrective measures.

1.6.2.2  Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing.

1.6.2.3  Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2  PRODUCTS

2.1  STEEL

2.1.1  Structural Steel

ASTM A36/A36M.

2.1.2  High-Strength Structural Steel

2.1.2.1  Low-Alloy Steel

ASTM A572/A572M, Grade 50.

2.1.2.2  Quenched and Tempered Alloy Steel

ASTM A514/A514M.

2.1.3  Weathering Structural Steel

ASTM A242/A242M, Type 1; ASTM A588/A588M.
2.1.4 Structural Grade Carbon-Manganese Steel

ASTM A529/A529M, high strength carbon-manganese steel of structural quality.

2.1.5 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A992/A992M.

2.1.6 Structural Steel Tubing

ASTM A500/A500M, Grade B; ASTM A501; ASTM A618/A618M, Grade II.

2.1.7 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard).

AWWA C200

AWWA C300

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel, Steel Pipe

2.2.1.1 Bolts

ASTM A307, Grade A; ASTM A325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers


2.2.2 High-Strength Structural Steel and Structural Steel Tubing

2.2.2.1 Bolts

ASTM A325, Type 1 ASTM A490, Type 1 or 2.

2.2.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F436, plain carbon steel.
2.2.3 Weathering Structural Steel

2.2.3.1 Bolts

ASTM A325, Type 3; ASTM A490, Type 3.

2.2.3.2 Nuts

ASTM A563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A325 bolts.

2.2.3.3 Washers

ASTM F436, weathering steel.

2.2.4 Foundation Anchorage

2.2.4.1 Anchor Bolts

ASTM F1554. Stainless steel ASTM A193/A193M.

2.2.4.2 Anchor Nuts

ASTM A563, Grade A, hex style. Stainless steel ASTM A193/A193M.

2.2.4.3 Anchor Washers

ASTM F844. Stainless steel Type 304 conforming to ASTM A276.

2.2.4.4 Anchor Plate Washers

ASTM A36/A36M Stainless steel Type 304 conforming to ASTM A276.

2.2.5 Load Indicator Washers

ASTM F959. Provide ASTM B695, Class 50, Type 1 galvanizing.

2.2.6 Load Indicator Bolts

ASTM A325, Type 1; ASTM A490, Type 1, with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

2.2.7 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.
2.3.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 FABRICATION

2.5.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded or on surfaces of weathering steels that will be exposed in the completed structure. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.5.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive epoxy coatings, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless reviewed otherwise by the Engineer.

2.5.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.5.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.
2.5.3 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

2.6 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC 201 for Category Supplement structural steelwork.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6/A6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC 201 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the review of the Engineer.

3.2 INSTALLATION

3.3 ERECTION

a. Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC 325. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

b. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and the structure shall be erected in accordance with AISC DESIGN GUIDE 10.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.
3.4 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.4.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Engineer for further instructions.

3.4.2 High-Strength Bolts

ASTM A325 and ASTM A490 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4.2.1 Installation of Load Indicator Washers (LIW)

ASTM F959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F436 washers under both the bolt head and nut when ASTM A490 bolts are used.

3.5 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after reviewal has been obtained from the Engineer.

3.6 WELDING

AWS D1.1/D1.1M, except use only shielded metal arc welding and low hydrogen electrodes for ASTM A514/A514M steel. Do not stress relieve ASTM A514/A514M steel by heat treatment. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and takers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for reviewal.
3.6.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.7 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.7.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Engineer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns. The inspections shall apply to the welding of Steel Pipes addressed in Section 33 11 00 and Section 33 40 00.

3.8.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be selected by the Engineer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as reviewed by the Engineer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair. The nondestructive testing shall apply to the welding of Steel Pipes addressed in Section 33 11 00 and Section 33 40 00. The Agency reserves the right to perform QA testing from no testing to the same frequency as the contractor QC testing.

Testing frequency: Provide the following types and number of tests:

<table>
<thead>
<tr>
<th>Test Type</th>
<th>Number of Tests</th>
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</thead>
<tbody>
<tr>
<td>Radiographic</td>
<td>10 Percent</td>
</tr>
<tr>
<td>Ultrasonic</td>
<td>10 Percent</td>
</tr>
<tr>
<td>Magnetic Particle</td>
<td>10 Percent</td>
</tr>
</tbody>
</table>

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Test Type       Number of Tests
Dye Penetrant                     100 Percent

3.8.2 Load Indicator Washers

3.8.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F959.

3.8.3 High-Strength Bolts

3.8.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. The inspections shall apply to the welding of Steel Pipes addressed in Section 33 11 00 and Section 33 40 00.

3.8.3.2 Inspection

Inspection procedures shall be in accordance with AISC 360. Confirm and report to the Engineer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned. The inspections shall apply to the welding of Steel Pipes addressed in Section 33 11 00 and Section 33 40 00.

The Contractor shall inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use; and calibration of torque wrenches for high-strength bolts.

3.8.3.3 Testing

The Agency has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Engineer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.
3.8.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.

3.9 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01 45 35 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

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DIVISION 05 - METALS

SECTION 05 50 13

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-- End of Section Table of Contents --
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.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)


AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1 (2012) Square and Hex Bolts and Screws (Inch Series)


ASTM INTERNATIONAL (ASTM)


ASTM A500/A500M  (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes


ASTM A653/A653M  (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


ASTM C1513  (2013) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections

ASTM D1187/D1187M  (1997; E 2011; R 2011) Asphalt-Base
Emulsions for Use as Protective Coatings for Metal

MASTER PAINTERS INSTITUTE (MPI)

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)


THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3 (1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

1.2 SUBMITTALS

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

SD-02 Shop Drawings
Cover plates and frames, installation drawings
Expansion joint covers, installation drawings
Floor gratings and roof walkways, installation drawings

SD-04 Samples
Expansion joint covers
Control-joint covers
Provide full size samples, taken from manufacturer's stock, and be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.
PART 2   PRODUCTS

2.1   MATERIALS

2.1.1   Structural Carbon Steel
   ASTM A36/A36M.

2.1.2   Structural Tubing
   ASTM A500/A500M.

2.1.3   Steel Pipe
   ASTM A53/A53M, Type E or S, Grade B.

2.1.4   Fittings for Steel Pipe
   Standard malleable iron fittings ASTM A47/A47M.

2.1.5   Gratings
   c. Metal bar type grating NAAMM MBG 531 and NAAMM MBG 532.

2.1.6   Floor Plates, Patterned
   Floor plate ASTM A786/A786M. Steel plate shall not be less than 14 gage.

2.1.7   Anchor Bolts
   ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.7.1   Lag Screws and Bolts
   ASME B18.2.1, type and grade best suited for the purpose.

2.1.7.2   Toggle Bolts
   ASME B18.2.1.

2.1.7.3   Bolts, Nuts, Studs and Rivets
   ASME B18.2.2 or ASTM A307.

2.1.7.4   Powder Actuated Fasteners
   Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.5   Screws
   ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.
2.1.7.6 Washers

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

2.1.8 Aluminum Alloy Products

Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as reviewed by Engineer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

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

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45. Unless otherwise specified, provide all other aluminum items with a hand sanded or machine finish to a 240 grit. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Provide a polished satin finish on items to be anodized.

2.3 FLOOR GRATINGS AND ROOF WALKWAYS

Design steel grating in accordance with NAAMM MBG 531 and NAAMM MBG 532 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a live load of 60 pounds per square foot for the spans indicated, with maximum deflection of L/240.

b. NAAMM MBG 532, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.

--or--

NAAMM MBG 532, band ends of gratings with bars of the same or greater thickness than the metal used for grating. Weld banding bars to the bearing bars or channels at least every fourth bar or channel and in every corner. Tack weld intervening bars or channels. Band diagonal or round cuts by welding bars of the same or greater thickness metal used for grating in accordance with the manufacturer's standard for trim unless otherwise indicated.

c. Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.

d. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.6.

2.4 GAS-TIGHT MANHOLE COVER AND FRAME

Provide a heavy duty type made of ductile cast-iron with bolted lid, machined bearing surfaces and gasket grooves, continuous neoprene gasket, counter sunk bronze hex head cap screws, and concealed watertight...
pickholes. Provide frame with a 30 inch diameter clear opening. Maximum weight of frame and cover together to be 530 pounds.

2.5 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide 6 inch prime coated extra strong weight steel pipe as specified in ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.6 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as required to support wall loads over openings. Provide with connections and fasteners. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A123/A123M.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be cope or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

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

3.4 BUILT-IN WORK

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

3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.8 CONTROL-JOINT COVERS

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides of joint throughout the entire length of cover.

3.9 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.10 WHEEL GUARDS

Anchor guards to concrete or masonry in accordance with manufacturer's instructions. Fill hollow cores solid with concrete with minimum compressive strength of 2500 psi.

3.11 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi.

-- End of Section --
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DIVISION 05 - METALS

SECTION 05 50 14

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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.

ALUMINUM ASSOCIATION (AA)


AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)


ANSI/AGMA 6001 (2008E) Design and Selection of Components for Enclosed Gear Drives

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2012; Errata 2011) Structural Welding Code - Steel


ASME INTERNATIONAL (ASME)

ASME B4.1 (1967; R 2009) Preferred Limits and Fits for Cylindrical Parts

ASME B46.1 (2009) Surface Texture, Surface Roughness, Waviness and Lay

ASME BPVC SEC IX (2010) BPVC Section IX-Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)


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ASTM E446 (2010) Radiographs for Steel Castings Up to 2 In. (51mm) in Thickness


ASTM E94 (2004; R 2010) Radiographic Examination

1.2 SUBMITTALS

Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
   Detail Drawings; EN

SD-03 Product Data
   Welding of Structural Steel; EN
   Welding of Aluminum; EN
   Structural Steel Welding Repairs; EN
   Materials Orders
   Materials List
   Shipping Bill

SD-06 Test Reports
   Tests, Inspections, and Verifications

SD-07 Certificates
   Qualification of Welders and Welding Operators
   Application Qualification for Steel Studs; EN
   Welding of Aluminum; EN
1.3 QUALITY ASSURANCE

1.3.1 Qualification of Welders and Welding Operators

Certify that the qualification of welders and welding operators and tack welders who will perform structural steel welding have been qualified for the particular type of work to be done in accordance with the requirements of AWS D1.1/D1.1M, Section 4, or ASME BPVC SEC IX, Section IX, prior to commencing fabrication.

a. List the qualified welders by name and specify the code and procedures under which qualified and the date of qualification within the certification. Prior qualification will be accepted if welders have performed satisfactory work under the code for which qualified within the preceding three months. Welders are required to repeat the qualifying tests when their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests will be recertified. Those not passing will be disqualified until passing. Contractor incurs all expenses in connection with qualification and requalification.

b. Perform welding of aluminum conforming to AA ADM or AWS D1.2/D1.2M, Sections 1 through 7, 9 and 10. The welding process and welding operators shall be prequalified as required by AWS D1.2/D1.2M, Section 5 or AA ADM, Subsection 7.2.4 in accordance with the methods described in ASME BPVC SEC IX, Section IX. Furnish for review a certified report giving the results of the qualifying tests, and a complete schedule of the welding process for each aluminum fabrication to be welded prior to commencing fabrication prior to commencing welding.

c. Maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding will be subjected to inspection to determine conformance with the requirements of AWS D1.1/D1.1M, the approved welding procedures and provisions stated in other sections of these specifications.

1.3.2 Detail Drawings

Submit detail drawings for metalwork and machine work, prior to fabrication, include within the detail drawings catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator and indicated on the detail drawings.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Materials Orders

Furnish six (6) copies of purchase orders, mill orders, shop orders and work orders for all materials orders prior to the use of the materials in the work. Where mill tests are required, purchase orders include the test site address and the name of the testing agency.
2.1.2 Materials List

Submit a list of the materials to be used in the fabrication of each item at the time of submittal of detail drawings.

2.1.3 Shipping Bill

Submit a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots. Promptly mail duplicate copies of shipping bills to Agency Office.

2.2 FABRICATION

2.2.1 Structural Fabrication

Material shall be straight before being laid off or worked. Perform straightening, if necessary, by methods that will not impair the metal. Sharp kinks or bends will be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Make bends using approved dies, press brakes or bending rolls. Where heating is required, take precautions to avoid overheating the metal and allow it to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material, other than structural steel, will be subject to reviewal and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Provide finished members free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

2.2.1.1 Dimensional Tolerances for Structural Work

Measure dimensions using an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled; component members without milled ends shall not deviate from the dimensions shown by more than 1/16 inch for members 30 feet or less in length, and by more than 1/8 inch for members over 30 feet in length.

2.2.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Prepare surfaces and edges in accordance with AWS D1.1/D1.1M, Subsection 3.2. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Chip, grind or machine to sound metal hand-guided cuts which are to be exposed or visible.
2.2.1.3 Structural Aluminum Fabrication

Lay out and cut aluminum in accordance with the AA ADM, Section 6.

2.2.2 Welding

2.2.2.1 Welding of Structural Steel

a. Welding Procedures for Structural Steel - Prequalify welding procedures for structural steel as described in AWS D1.1/D1.1M, Subsection 3.1 or qualify by tests as prescribed in AWS D1.1/D1.1M, Section 4. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish a welding procedure as prequalified. For welding procedures qualified by tests, the test welding and specimen testing will be witnessed and the test report document signed by the Engineer. Review of any welding procedure will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Contractor Officer. Submit a complete schedule of welding procedures for each steel structure to be welded prior to commencing fabrication. The schedule shall conform to the requirements specified in the provisions AWS D1.1/D1.1M, Sections 2, 3, 4, 6, 7 and applicable portions of Section 8. Provide within the schedule detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint. Include in the welding procedures filler metal, preheat, interpass temperature and stress-relief heat treatment requirements. Each welding procedure shall be clearly identified as being prequalified or required to be qualified by tests. Welding procedures shall show types and locations of welds designated or in the specifications to receive nondestructive examination.

b. Welding Process - Perform welding of structural steel by an electric arc welding process using a method which excludes the atmosphere from the molten metal and conforms to the applicable provisions of AWS D1.1/D1.1M. Minimize residual stresses, distortion and shrinkage from welding.

c. Welding Technique

(1) Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or be as shown where a specific choice of AWS specification allowables is required. Include the AWS designation of the electrodes to be used in the schedule of welding procedures. Use only low hydrogen electrodes for manual shielded metal-arc welding regardless of the thickness of the steel. Use a controlled temperature storage oven at the job site as prescribed by AWS D1.1/D1.1M, Subsection 3.5 to maintain low moisture of low hydrogen electrodes.

(2) Preheat and Interpass Temperature - Perform preheating as required by AWS D1.1/D1.1M, Subsection 3.5 or as otherwise specified except that the temperature of the base metal shall be at least 70 degrees F. Slowly and uniformly preheat the weldments by approved means to the prescribed temperature, held at that...
temperature until the welding is completed and then permitted to cool slowly in still air.

(3) Stress-Relief Heat Treatment - Where stress relief heat treatment is specified or shown, perform in accordance with the requirements of AWS D1.1/D1.1M, Subsection 5.8 unless otherwise authorized or directed.

d. Workmanship - Perform welding workmanship in accordance with AWS D1.1/D1.1M, Section 3 and other applicable requirements of these specifications.

(1) Preparation of Base Metal - Prior to welding inspect surfaces to be welded to ensure compliance with AWS D1.1/D1.1M, Subsection 3.2.

(2) Temporary Welds - Make temporary welds, required for fabrication and erection, under the controlled conditions prescribed for permanent work. Make temporary welds using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Conduct preheating for temporary welds as required by AWS D1.1/D1.1M for permanent welds except that the minimum temperature shall be 120 degrees F in any case. In making temporary welds, arcs shall not be struck in other than weld locations. Remove each temporary weld and grind flush with adjacent surfaces after serving its purpose.

(3) Tack Welds - Subject tack welds that are to be incorporated into the permanent work to the same quality requirements as the permanent welds; clean and thoroughly fuse them with permanent welds. Perform preheating as specified above for temporary welds. Multiple-pass tack welds shall have cascaded ends. Remove defective tack welds before permanent welding.

2.2.2.2 Welding of Steel Castings

Remove unsound material from the surfaces of steel castings, to be incorporated into welded connections, by chipping, machining, air-arc gouging or grinding. Do not weld major connections designed for transfer of stresses if the temperature of the casting is lower than 100 degrees F. Castings containing over 0.35 percent carbon or over 0.75 percent manganese shall be preheated to a temperature not to exceed 450 degrees F and conduct welding while the castings are maintained at a temperature above 350 degrees F. Welding will not be permitted on castings containing carbon in excess of 0.45 percent except on written authorization. Castings requiring welding repairs after the first annealing and castings involving welding fabrication shall be stress-relieved annealed prior to receiving final machining unless otherwise permitted.

2.2.2.3 Welding of Steel Studs

Conform to the requirements of AWS D1.1/D1.1M, Section 7, except as otherwise specified for the procedures for welding steel studs to structural steel, including mechanical, workmanship, technique, stud application qualification, production quality control and fabrication and verification inspection procedures.

a. Application Qualification for Steel Studs - As a condition of reviewal of the stud application process, furnish certified test reports and certification that the studs conform to the requirements of
AWS D1.1/D1.1M, Subsections 7.2 and 7.3, certified results of the stud manufacturer's stud base qualification test, and certified results of the stud application qualification test as required by AWS D1.1/D1.1M, Subsection 7.6, prior to commencing fabrication, except as otherwise specified.

b. Production Quality Control - Conform to the requirements of AWS D1.1/D1.1M, Subsection 7.7, except as otherwise specified for quality control for production welding of studs. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production studs (flat, vertical, overhead or sloping). If the reduction of the length of studs becomes less than normal as they are welded, stop welding immediately and do not resume until the cause has been corrected.

2.2.3 Bolted Connections

2.2.3.1 Bolted Structural Steel Connections

Provide bolts, nuts and washers of the type specified or indicated. Equip all nuts with washers except for high strength bolts. Use beveled washers where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated, the materials, workmanship and installation shall conform to the applicable provisions of ASTM A325 or ASTM A490.

a. Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

b. Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and not be more than 1/16 inch larger than the diameter of the bolt.

c. Holes for fitted bolts shall be match-reamed or drilled in the shop. Remove burrs resulting from reaming. Keep bolt threads entirely outside of the holes. The body diameter of bolts shall have tolerances as recommended by ASME B4.1for the class of fit specified. Place fitted bolts in reamed holes by selective assembly to provide an LN-2 fit.

d. Holes for high strength bolts shall not have diameters more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts, the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.

2.2.3.2 Bolted Aluminum Connections

Conform to the requirements of AA ADM, Section 6 for punching, drilling, reaming and bolting for bolted aluminum connections.

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2.2.4 Riveted Connections

2.2.4.1 Riveted Structural Steel Connections

a. Rivet Holes - Rivet holes shall be accurately spaced, cylindrical, perpendicular to the member and 1/16 inch larger than the diameter of the rivet. Countersinking shall be true and square with the hole. If the thickness of the material is not greater than the diameter of the rivet, the holes may be punched full size. If the thickness of the material is greater than the diameter of the rivet, drill the holes full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the rivet and then reamed to full size in accordance with the following provisions unless otherwise specified or authorized. For shop connections, rivet holes may be drilled full size if the component parts to be riveted are welded, bolted or clamped together before drilling of rivet holes. For field connections the holes required to be subpunched or subdrilled shall be reamed in the shop if the work is assembled and matchmarked in the shop. For field connections not assembled in the shop, the holes required to be subpunched or subdrilled will be reamed in the field after the work has been assembled and bolted together.

(1) Punched Holes - Punching shall be accurate. The diameter of the punch is not to be more than 1/16 inch greater than the diameter of the rivet. The diameter of the die opening is not to be more than 1/16 inch greater than the diameter of the punch. Holes shall be clean cut without torn or ragged edges.

(2) Reamed and Drilled Holes - Reaming and final drilling is to be done with the component parts of the member assembled and firmly fastened together. Use twist drills for drilling. Use short taper reamers having not less than four flutes for reaming. Make reamed holes smooth by the reamer touching the entire circumference of the hole. Remove outside burrs on reamed holes to the extent of making a 1/16 inch chamfer.

(3) Accuracy of Punched and Drilled Holes - The accuracy of holes punched or drilled full size shall be such that for assembled components with a group of contiguous holes in the same plane 75 percent of the holes will admit a rod equal to the diameter of the cold rivet at right angles to the plane of the connection. The accuracy of holes required to be reamed or drilled after assembly will be such that any group of contiguous holes in the same plane show no offset greater than 1/32 inch between adjacent thicknesses of metal. Drifting to enlarge holes is not allowed. Poor matching of holes will be cause for rejection. Reaming to a larger diameter for the next standard size rivet will be allowed for slight mismatching.

b. Driving Rivets - Pin and firmly draw together with bolts all components to be riveted before commencing. Heat Rivets uniformly to a light cherry red color at a temperature not over 1950 degrees F in a gas, oil or electric furnace constructed so that it can be adjusted to the proper temperature except that an approved coal or coke furnace may be used for heating field rivets. Do not drive rivets after their temperature falls below 1000 degrees F. When heated and ready for driving, rivets shall be free from slag, scale and adhesive materials. Hot drive rivets with pressure tools. Completely fill the holes with driven rivets. Neatly form rivet heads with dies of approved shape and
full size, concentric with the rivet hole and in full contact with the member. Remove loose, burned, badly formed or otherwise defective rivets and replace with care to avoid damage to adjacent metal. Recupping or caulking will not be permitted. Chip or grind flush countersunk rivet with the surface of the plate unless otherwise specified or authorized. Do not paint field rivets until they have been inspected and accepted.

2.2.4.2 Riveted Aluminum Connections

Conform to the requirements of AA ADM, Section 6 for punching, drilling, reaming and riveting for riveted aluminum connections.

2.2.5 Patterns

Take care to avoid sharp corners or abrupt changes in cross section; ample fillets are to be used in the construction of patterns. Add, as required, draft and increases in pattern thicknesses to conform to the standard foundry practice applied and as necessary to ensure that all metal thicknesses of the finished castings conform to the dimensions shown and are within the tolerances specified in paragraph INSPECTION OF STEEL CASTINGS.

2.2.6 Castings

Each casting and castings weighing more than 500 required pounds shall bear cast or stamped heat numbers. Deviations from the dimensions of castings shown shall not exceed amounts that will impair the strength of castings by more than 10 percent as computed from the dimensions shown. Dimensions of castings shown on approved detail drawings are finished dimensions. Castings that are warped or otherwise distorted or that are oversized to an extent that will interfere with proper fit with other parts of the machinery or structure will be rejected. The structure of metal in castings shall be homogeneous and free from excessive nonmetallic inclusions. Excessive segregation of impurities or alloys at critical points in castings will be cause for rejection. Do not make repairs to castings prior to reviewal. Minor surface imperfections not affecting the strength of casting may be welded in the "green" if approved. Surface imperfections will be considered minor when the depth of the cavity prepared for welding is the lesser of 20 percent of the actual wall thickness or 1 inch. Defects other than minor surface imperfections may be welded only when specifically authorized in accordance with the following requirements:

a. The defects have been entirely removed and are judged not to affect the strength, use or machineability of the castings when properly welded and stress relieved.

b. The proposed welding procedure, stress relief and method of examination of the repair work have been submitted and reviewed.

2.2.7 Machine Work

Tolerances, allowances and gauges for metal fits between plain, non-threaded, cylindrical parts shall conform to ASME B4.1 for the class of fit shown or required unless otherwise shown on approved detail drawings. Where fits are not shown they will be suitable as approved. Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock will be allowed on placing...
pads to ensure true surfaces of solid material. Provide finished contact or bearing surfaces true and exact to secure full contact. Polish journal surfaces and finish all surfaces with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be interchangeable with like parts. Accurately locate all drilled holes bolts.

2.2.7.1 Finished Surfaces

Provide surface finishes, indicated or specified, in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microrinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified use that which is most suitable for the particular surface, provide the class of fit required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for rejection.

2.2.7.2 Unfinished Surfaces

Lay out all work to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces chip and grind smooth or machine to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and be chipped or ground free of all projections and rough spots. Fill in depressions or holes not affecting the strength or usefulness of the parts in an approved manner.

2.2.7.3 Pin Holes

Pin holes are to be bored true to gauges, smooth, straight and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

2.2.7.4 Gears

Provide gears that have machine cut teeth of a form conforming to applicable design requirements of ANSI/AGMA 2005 and ANSI/AGMA 6001 unless otherwise specified or shown.

2.2.7.5 Shafting

Turn or grind shafting with hot-rolled or cold-rolled steel, as required, unless otherwise specified or authorized. Provide fillets where changes in section occur. Cold-finished shafting may be used where keyseating is the only machine work required.

2.2.7.6 Bearings

Bearings may be lined with babbit or bronze unless otherwise specified or
shown. Where the bearing pressure is in excess of 200 psi, bearings shall be lined with bronze. Pressures on lined bearings shall not exceed 500 psi of projected area unless otherwise required or authorized. Anti-friction bearings of approved types and of sizes not less than those recommended by the bearing manufacturer for the duty intended will be permitted subject to reviewal. Properly align all bearings provided with a suitable means of lubrication. Install anti-friction bearings as required to provide for retention of the lubricant and to exclude dirt and grit.

2.2.8 Miscellaneous Provisions

2.2.8.1 Metallic Coatings

a. Zinc Coatings - Apply zinc coatings in a manner and of a thickness and quality conforming to ASTM A123/A123M. Where zinc coatings are destroyed by cutting, welding or other causes regalvanize the affected areas. Regalvanize coatings 2 ounces or heavier with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Repair coatings less than 2 ounces in accordance with ASTM A780/A780M.

b. Cadmium Coatings - Provide cadmium coatings of a quality and thickness conforming to the requirements of ASTM B766 and inspections conforming to the requirements of ASTM B165.

c. Chromium Coatings - Apply chromium coatings for engineering in conformance with ASTM B177/B177M.

2.2.8.2 Cleaning of Corrosion-Resisting Steel

Remove oil, paint and other foreign substances from corrosion-resisting steel surfaces after fabrication. Perform cleaning by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned give a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. Visually inspect the surfaces for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance is found, clean again in accordance with the applicable provisions of ASTM A380. Furnish the proposed method of treatment for reviewal. Visually reinspect after treatment. Use only stainless steel or nonmetallic bristle brushes to remove foreign substances. Any contamination occurring subsequent to the initial cleaning shall be removed by one or more of the methods indicated above.

2.2.8.3 Lubrication

The arrangement and details for lubrication shall be as shown. Thoroughly clean and lubricate, with an approved lubricant, all bearing surfaces before erection or assembly.

2.2.9 Shop Assembly

Assemble each machinery and structural unit furnished in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Do not exceed those tolerances shown. Closely check each unit assembled to ensure that all necessary clearances...
have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Perform assembly and disassembly work in the presence of the Engineer unless waived in writing. Immediately remedy errors or defects disclosed by the Contractor without cost to the Agency. Before disassembly for shipment each piece of a machinery or structural unit shall be match-marked to facilitate erection in the field. Indicate the location of match-marks by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform material tests and analyses certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses shall be performed and certified at the Contractor's expense. Perform tests, inspections, and verifications conforming to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Conduct tests in the presence of the Engineer if so required. Furnish specimens and samples for additional independent tests and analyses upon request by the Engineer. Properly label specimens and samples and prepare for shipment. Submit certified test reports for materials with all materials delivered to the site.

2.3.1 Nondestructive Testing

When doubt exists as to the soundness of any material part, such part may be subjected to any form of nondestructive testing determined by the Engineer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Agency. Any defects will be cause for rejection; replace and retest rejected parts at the Contractor's expense.

2.3.2 Tests of Machinery and Structural Units

The details for tests of machinery and structural units shall conform to the requirements of the particular sections of these specifications covering these items. Assemble each complete machinery and structural unit and test them in the shop, in the presence of the Engineer, unless otherwise directed. Waiving of tests will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that occurs before the completion of the contract or guarantee. After being installed at the site, each complete machinery or structural unit shall be operated through a sufficient number of complete cycles to demonstrate to the satisfaction of the Engineer that it meets the specified operational requirements in all respects.

2.3.3 Inspection of Structural Steel Welding

Nondestructive examination of designated welds will be required. Supplemental examination of any joint or coupon cut from any location in any joint may be required.

2.3.3.1 Visual Examination

For all visual examination of completed welds clean and carefully examine for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure
2.3.3.2 Nondestructive Examination

Perform as designated or described in the sections of these specifications, the nondestructive examination of shop and field welds covering the particular items of work.

a. Testing Agency - The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. In either case, written review of the examination procedures is required and the examination tests shall be made in the presence of the Engineer. The evaluation of examination tests are subject to the reviewal and all records become the property of the Agency.

b. Examination Procedures - Conform to the following requirements.

(1) Ultrasonic Testing - Making, evaluating and reporting ultrasonic testing of welds shall conform to the requirements of AWS D1.1/D1.1M, Section 6, Part C. Provide ultrasonic equipment capable of making a permanent record of the test indications. Make a record of each weld tested.

(2) Radiographic Testing - Making, evaluating and reporting radiographic testing of welds shall conform to the requirements of AWS D1.1/D1.1M, Section 6, Parts C and E.

(3) Magnetic Particle Inspection - Magnetic particle inspection of welds shall conform to the applicable provisions of ASTM E709.

(4) Dye Penetrant Inspection - Perform dye penetrant inspection of welds conforming to the applicable provisions of ASTM E165.

c. Acceptability of Welds - Welds will be unacceptable if shown to have defects prohibited by AWS D1.1/D1.1M, or possess any degree of incomplete fusion, inadequate penetration or undercutting.

d. Welds to be Subject to Nondestructive Examination

2.3.3.3 Test Coupons

The Agency reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive examination. Should tests of any two coupons cut from the work of any welder show strengths less than that specified for the base metal it will be considered evidence of negligence or incompetence and such welder will be removed from the work. When coupons are removed from any part of a structure, repair the members cut in a neat manner with joints of the proper type to develop the full strength of the members. Repaired joints shall be peened as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive examination of repairs shall be borne by the Agency or the Contractor in accordance with the Contract Clauses INSPECTION AND ACCEPTANCE.
2.3.3.4 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection, the Agency reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Agency.

2.3.4 Structural Steel Welding Repairs

Repair defective welds in the structural steel welding repairs in accordance with AWS D1.1/D1.1M, Subsection 3.7. Remove defective weld metal to sound metal by use of air carbon-arc or oxygen gouging. Do not use oxygen gouging on ASTM A514/A514M steel. Thoroughly clean surfaces before welding. Retest welds that have been repaired by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting will be borne by the Contractor. Submit welding repair plans for steel, prior to making repairs.

2.3.5 Inspection and Testing of Steel Stud Welding

Perform fabrication and verification inspection and testing of steel stud welding conforming to the requirements of AWS D1.1/D1.1M, Subsection 7.8 except as otherwise specified. The Engineer will serve as the verification inspector. One stud in every 100 and studs that do not show a full 360 degree weld flash, have been repaired by welding or whose reduction in length due to welding is less than normal shall be bent or torque tested as required by AWS D1.1/D1.1M, Subsection 7.8. If any of these studs fail, bend or torque test two additional studs. If either of the two additional studs fails, all of the studs represented by the tests will be rejected. Studs that crack under testing in either the weld, base metal or shank will be rejected and replaced by the Contractor at no additional cost.

2.3.6 Inspection of Steel Castings

Perform radiographic inspection of steel castings as designated and as described in the section of these specifications covering the particular item of work. The procedure for making, evaluating and reporting the radiographic inspection shall conform to the requirements of ASTM E94. Use the applicable referenced standards as illustrated in ASTM E446. The evaluation of the radiographs will be subject to reviewal and all records will become the property of the Agency.

PART 3 EXECUTION

3.1 INSTALLATION

Thoroughly clean all parts to be installed. Remove packing compounds, rust, dirt, grit and other foreign matter. Clean holes and grooves for lubrication. Examine enclosed chambers or passages to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Do not use pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts used for assembling and tightening parts. Tighten bolts and screws firmly and uniformly but take
care not to overstress the threads. When a half nut is used for locking a full nut place the half nut first followed by the full nut. Lubricate threads of all bolts except high strength bolts, nuts and screws with an approved lubricant before assembly. Coat threads of corrosion-resisting steel bolts and nuts with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

3.1.1 Alignment and Setting

Accurately align each machinery or structural unit by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Set true machines to the elevations shown.

3.1.2 Blocking and Wedges

Remove all blocking and wedges used during installation for the support of parts to be grouted in foundations before final grouting unless otherwise directed. Blocking and wedges left in the foundations with reviewal shall be of steel or iron.

3.1.3 Foundations and Grouting

Concreting of subbases and frames and the final grouting under parts of machines shall be in accordance with the procedures as specified in Section 03 30 53 MISCELLANEOUS CAST-IN-PLACE CONCRETE.

3.2 TESTS

3.2.1 Workmanship

Workmanship must be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

3.2.2 Production Welding

Perform production welding conforming to the requirements of AWS D1.1/D1.1M or AWS D1.2/D1.2M, as applicable. Studs, on which pre-production testing is to be performed, shall be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the reduction of the length of studs becomes less than normal as they are welded, stop welding immediately and do not resume until the cause has been corrected.

3.3 PROTECTION OF FINISHED WORK

3.3.1 Machined Surfaces

Thoroughly clean foreign matter off machined surfaces. All finished surfaces shall be protected by suitable means. Oil and wrap unassembled pins and bolts with moisture resistant paper or protect them by other approved means. Wash finished surfaces of ferrous metals to be in bolted contact, with an approved rust inhibitor and coat them with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Paint finished surfaces of metals which will be exposed after installation, except corrosion resisting steel or
nonferrous metals as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.2 Lubrication After Assembly

After assembly fill all lubricating systems with the lubricant specified and apply additional lubricant at intervals as required to maintain the equipment in satisfactory condition until acceptance of the work.

3.3.3 Aluminum

Protect aluminum that will be in contact with grout or concrete from galvanic or corrosive action, with a coat of zinc-chromate primer and a coat of aluminum paint. Protect aluminum in contact with structural steel against galvanic or corrosive action with a coat of zinc-chromate primer and a coat of aluminum paint. Provide aluminum paint consisting of a aluminum paste conforming to ASTM D962, spar varnish and thinner compatible with the varnish. Field mix the aluminum paint in proportion of 2 pounds of paste, not more than one gallon of spar varnish and not more than one pint of thinner.

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SECTION 05 51 33

METAL LADDERS

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METAL LADDERS

05/10

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.

ALUMINUM ASSOCIATION (AA)

AA DAF45   (2003; Reaffirmed 2009) Designation System for Aluminum Finishes

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M   (2010; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)


ASTM A500/A500M   (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes


ASTM A653/A653M   (2011) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process


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1.2 SUBMITTALS

Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Ladders, installation drawings, "EN"

SD-03 Product Data

Ladders

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures,
materials, and equipment of the type required for the work.

1.4 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.5 Aluminum Alloy Products

Conform to ASTM B209 for sheet plate, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

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

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Engineer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.
2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

2.2.4.2 Pretreatment, Priming and Painting

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

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with hand sanded or machine finish to a 240 grit. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF45.

2.3 LADDERS

Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2 1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 16 inches wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts as indicated. Provide intermediate clip angles not over 48 inches on centers.

2.3.1 Ladder Cages

Conform to 29 CFR 1910.27. Fabricate 2 by 1/4 inch horizontal bands and 1 1/2 by 3/16 inch vertical bars. Provide attachments for fastening bands to the side rails of ladders or directly to the structure. Provide and fasten vertical bars on the inside of the horizontal bands. Extend cages not less
than 27 inches or more than 28 inches from the centerline of the rungs, excluding the flare at the bottom of the cage, and not less than 27 inches in width. Clear the inside of the cage of projections.

PART 3  EXECUTION

3.1  GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Provide Exposed fastenings of compatible materials, generally matching in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners will be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports must provide strength and stiffness. Formed joints exposed to the weather to exclude water. Items listed below require additional procedures.

3.2  WORKMANSHIP

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

3.3  ANCHORAGE, FASTENINGS, AND CONNECTIONS

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

3.4  WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.5  FINISHES

3.5.1  Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to MPI 79 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.
3.5.2 Field Preparation

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

3.5.3 Environmental Conditions

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

3.6 LADDERS

Secure to the adjacent construction with the clip angles attached to the stringer. Secure to masonry or concrete with not less than two 1/2 inch diameter expansion bolts. Install intermediate clip angles not over 48 inches on center. Install brackets as required for securing of ladders welded or bolted to structural steel or built into the masonry or concrete. Ends of ladders must not rest upon floor.

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SECTION 05 52 00

METAL RAILINGS

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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 WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)


ASTM A500/A500M (2010a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes


NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)


1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

Within 30 days of Contract Award, submit fabrication drawings to the Engineer for the following items:

  a. Iron and Steel Hardware
  
  c. Steel Railings and Handrails

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d. Aluminum Railings and Handrails

e. Anchorage and fastening systems

Submit manufacturer's catalog data, including two copies of manufacturers' specifications, load tables, dimension diagrams, and anchor details for the following items:

f. Concrete inserts

h. Protective coating

i. Steel railings and handrails

j. Aluminum railings and handrails

k. Anchorage and fastening systems

1.3 SUBMITTALS

Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. Submit the following in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings; EN

Iron and Steel Hardware; EN

Steel Shapes, Plates, Bars and Strips; EN

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars; EN

Structural Steel Tubing; EN

Cold-Finished Steel Bars; EN

Hot-Rolled Carbon Steel Bars; EN

Cold-Drawn Steel Tubing; EN

Concrete Inserts; EN

Masonry Anchorage Devices; EN

Protective Coating; EN

Steel Railings and Handrails; EN

Aluminum Railings and Handrails; EN

Anchorage and Fastening Systems; EN
1.4 QUALITY ASSURANCE

1.4.1 Welding Procedures

Section 05 05 23 WELDING, STRUCTURAL applies to work specified in this section.

Submit welding procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Engineer and by an approved testing laboratory at the Contractor's expense.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition be performed on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, make an immediate retest of two test welds and ensure each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

Pre-assemble items in the shop to the greatest extent possible.

Disassemble units only to the extent necessary for shipping and handling.

Clearly mark units for reassembly and coordinated installation.

For the fabrication of work exposed to view, use only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding, or by welding and grinding, prior to cleaning, treating, and application of surface finishes, including zinc coatings.

2.2 GENERAL FABRICATION

Provide railings and handrails detail plans and elevations at not less than 1 inch to 1 foot. Provide details of sections and connections at not less than 3 inches to 1 foot. Also detail setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.
Use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Work materials to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Use type of materials indicated or specified for the various components of work.

Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ensure all exposed edges are eased to a radius of approximately 1/32 inch. Bend metal corners to the smallest radius possible without causing grain separation or otherwise impairing the work.

Weld corners and seams continuously and in accordance with the recommendations of AWS D1.1/D1.1M. Grind exposed welds smooth and flush to match and blend with adjoining surfaces.

Form exposed connections with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of the type indicated or, if not indicated, use Phillips flathead (countersunk) screws or bolts.

Provide anchorage of the type indicated and coordinated with the supporting structure. Fabricate anchoring devices and space as indicated and as required to provide adequate support for the intended use of the work.

Use hot-rolled steel bars for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.3 STEEL RAILINGS AND HANDRAILS

Design handrails to resist a concentrated load of 250 lbs in any direction at any point of the top of the rail or 20 lbs per foot applied horizontally to top of the rail, whichever is more severe. NAAMM AMP 521, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts.

2.3.1 Steel Handrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M or structural tubing conforming to ASTM A500/A500M, Grade A or B of equivalent strength. Provide steel railings of 2 inches nominal size, hot-dip galvanized.

a. Fabrication: Joint posts, rail, and corners by one of the following methods:

(1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 3/8 inch hexagonal-recessed-head setscrews.

(2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Butt railing splices and reinforce them by a tight fitting interior sleeve not less than 6 inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.
Provide kickplates between railing posts where indicated, and consist of 1/8-inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

Galvanize exterior railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings.

2.4 ALUMINUM RAILINGS AND HANDRAILS

Provide railings and handrails consisting of 2 inch nominal schedule 40 pipe ASTM B429/B429M, 1 3/4 inch square aluminum semi-hollow tube with rounded corners ASTM B221. Provide anodized aluminum railings. Ensure all fasteners are Series 300 stainless steel.

a. Fabrication: Provide jointing by one of the following methods:

(1) Flush-type rail fittings, welded and ground smooth with splice locks secured with 3/8 inch recessed head set screws.

(2) Ensure all mitered and welded joints made by fitting post to top rail, intermediate rail to post, and corners, are groove welded and ground smooth. Provide butted splices, where allowed by the Contracting Officer, reinforced by a tight fitting dowel or sleeve not less than 6 inches in length. Tack weld or epoxy cement dowel or sleeve to one side of the splice.

(3) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8 inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide alloy fittings to conform to ASTM B26/B26M.

2.5 SAFETY CHAINS

Provide safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Locate safety chain where indicated. Mount the top chain feet 6 inches above the ground and mount the lower chain 2 feet above the ground.

PART 3 EXECUTION

3.1 INSTALLATION INSTRUCTIONS

Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel stair railing and hand rail work:

h. Steel railings and handrails
i. Aluminum railings and handrails
j. Anchorage and fastening systems
Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars and strips used in accordance with the design specifications referenced in this section.

3.2 PREPARATION

Adjust stair railings and handrails prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Space posts not more than 8 feet on center. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

Anchor posts in concrete by means of pipe sleeves set and anchored into concrete. Provide sleeves of galvanized, standard weight, steel pipe, not less than 6 inches long, and having an inside diameter not less than 1/2-inch greater than the outside diameter of the inserted pipe post. Provide steel plate closure secured to the bottom of the sleeve, with closure width and length not less than 1-inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, fill the annular space between post and sleeve with molten lead, sulfur, or a quick-setting hydraulic cement. Cover anchorage joint with a round steel flange welded to the post.

Secure handrails to walls by means of wall brackets and wall return fitting at handrail ends. Provide brackets of malleable iron castings, with not less than 3-inch projection from the finish wall surface to the center of the pipe drilled to receive one 3/8-inch bolt. Locate brackets not more than 60 inches on center. Provide wall return fittings of cast iron castings, flush-type, with the same projection as that specified for wall brackets. Secure wall brackets and wall return fittings to building construction as follows:

For concrete and solid masonry anchorage, use bolt anchor expansion shields and lag bolts.

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

3.3 STEEL HANDRAIL

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement with anchorage covered with standard pipe collar pinned to post. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts.

3.4 ALUMINUM HANDRAIL

Affix to base structure by flanges anchored to concrete or other existing masonry by expansion shields. Provide Series 300 stainless steel bolts to anchor aluminum alloy flanges, of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or concrete, coat the contact surface a heavy coating of bituminous paint.

3.5 FIELD WELDING

Ensure procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work comply
with AWS D1.1/D1.1M.

3.6 TOUCHUP PAINTING

Immediately after installation, clean field welds, bolted connections, abraded areas of the shop paint, and exposed areas painted with the paint used for shop painting. Apply paint by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --
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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 CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100 (2001; Supplements 2002-2008) Documentation of the Threshold Limit Values and Biological Exposure Indices

ASTM INTERNATIONAL (ASTM)


ASTM D2824 (2006; E 2012; R 2012) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos


ASTM D4263 (1983; R 2012) Indicating Moisture in Concrete by the Plastic Sheet Method


ASTM F1869 (2011) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 1 (Oct 2009) Aluminum Paint

MPI 10 (Oct 2009) Exterior Latex, Flat, MPI Gloss Level 1

MPI 101 (Oct 2009) Epoxy Anti-Corrosive Metal Primer
<table>
<thead>
<tr>
<th>MPI</th>
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<tr>
<td>MPI 107</td>
<td>(Oct 2009) Rust Inhibitive Primer (Water-Based)</td>
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<td>MPI 108</td>
<td>(Oct 2009) High Build Epoxy Coating, Low Gloss</td>
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<tr>
<td>MPI 119</td>
<td>(Oct 2009) Exterior Latex, Gloss</td>
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<td>MPI 13</td>
<td>(Oct 2009) Exterior Solvent-Based Semi-Transparent Stain</td>
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<tr>
<td>MPI 134</td>
<td>(Oct 2009) Galvanized Primer (Waterbased)</td>
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<tr>
<td>MPI 16</td>
<td>(Oct 2009) Exterior Latex-Based Solid Hide Stain</td>
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<tr>
<td>MPI 161</td>
<td>(Oct 2009) Exterior W.B. Light Industrial Coating, MPI Gloss Level 3</td>
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<td>MPI 164</td>
<td>(Oct 2009) Exterior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6</td>
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<td>MPI 19</td>
<td>(Oct 2009) Inorganic Zinc Rich Primer</td>
</tr>
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<td>MPI 2</td>
<td>(Oct 2009) Aluminum Heat Resistant Enamel (up to 427 C and 800 F)</td>
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<td>MPI 21</td>
<td>(Oct 2009) Heat Resistant Enamel, Gloss (up to 205 degrees C and 400 degrees F), MPI Gloss Level 6</td>
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<td>MPI 22</td>
<td>(Oct 2009) Aluminum Paint, High Heat (up to 590 degrees C and 1100 degrees F)</td>
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<td>MPI 23</td>
<td>(Oct 2009) Surface Tolerant Metal Primer</td>
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<td>MPI 26</td>
<td>(Oct 2009) Cementitious Galvanized Metal Primer</td>
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<td>MPI 27</td>
<td>(Oct 2009) Exterior / Interior Alkyd Floor Enamel, Gloss</td>
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<td>MPI 5</td>
<td>(Oct 2009) Exterior Alkyd Wood Primer</td>
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<td>MPI 59</td>
<td>(Oct 2009) Interior/Exterior Floor Enamel, Low Gloss</td>
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<tr>
<td>MPI 6</td>
<td>(Oct 2009) Exterior Latex Wood Primer</td>
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<tr>
<td>MPI 60</td>
<td>(Oct 2009) Interior/Exterior Latex Floor Paint, Low Gloss</td>
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MPI 68 (Oct 2009) Interior/Exterior Latex Floor Enamel, Gloss

MPI 7 (Oct 2009) Exterior Oil Wood Primer

MPI 72 (Oct 2009) Polyurethane, Two Component, Pigmented, Gloss

MPI 77 (Oct 2009) Epoxy Gloss

MPI 79 (Oct 2009) Alkyd Anti-Corrosive Metal Primer

MPI 8 (Oct 2009) Exterior Alkyd, Flat, MPI Gloss Level I

MPI 9 (Oct 2009) Exterior Alkyd, Gloss, MPI Gloss Level 6

MPI 94 (Oct 2009) Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5

MPI 95 (Oct 2009) Quick Drying Primer for Aluminum

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1 (2000; E 2004) Shop, Field, and Maintenance Painting of Steel


SSPC SP 1 (1982; E 2004) Solvent Cleaning

SSPC SP 10/NACE No. 2 (2007) Near-White Blast Cleaning

SSPC SP 12/NACE No.5 (2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating

SSPC SP 2 (1982; E 2004) Hand Tool Cleaning

SSPC SP 3 (1982; E 2004) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning


1.2 SUBMITTALS

Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-03 Product Data

Coating; EN

Manufacturer's Technical Data Sheets

SD-04 Samples

Color; EN

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates
1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Engineer of any change in contractor certification status.

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Engineer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Agency. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Agency.

1.4.1.1 Sampling Procedure

The Engineer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Engineer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality
Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Engineer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100 and confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract
specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 Agency SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation.

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Engineer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.
1.9 LOCATION AND SURFACE TYPE TO BE PAINTED

1.9.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.9.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the building(s) and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.9.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building(s) and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.9.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.9.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and existing surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
(1) Exposed piping, conduit, and ductwork;
(2) Supports, hangers, air grilles, and registers;
(3) Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:
(1) New zinc-coated, aluminum, and copper surfaces under insulation
(2) New aluminum jacket on piping
(3) New interior ferrous piping under insulation.

1.9.4 Definitions and Abbreviations

1.9.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in
the product specification. This testing is accomplished by MPI to qualify
each product for the MPI Approved Product List, and may also be
accomplished by Contractor's third party testing lab if an alternative to
Batch Quality Conformance Testing by MPI is desired.

1.9.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is
the same as the product qualified to the appropriate product
specification. This testing shall only be accomplished by MPI testing lab.

1.9.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on
various substrates (metals, plastics, wood, paper, leather, cloth, etc.).
They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller
coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels,
stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used
interchangeably.

1.9.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or
coating.

1.9.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface
degradation. Five (5) levels are generically defined under the Assessment
sections in the MPI Maintenance Repainting Manual.

1.9.4.6 EPP

Environmentally Preferred Products, a standard for determining
environmental preferability in support of Executive Order 13101.
1.9.4.7  EXT

MPI short term designation for an exterior coating system.

1.9.4.8  INT

MPI short term designation for an interior coating system.

1.9.4.9  micron / microns

The metric measurement for 0.001 mm or one/thousandth of a millimeter.

1.9.4.10  mil / mils

The English measurement for 0.001 in or one/thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.9.4.11  mm

The metric measurement for millimeter, 0.001 meter or one/thousandth of a meter.

1.9.4.12  MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

<table>
<thead>
<tr>
<th>Gloss Level</th>
<th>Description</th>
<th>Units at 60 degrees</th>
<th>Units at 85 degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>Matte or Flat</td>
<td>0 to 5</td>
<td>10 max</td>
</tr>
<tr>
<td>G2</td>
<td>Velvet</td>
<td>0 to 10</td>
<td>10 to 35</td>
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<tr>
<td>G3</td>
<td>Eggshell</td>
<td>10 to 25</td>
<td>10 to 35</td>
</tr>
<tr>
<td>G4</td>
<td>Satin</td>
<td>20 to 35</td>
<td>35 min</td>
</tr>
<tr>
<td>G5</td>
<td>Semi-Gloss</td>
<td>35 to 70</td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>Gloss</td>
<td>70 to 85</td>
<td></td>
</tr>
<tr>
<td>G7</td>
<td>High Gloss</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gloss is tested in accordance with ASTM D523. Historically, the Agency has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.9.4.13  MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

December 30, 2019
The Division number follows the CSI Master Format.

1.9.4.14 Paint

See Coating definition.

1.9.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.9.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer’s technical data sheets for specified coatings and solvents. Comply with applicable regulations regarding toxic and hazardous materials.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.2.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing.
If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

d. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.

e. Previously painted surfaces damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

f. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

g. Chalk shall be removed so that when tested in accordance with ASTM D4214, the chalk resistance rating is no less than 8.

h. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

i. Edges of chipped paint shall be feather edged and sanded smooth.

j. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

k. New, proposed coatings shall be compatible with existing coatings.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC SP 7/NACE No.4; Water jetting to SSPC SP 12/NACE No.5 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3 /SSPC SP 12/NACE No.5 WJ-3.

c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10/NACE No. 2.
3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12/NACE No.5. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4/NACE VIS 7.

3.3.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized". If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12/NACE No.5 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12/NACE No.5 WJ3 degree of cleanliness.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.3.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure.
at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, existing coated, and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.5 APPLICATION

3.5.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.
Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

e. Floors: For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's instructions.

3.5.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Engineer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.5.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.
3.5.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

<table>
<thead>
<tr>
<th>Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTERIOR</td>
</tr>
<tr>
<td>Division 3. Exterior Concrete Paint Table</td>
</tr>
<tr>
<td>Division 4. Exterior Concrete Masonry Units Paint Table</td>
</tr>
<tr>
<td>Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table</td>
</tr>
<tr>
<td>Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table</td>
</tr>
<tr>
<td>Division 9. Exterior Stucco Paint Table</td>
</tr>
<tr>
<td>Division 10. Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table</td>
</tr>
</tbody>
</table>

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

   (1) One coat of primer.

   (2) One coat of undercoat or intermediate coat.

   (3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that
pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.6 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.7 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.8 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.9 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.10 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Engineer. Perform this demonstration after appropriate curing and drying times of
coatings have elapsed and prior to invoicing for final payment.

3.11 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers.

3.12 PAINT TABLES

All DFT's are minimum values. Acceptable products are listed in the MPI Green Approved Products List, available at [http://www.specifygreen.com/APL/ProductIdxByMPInum.asp](http://www.specifygreen.com/APL/ProductIdxByMPInum.asp).

3.12.1 EXTERIOR PAINT TABLES

| DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE |
| STEEL / FERROUS SURFACES |
| A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3 |
| 1. Alkyd |
| New; MPI EXT 5.1Q-G5 (Semigloss) / Existing; MPI REX 5.1D-G5 |
| Primer: MPI 23 | Intermediate: MPI 94 | Topcoat: MPI 94 |
| System DFT: 5.25 mils |
| New; MPI EXT 5.1Q-G6 (Gloss) / Existing; MPI REX 5.1D-G6 |
| Primer: MPI 23 | Intermediate: MPI 9 | Topcoat: MPI 9 |
| System DFT: 5.25 mils |
| B. New Steel that has been blast-cleaned to SSPC SP 6/NACE No.3: |
| 1. Alkyd |
| New; MPI EXT 5.1D-G5 (Semigloss) / Existing; MPI REX 5.1D-G5 |
| Primer: MPI 79 | Intermediate: MPI 94 | Topcoat: MPI 94 |
| System DFT: 5.25 mils |
## DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

<table>
<thead>
<tr>
<th>New; MPI EXT 5.1D-G6 (Gloss) / Existing; MPI REX 5.1D-G6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primer: MPI 79</td>
</tr>
<tr>
<td>System DFT: 5.25 mils</td>
</tr>
</tbody>
</table>

C. Existing steel that has been spot-blasted to SSPC SP 6/NACE No.3:

1. Surface previously coated with alkyd or latex:

   Waterborne Light Industrial Coating

   MPI REX 5.1C-G5 (Semigloss)

<table>
<thead>
<tr>
<th>Spot Primer: MPI 79</th>
<th>Intermediate: MPI 163</th>
<th>Topcoat: MPI 163</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   MPI REX 5.1C-G6 (Gloss)

<table>
<thead>
<tr>
<th>Spot Primer: MPI 79</th>
<th>Intermediate: MPI 164</th>
<th>Topcoat: MPI 164</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Surface previously coated with epoxy:

   Waterborne Light Industrial

   a. MPI REX 5.1L-G5 (Semigloss)

      | Spot Primer: MPI 101 | Intermediate: MPI 163 | Topcoat: MPI 163 |
      |----------------------|-----------------------|------------------|
      | System DFT: 5 mils   |                       |                  |

   MPI REX 5.1L-G6 (Gloss)

<table>
<thead>
<tr>
<th>Spot Primer: MPI 101</th>
<th>Intermediate: MPI 164</th>
<th>Topcoat: MPI 164</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: 5 mils</td>
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</tbody>
</table>

   Pigmented Polyurethane

   b. MPI REX 5.1H-G6 (Gloss)
<table>
<thead>
<tr>
<th>DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot Primer: MPI 101</td>
</tr>
<tr>
<td>System DFT: 8.5 mils</td>
</tr>
<tr>
<td><strong>D. New and existing steel blast cleaned to SSPC SP 10/NACE No. 2:</strong></td>
</tr>
<tr>
<td><strong>1. Waterborne Light Industrial</strong></td>
</tr>
<tr>
<td>MPI EXT 5.1R-G5 (Semigloss)</td>
</tr>
<tr>
<td>Primer: MPI 101</td>
</tr>
<tr>
<td>System DFT: 8.5 mils</td>
</tr>
<tr>
<td>MPI EXT 5.1R-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 101</td>
</tr>
<tr>
<td>System DFT: 8.5 mils</td>
</tr>
<tr>
<td><strong>2. Pigmented Polyurethane</strong></td>
</tr>
<tr>
<td>MPI EXT 5.1J-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 101</td>
</tr>
<tr>
<td>System DFT: 8.5 mils</td>
</tr>
<tr>
<td><strong>E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations:</strong></td>
</tr>
<tr>
<td><strong>1. Alkyd Floor Enamel</strong></td>
</tr>
<tr>
<td>MPI EXT 5.1S-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 79</td>
</tr>
<tr>
<td>System DFT: 5.25 mils</td>
</tr>
</tbody>
</table>

**EXTERIOR GALVANIZED SURFACES**

**F. New Galvanized surfaces:**
## DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

### 1. Cementitious primer / Latex

<table>
<thead>
<tr>
<th>System</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.3A-G1 (Flat)</td>
<td>MPI 26</td>
<td>MPI 10</td>
<td>MPI 10</td>
</tr>
<tr>
<td>System DFT: 4.5 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPI EXT 5.3A-G5 (Semigloss)</td>
<td>MPI 26</td>
<td>MPI 11</td>
<td>MPI 11</td>
</tr>
<tr>
<td>System DFT: 4.5 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPI EXT 5.3A-G6 (Gloss)</td>
<td>MPI 26</td>
<td>MPI 119</td>
<td>MPI 119</td>
</tr>
<tr>
<td>System DFT: 4.5 mils</td>
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</tbody>
</table>

### 2. Waterborne Primer / Latex

<table>
<thead>
<tr>
<th>System</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.3H-G1 (Flat)</td>
<td>MPI 134</td>
<td>MPI 10</td>
<td>MPI 10</td>
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<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MPI EXT 5.3H-G5 (Semigloss)</td>
<td>MPI 134</td>
<td>MPI 11</td>
<td>MPI 11</td>
</tr>
<tr>
<td>System DFT: 4.5 mils</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>MPI EXT 5.3H-G6 (Gloss)</td>
<td>MPI 134</td>
<td>MPI 119</td>
<td>MPI 119</td>
</tr>
<tr>
<td>System DFT: 4.5 mils</td>
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</tr>
</tbody>
</table>

### 3. Waterborne Primer / Waterborne Light Industrial Coating

<table>
<thead>
<tr>
<th>System</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.3J-G5 (Semigloss)</td>
<td>MPI 134</td>
<td>MPI 163</td>
<td>MPI 163</td>
</tr>
<tr>
<td>System DFT: 4.5 mils</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
### DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

<table>
<thead>
<tr>
<th>System DFT: 4.5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.3J-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 134</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System DFT: 4.5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.3K-G5 (Semigloss)</td>
</tr>
<tr>
<td>Primer: MPI 101</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System DFT: 5 mils</th>
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</thead>
<tbody>
<tr>
<td>MPI EXT 5.3K-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 101</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>System DFT: 5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.3L-G6 (Gloss)</td>
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<td>Primer: MPI 101</td>
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<table>
<thead>
<tr>
<th>System DFT: 4.5 mils</th>
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<tbody>
<tr>
<td>MPI REX 5.3J-G5 (Semigloss)</td>
</tr>
<tr>
<td>Primer: MPI 134</td>
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</table>

<table>
<thead>
<tr>
<th>System DFT: 4.5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI REX 5.3D-G6 (Gloss)</td>
</tr>
</tbody>
</table>

G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating

<table>
<thead>
<tr>
<th>System DFT: 4.5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI REX 5.3J-G5 (Semigloss)</td>
</tr>
<tr>
<td>Primer: MPI 134</td>
</tr>
</tbody>
</table>

2. Pigmented Polyurethane
### DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

<table>
<thead>
<tr>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 101</td>
<td>N/A</td>
<td>MPI 72</td>
</tr>
</tbody>
</table>

**System DFT:** 5 mils

**H. Galvanized surfaces with severely deteriorated coating or rusting:**

**1. Waterborne Light Industrial Coating**

**MPI REX 5.3L-G5 (Semigloss)**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 101</td>
<td>MPI 108</td>
<td>MPI 163</td>
</tr>
</tbody>
</table>

**System DFT:** 8.5 mils

**MPI REX 5.3L-G6 (Gloss)**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 101</td>
<td>MPI 108</td>
<td>MPI 164</td>
</tr>
</tbody>
</table>

**System DFT:** 8.5 mils

**2. Pigmented Polyurethane**

**MPI REX 5.3K-G6 (Gloss)**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 101</td>
<td>MPI 108</td>
<td>MPI 72</td>
</tr>
</tbody>
</table>

**System DFT:** 5 mils

### EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

**I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:**

**1. Alkyd**

**MPI EXT 5.4F-G1 (Flat)**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 95</td>
<td>MPI 8</td>
<td>MPI 8</td>
</tr>
</tbody>
</table>

**System DFT:** 5 mils

**MPI EXT 5.4F-G5 (Semigloss)**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI 95</td>
<td>MPI 94</td>
<td>MPI 94</td>
</tr>
</tbody>
</table>

---

*December 30, 2019*
<table>
<thead>
<tr>
<th>System DFT: 5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.4F-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System DFT: 5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Waterborne Light Industrial Coating</td>
</tr>
<tr>
<td>MPI EXT 5.4G-G3 (Eggshell)</td>
</tr>
<tr>
<td>Primer: MPI 95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System DFT: 5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.4G-G5 (Semigloss)</td>
</tr>
<tr>
<td>Primer: MPI 95</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System DFT: 5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.4G-G6 (Gloss)</td>
</tr>
<tr>
<td>Primer: MPI 95</td>
</tr>
</tbody>
</table>

J. Existing roof surfaces previously coated:

1. Aluminum Pigmented Asphalt Roof Coating

ASTM D2824: Sufficient coats to provide not less than 8 mils of finished coating system (without asbestos fibers).

2. Aluminum Paint

<table>
<thead>
<tr>
<th>System DFT: 3.5 mils</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI REX 10.2D</td>
</tr>
<tr>
<td>Primer: MPI 107</td>
</tr>
</tbody>
</table>
DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

K. Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd

<table>
<thead>
<tr>
<th>Description</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.1D-G1 (Flat)</td>
<td>MPI 79</td>
<td>MPI 8</td>
<td>MPI 8</td>
</tr>
<tr>
<td>System DFT: 5.25 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.1D-G5 (Semigloss)</td>
<td>MPI 79</td>
<td>MPI 94</td>
<td>MPI 94</td>
</tr>
<tr>
<td>System DFT: 5.25 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.1D-G6 (Gloss)</td>
<td>MPI 79</td>
<td>MPI 9</td>
<td>MPI 9</td>
</tr>
<tr>
<td>System DFT: 5.25 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Waterborne Light Industrial Coating

<table>
<thead>
<tr>
<th>Description</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.1C-G3 (Eggshell)</td>
<td>MPI 79</td>
<td>MPI 161</td>
<td>MPI 161</td>
</tr>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.1C-G5 (Semigloss)</td>
<td>MPI 79</td>
<td>MPI 163</td>
<td>MPI 163</td>
</tr>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 5.1C-G6 (Gloss)</td>
<td>MPI 79</td>
<td>MPI 164</td>
<td>MPI 164</td>
</tr>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

### L. Hot metal surfaces including smokestacks subject to temperatures up to 400 degrees F:

1. **Heat Resistant Enamel**

   **MPI EXT 5.2A**

   | Primer: MPI 21 | Intermediate: Surface preparation and number of coats per manufacturer's instructions. | Topcoat: Surface preparation and number of coats per manufacturer's instructions. |

   System DFT: Per Manufacturer

### M. Ferrous metal subject to high temperature, up to 750 degrees F:

1. **Inorganic Zinc Rich Coating**

   **MPI EXT 5.2C**

   | Primer: MPI 19 | Intermediate: Surface preparation and number of coats per manufacturer's instructions. | Topcoat: Surface preparation and number of coats per manufacturer's instructions. |

   System DFT: Per Manufacturer

2. **Heat Resistant Aluminum Enamel**

   **MPI EXT 5.2B (Aluminum Finish)**

   | Primer: MPI 2 | Intermediate: Surface preparation and number of coats per manufacturer's instructions. | Topcoat: Surface preparation and number of coats per manufacturer's instructions. |

   System DFT: Per Manufacturer

### N. New surfaces and Existing surfaces made bare cleaning to SSPC SP 10/NACE No. 2 subject to temperatures up to 1100 degrees F:

1. **Heat Resistant Coating**
### DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

**MPI EXT 5.2D**

<table>
<thead>
<tr>
<th>Primer: MPI 22</th>
<th>Intermediate: Surface preparation and number of coats per manufacturer's instructions.</th>
<th>Topcoat: Surface preparation and number of coats per manufacturer's instructions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: Per Manufacturer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES

**PAINT TABLE**

A. New and existing, uncoated Dressed lumber, Wood and plywood, trim, including top, bottom and edges of doors not otherwise specified:

1. Alkyd

**MPI EXT 6.3B-G5 (Semigloss)**

<table>
<thead>
<tr>
<th>Primer: MPI 7</th>
<th>Intermediate: MPI 94</th>
<th>Topcoat: MPI 94</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MPI EXT 6.3B-G6 (Gloss)**

<table>
<thead>
<tr>
<th>Primer: MPI 7</th>
<th>Intermediate: MPI 9</th>
<th>Topcoat: MPI 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Latex

**MPI EXT 6.3A-G1 (Flat)**

<table>
<thead>
<tr>
<th>Primer: MPI 7</th>
<th>Intermediate: MPI 10</th>
<th>Topcoat: MPI 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES

#### PAINT TABLE

<table>
<thead>
<tr>
<th>Paint System</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
<th>System DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 6.3A-G5 (Semigloss)</td>
<td>MPI 7</td>
<td>MPI 11</td>
<td>MPI 11</td>
<td>5 mils</td>
</tr>
<tr>
<td>MPI EXT 6.3A-G6 (Gloss)</td>
<td>MPI 7</td>
<td>MPI 119</td>
<td>MPI 119</td>
<td>5 mils</td>
</tr>
<tr>
<td>3. Waterborne Solid Color Stain</td>
<td>MPI EXT 6.3K</td>
<td>MPI 7</td>
<td>MPI 16</td>
<td>MPI 16</td>
</tr>
<tr>
<td>1. Alkyd</td>
<td>MPI REX 6.3B-G5 (Semigloss)</td>
<td>MPI 5</td>
<td>MPI 94</td>
<td>MPI 94</td>
</tr>
<tr>
<td>2. Latex</td>
<td>MPI REX 6.3B-G6 (Gloss)</td>
<td>MPI 5</td>
<td>MPI 9</td>
<td>MPI 9</td>
</tr>
<tr>
<td></td>
<td>MPI REX 6.3A-G1 (Flat)</td>
<td>MPI 5</td>
<td>MPI 10</td>
<td>MPI 10</td>
</tr>
<tr>
<td></td>
<td>MPI REX 6.3A-G5 (Semigloss)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Existing, dressed lumber, wood and plywood, trim including top, bottom and edges of doors previously coated with an alkyd / oil based finish coat not otherwise specified:

1. Alkyd

<table>
<thead>
<tr>
<th>Paint System</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
<th>System DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI REX 6.3B-G5 (Semigloss)</td>
<td>MPI 5</td>
<td>MPI 94</td>
<td>MPI 94</td>
<td>5 mils</td>
</tr>
<tr>
<td>MPI REX 6.3B-G6 (Gloss)</td>
<td>MPI 5</td>
<td>MPI 9</td>
<td>MPI 9</td>
<td>5 mils</td>
</tr>
</tbody>
</table>

2. Latex

<table>
<thead>
<tr>
<th>Paint System</th>
<th>Primer</th>
<th>Intermediate</th>
<th>Topcoat</th>
<th>System DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI REX 6.3A-G1 (Flat)</td>
<td>MPI 5</td>
<td>MPI 10</td>
<td>MPI 10</td>
<td>5 mils</td>
</tr>
</tbody>
</table>

| MPI REX 6.3A-G5 (Semigloss) | | | | |

December 30, 2019
| DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES | PAINT TABLE |
|---|---|---|
| **Primer:** MPI 5 | **Intermediate:** MPI 11 | **Topcoat:** MPI 11 |
| **System DFT:** 5 mils |
| **MPI REX 6.3A-G6 (Gloss)** |
| **Primer:** MPI 5 | **Intermediate:** MPI 119 | **Topcoat:** MPI 119 |
| **System DFT:** 5 mils |
| **C. Existing, dressed lumber, Wood and plywood, trim, including top, bottom and edges of doors previously coated with a latex / waterborne finish coat not otherwise specified:** |
| **1. Latex** |
| **MPI REX 6.3L-G1 (Flat)** |
| **Primer:** MPI 6 | **Intermediate:** MPI 10 | **Topcoat:** MPI 10 |
| **System DFT:** 5 mils |
| **MPI REX 6.3L-G5 (Semigloss)** |
| **Spot Primer:** MPI 6 | **Intermediate:** MPI 11 | **Topcoat:** MPI 11 |
| **System DFT:** 4.5 mils |
| **MPI REX 6.3L-G6 (Gloss)** |
| **Spot Primer:** MPI 6 | **Intermediate:** MPI 119 | **Topcoat:** MPI 119 |
| **System DFT:** 4.5 mils |
| **2. Waterborne Solid Color Stain** |
| **MPI REX 6.3K (Stain)** |
| **Spot Primer:** MPI 6 | **Intermediate:** MPI 16 | **Topcoat:** MPI 16 |
| **System DFT:** 4 mils |
| **D. New, Uncoated wood siding:** |
| **1. Semi-Transparent Stain** |
| **MPI EXT 6.3D** |
| **Spot Primer:** N/A | **Intermediate:** MPI 13 | **Topcoat:** MPI 13 |
DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER, PANELING, DECKING, SHINGLES

PAINT TABLE

System DFT: N/A

E. Existing, previously stained wood siding:

1. Latex

MPI REX 6.2K-G1 (Flat)

| Primer: MPI 5 | Intermediate: MPI 10 | Topcoat: MPI 10 |
| System DFT: 4.5 mils |

MPI REX 6.2K-G5 (Semigloss)

| Primer: MPI 5 | Intermediate: MPI 11 | Topcoat: MPI 11 |
| System DFT: 4.5 mils |

F. Existing Uncoated or previously semitransparent stained wood siding:

1. Semi-Transparent Stain

MPI REX 6.3D

| Spot Primer: N/A | Intermediate: MPI 13 | Topcoat: MPI 13 |
| System DFT: Per Manufacturer |

G. Wood: Steps, platforms, floors of open porches, and _____ with non-skid additive (NSA), load at manufacturer's recommendations:

1. Latex Floor Paint

MPI EXT 6.3A-G2 (Flat)

| Primer: MPI 5 | Intermediate: MPI 60 plus NSA | Topcoat: MPI 60 plus NSA |
| System DFT: 4.5 mils |

MPI EXT 6.5A-G6 (Gloss)

| Primer: MPI 5 | Intermediate: MPI 68 plus NSA | Topcoat: MPI 68 plus NSA |
| System DFT: 4.5 mils |

2. Alkyd Floor Paint
<table>
<thead>
<tr>
<th>DIVISION 6: EXTERIOR WOOD, DRESSED LUMBER, PANELING, DECKING, SHINGLES</th>
<th>PAINT TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPI EXT 6.5B-G2 (Flat)</td>
<td></td>
</tr>
<tr>
<td>Primer: MPI 59</td>
<td>Intermediate: MPI 59 plus NSA</td>
</tr>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
</tr>
<tr>
<td>MPI EXT 6.5B-G6 (Gloss)</td>
<td></td>
</tr>
<tr>
<td>Primer: MPI 27</td>
<td>Intermediate: MPI 27 plus NSA</td>
</tr>
<tr>
<td>System DFT: 5 mils</td>
<td></td>
</tr>
</tbody>
</table>

-- End of Section --
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DIVISION 31 - EARTHWORK

SECTION 31 00 00

EARTHWORK

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  1.2.2  Unsuitable Materials
  1.2.3  Unsuitable Debris
  1.2.4  Fill Materials
  1.2.5  Structural Backfill
  1.2.6  Relative Compaction
1.3   QUALIFICATIONS
1.4   SUBMITTALS
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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 D 698 (2007e1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

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 D422 (1963; R 2007) Particle-Size Analysis of Soils


ASTM D4643 (2008) Determination of Water (Moisture) Content of Soil by the Microwave Oven Method


ASTM D698 (2012) 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 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

December 30, 2019
1.2 DEFINITIONS

1.2.1 Suitable Materials

Suitable materials shall consist of materials classified in accordance with ASTM D2487 as CL, CL-ML, MH, ML, SC, SM, GP, GW, GP-GM, GW-GM, GP-GC, GW-GC, SP, SW, SP-SM, SW-SM, SP-SC, SW-SC, and CH meeting the additional requirements of paragraph 2.2, types of fill materials. Suitable materials are free from unsuitable debris and organic material as defined herein.

1.2.2 Unsuitable Materials

Unsuitable materials include all other materials that are not defined as suitable materials in paragraph 1.2.1 herein. Materials are not classified as unsuitable based solely on moisture content. See paragraph 3.5 Moisture Control. Unsuitable materials shall be disposed of in accordance with Section 02 41 00 DEMOLITION AND DECONSTRUCTION.

1.2.3 Unsuitable Debris

Material containing organic content or roots greater than 1/2-inch in diameter and 6 inches in length, debris, rubble, trash or other deleterious items shall be classified as unsuitable debris.

1.2.4 Fill Materials

The terms "fill" or "embankment" as used in these specifications are defined as the earth fill portions of the levee embankment structure, berms, or other fills related to the levee, and all other fills within the limits of the project.

1.2.5 Structural Backfill

Earthen fill to be placed within 4-feet of completed or partially completed structures.

1.2.6 Relative Compaction

Relative Compaction refers to the in-place dry unit weight of soil expressed as a percentage of the maximum dry unit weight of the same soil, as determined by the ASTM D698 (latest edition) laboratory compaction test procedure.

1.3 QUALIFICATIONS

The earthwork contractor performing levee construction and reconstruction shall have experience in projects of 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 levee construction and reconstruction shall consist of the following:

'Satisfactorily performed the work and completed the construction of at least three levee projects including either (1) levee construction, or (2)
levee degrading and reconstruction for the purpose of cutoff wall construction'. The projects must have included a minimum levee embankment quantity of 75,000 cubic yards.

Refer to the proposal forms for additional information.

1.4 SUBMITTALS

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

SD-01 Preconstruction Submittals

Excavation;

Submit a written excavation plan a minimum of twenty (20) days prior to the beginning of any 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 the required 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 excavation and transport of the excavated material.

e. The Contractor's proposed sequence of work for excavating with plan and cross sectional views showing starting and final work locations and clearing, grubbing and stripping limits.

f. The Contractor's proposed road pattern and plan for implementing dust control measures.

Survey Data;

Copies of survey data in the form of cross sections of the levee 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.

Equipment Data;

Equipment data used for hauling, fill placement, compaction, and sprinkling equipment shall be submitted and include weights, size,
and contact pressures.

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.

Description of how materials excavated from the borrow area for levee embankment and seepage berm shall be identified to allow field personnel to determine the appropriate end use of the material.

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.

Geotechnical Engineer;

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, sheeting, and dewatering plans 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.

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, irrigation canal relocation and fill plan 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.
Flood Stage Contingency Plan;

In the event the water surface elevation of the Yuba 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 and to begin continuous operations to complete all partially completed section(s) of the levee embankment, the slurry cutoff wall including capping layers, and seepage berm. At least 15 days prior to any levee excavation, the Contractor shall submit a contingency plan outlining the contingency operations in the event that river elevations above the flood stage (as defined by the Agency) are forecasted. The contingency plan shall include the proposed measures to protect the landside areas which have a reduced level of protection due to construction activities. The plan shall include river stage monitoring, river stage at which the plan will be activated, material and equipment to be used in performance of the contingency plan, and the existing location, type and quantity of the stockpiled emergency material. The plan shall also include the length of levee to be degraded at any one time, where stockpiled materials will be stored, and the method for monitoring river elevations. The Contractor shall keep any levee degrade material on the project site for the duration of the construction period, protected from inclement weather, for use as emergency backfill as necessary.

SD-03 Product Data

Embankment and Backfill Materials;

At least 15 days prior to delivery of any Contractor-furnished material to the site of the work, the Contractor shall submit soil classification test results, moisture-density curves, gradation curves, and laboratory results of the required tests of the proposed borrow material for review by the Agency.

SD-09 Contractor's Field Reports

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.

Test Data Summaries;

Summaries comparing test results with specified requirements shall be provided in electronic format and hard copy, demonstrate
contract compliance, and be submitted with all requests for progress payments.

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 Levee 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 levee(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.

Surveyor's Name

CA PLS/CE No.: ______________________

Date
1.5  GENERAL CONDITIONS

1.5.1  Lines and Grades

The embankments and backfills shall be constructed to the lines, grades, and cross sections indicated on the Plans, unless otherwise directed by the Agency. 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.

1.5.2  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, 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 which is lost in transit or rendered unsuitable after being placed in the embankment or backfill and before final acceptance of the work shall be replaced 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, all at no cost to the Agency.

1.5.3  Fill Materials

Materials for embankment construction shall be suitable materials obtained from the designated borrow areas or project excavations. The Contractor shall blend and reuse soil from project excavations to the maximum extent possible. Materials shall be blended at the borrow site or approved stockpile area. Materials shall be tested for suitability prior to placement. Embankment materials shall have no visible concentrations of organics, roots greater than 1/2 inch in diameter and 6 inches in length, limbs, or wood fragments. Materials containing debris, rubble, other deleterious items, perishable material, and trash shall not be used in the fill. Excess material generated by the cutoff wall construction operations shall be used for levee embankment fill provided it meets, or can be blended to meet, the requirements of the Specifications. Material not meeting the specified requirements shall be hauled off site and disposed of in a legal manner.

1.5.4  Haul Roads

Haul roads and ramps 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 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

December 30, 2019
contract period. Haul roads and ramps which cross any creek or drainage channel shall be constructed and maintained by the Contractor so as 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 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 costs associated with these haul roads and ramps shall be considered as a subsidiary obligation of the Contractor.

1.5.5 Slides and Foundation Failures

The Contractor shall repair any sliding that occurs in any part of the embankment and backfills 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.

1.5.6 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 approval. This approval 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.

1.5.7 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.

1.5.8 Protection of Existing Man-Made Facilities and Natural Features

Construction shall be conducted in such a manner as to avoid damage to trees left standing and trees outside the excavation areas, 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   Fill Materials

Project fills shall be constructed of suitable earth materials as defined in 1.2 DEFINITIONS and obtained from project excavations or the borrow site(s) per Section 31 23 00.00 21 BORROW SITE EXCAVATION. Materials shall be screened and blended as needed to obtain a blended material suitable for construction meeting the fill requirements outlined in these Specifications. Materials shall be screened, blended and tested for suitability at the borrow site or at stockpile areas prior to placement. Soil classification tests shall be completed for all blended material in accordance with ASTM D2487.

Soils classified as organic clay or organic silt (OH or OL) are unsuitable and shall not be blended for use in the levee embankment or berm fill areas. These materials shall be hauled off-site or used for reclaiming the borrow site area in accordance with Section 31 23 00.00 21 BORROW SITE EXCAVATION. Unsuitable debris as defined in paragraph 1.2 DEFINITIONS shall be disposed of off-site.

2.2   TYPES OF FILL MATERIALS

2.2.1   Levee Embankment Fill Requirements

Levee embankment fill shall be obtained from project excavations and borrow sites approved by the Agency and shall be suitable as embankment fill as outlined below and as shown on the Plans. Levee embankment fill shall consist of low to high plasticity soils classified in accordance with ASTM D2487 as lean clay (CL), clayey sand (SC), or clayey gravel (GC). Fill material shall have no visible concentrations of organic content.

Levee embankment fill, temporary cutoff wall cap, inspection trench, and seepage berm construction shall meet the following requirements:

<table>
<thead>
<tr>
<th>GRADATION</th>
<th>ASTM TEST PROCEDURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>Percent Passing</td>
</tr>
<tr>
<td>2-inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 200</td>
<td>=/&gt;30</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>=/&lt;45</td>
</tr>
<tr>
<td>Plasticity Index:</td>
<td>=/&gt;8</td>
</tr>
</tbody>
</table>

2.2.2   Random Fill - Other

Random fill may be obtained from project excavations shall be suitable for
use as general site fill beyond the limits of the levee embankment. Random fill shall consist of suitable material with a maximum particle size less than 3 inches. Random fill shall not include topsoil material.

2.3 TOPSOIL

Levee embankment slopes shall be dressed with a minimum of 4 inches of topsoil (measured perpendicular to the slope) obtained from the stripping operations.

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 as determined by Contractor's (Agency-reviewed) pre-construction surveys. The levee side slopes shall have a tolerance of 0 to plus 0.4 feet for final dressing (measured perpendicular to the slope and prior to placement and respread of topsoils). The levee crown 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 crown and slopes of the levee 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 levee embankment provided that the surface drains away from the levee in the direction as indicated on the Plans with no abrupt humps or depressions.

3.2 PREPARATION OF FOUNDATION AND ABUTMENTS

3.2.1 Filling of Irrigation Canal

Unless otherwise indicated, irrigation canal shall be drained of water and excavated to a minimum depth of 1 foot or as shown on Plans. The canal shall be prepared as discussed in paragraph 3.2.2 Foundation Preparation prior to placement of fill. Fill shall be placed as discussed in paragraph 3.4 PLACEMENT AND SPREADING.

3.2.2 Foundation Preparation

After excavating or stripping (as described in Section 31 11 00 CLEARING, GRUBBING, AND STRIPPING) of the embankment and foundation area to the extent indicated or otherwise required, the sides of stump holes, test pits, and other similar cavities or depressions shall be broken down so as to flatten out the slopes to no steeper than 1H:1V, and the sides of the cut or hole shall be scarified to provide bond between the foundation material and the fill. Unless otherwise directed, each depression shall be filled with the same material type that is to be placed immediately above the foundation. The fill 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 that cannot be compacted by roller equipment because of inadequate clearances shall be compacted with power tampers in accordance with Paragraph 3.6 COMPACTION for the specific material type.

After filling of depressions and immediately prior to placement of fill, the foundation shall be loosened thoroughly by scarifying, plowing, discing
or harrowing to a minimum depth of 12 inches, and the moisture content shall be adjusted to the amount specified in Paragraph 3.5 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 in accordance with Paragraph 3.6 COMPACTION. No separate payment will be made for loosening and compacting the foundation area, but the entire cost thereof shall be included in the applicable contract price.

3.2.3 Benching

Benching into the existing levee embankment or existing side slopes is required to place and compact the material in horizontal layers. The vertical face cut into the existing surface resulting from the benching operation shall be a minimum of 6 inches in height but shall not exceed 12 inches in height.

3.2.4 Preparation of Cutoff Wall Working Surface to Receive Embankment Fill

The cutoff wall working surface shall be cleaned of excess cutoff wall material and debris prior to placement of levee embankment fill. Immediately prior to placement of fill, the working surface shall be scarified in accordance with Paragraph 3.2.2 Foundation Preparation, the moisture content shall be adjusted in accordance with Paragraph 3.5 MOISTURE CONTROL, and compacted in accordance with Paragraph 3.6 COMPACTION.

3.2.5 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.

3.2.6 Dewatering

Dewatering shall be performed in accordance with Section 31 23 19 DEWATERING. 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 of any structure, except with specific written direction, 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 the removal of the existing levee crown, existing seepage berm, excavation for inspection trench, excavation of roadways, excavation as necessary to key and bench fills, and removal of objectionable and unsuitable materials, and excavation for pipe crossings. Excavation for borrow materials shall be performed in accordance with Section 31 23 00.00 21, BORROW SITE EXCAVATION.

3.3.1 Levee Degrade

Levee degrade shall consist of the removal of the existing levee crown to the lines and grades shown on the Plans. Crown surfacing removal and salvage shall be performed in accordance with the Plans and these Specifications.

Materials obtained from project excavations that do not meet the requirements for Levee Embankment and/or Random Fill shall become the property of the Contractor and shall be disposed of off-site in a legal manner.

Levee degrade material shall be used as Levee Embankment and as Random Fill so long as it meets or can be blended to meet the requirements indicated in Paragraph 2.2, Materials, of these Specifications. Contractor shall maximize use of levee degrade material that meets or can be blended to meet the requirements for Levee Embankment.

Contractor may modify the working surface elevations indicated on the plans based on the capabilities of the contractor's cutoff wall construction equipment. The Contractor shall submit a plan, for any such modification to the working surface elevations, to the Agency for review. The Contractor's plan shall include the Contractor's proposed working surface elevations, the station limits where the change is proposed. All costs associated with any such modification to the working surface elevations, including costs associated with adjustments to the cutoff wall, levee degrade, levee embankment fill, detention basin excavation, etc., quantities shall be the responsibility of the contractor.

3.3.2 Over-Excavation

3.3.2.1 Within Limits of Levee Foundations or Structures

Over-excavation within the limits of the foundations of levees and structures shall be backfilled to grade with the same material type that is to be placed immediately above the excavation, respectively, keyed into adjacent ground, placed in uncompacted lifts not exceeding six inches and compacted in accordance with this Specification. Keying of fill shall be in accordance with the details shown on the Plans.

3.3.2.2 Slopes and Surcharges

Temporary excavation slopes shall not be steeper than the specified finished slope or the specified construction slope, as shown on the plans. This may be accomplished by benching the temporary slope so that the average slope is not steeper than the specified amount.

No temporary, permanent, or construction slope shall be surcharged with excavated or stockpiled material or with heavy construction equipment which would have the same effect as the surcharge material. The toe of
stockpiled material shall be maintained a minimum distance back from the
top of the finished excavation equal to the depth of the excavation. The
maximum height of such stockpile without causing instability of the
excavation slope shall be determined by the Contractor. Any slide or other
adverse conditions caused by failure of the Contractor to maintain these
conditions shall be considered the responsibility of the Contractor and
remedial measures shall be at the Contractor's expense.

3.3.3 Utilities

Excavations for utility removal shall be as specified on the Plans and in
these Specifications.

Excavate to the dimensions indicated or to safe limits if dimensions are
not provided. Grade 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. Rock, where encountered, shall be
excavated to a depth of at least 6 inches below the bottom of the pipe or
structure.

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 fill shall be placed on any part of the embankment foundation or levee
degrade surface 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 levee
embankment and berms will be free from lenses, pockets, streaks, and layers
of material differing substantially in texture or gradation from
surrounding material of the same class. If lenses, pockets, or layers of
materials differing substantially in texture or gradation from surrounding
material occur in the spread material, the layer shall be removed, blended,
and tested for suitability prior to replacement. Screening and blending of
materials shall occur in approved stockpile areas. During the placement and
spreading process, the Contractor shall maintain at all times a force of
workers adequate to remove oversized particles, oversized roots, debris,
rubble, trash, deleterious items, concentrations of organic material,
oversized stones, and all oversized rock fragments from all levee
embankment materials. The maximum allowed particle size for the appropriate
fill material type shall be as indicated in Section 2.2 TYPES OF FILL
MATERIALS.

3.4.1.2 Equipment Traffic

Equipment traffic on any embankment zone shall be routed to minimize
rutting of placed fill 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. If the compacted
surface of any layer of material is too smooth, as determined by the
Engineer, to bond properly with the succeeding layer, the surface shall be
loosened by scarifying and compacted before material for the succeeding
layer is placed.

3.4.2 Placement of Embankment and Structural Backfill

No embankment or structural backfill shall be placed on or against concrete less than 7 days after placement or 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 any existing utilities. Any damage caused by the Contractor's operation shall be repaired at the Contractor's expense.

3.4.3 Fill Lift Thickness

Levee embankment fill and Random fill materials shall be placed and spread in layers not more than 6 inches in uncompacted thickness, except within four (4) feet of structures, where the uncompacted layer thickness shall be reduced to four (4) inches unless otherwise indicated on the plans.

3.4.4 Canal Fill

The existing irrigation canal within levee embankment footprint shall be filled using material meeting the requirements for levee embankment fill. Filling of the canal shall be completed by dumping the appropriate fill material types into the fill area and up to approximately 3-ft above the existing water surface elevations (refer to the elevations shown on the plans). Contractor to provide a canal fill plan using levee embankment and random fill material detailing the equipment, operations and methods to be used to fill the canal as outlined in this paragraph and as shown on the plans. The contractor's plan shall be submitted to the Agency for review prior to start of any canal filling operations.

3.4.5 Topsoil

Levee embankment slopes shall be dressed with a minimum of 4 inches of topsoil (measured perpendicular to the levee slopes) obtained from the stripping operations. Top soil shall be uniformly blended in stockpile areas then placed in uniform thickness across the finished levee embankment slopes.

Before topsoil application, the finish grade surface of the levee or berm shall be uniformly scarified to a depth of 6 inches. Soil scarification shall be conducted using one of the following methods: a chisel tool with rigid teeth 12 - 18 inch centers or a disk harrow.

Topsoil shall have sufficient moisture before spreading to ensure proper placement. Unnecessary vehicle operation or hauling on the levee and berm surfaces following topsoil placement will not be allowed.

3.4.6 Erosion Control Seeding

Slopes shall be track-walked and seeded in accordance with the requirements of 32 92 19 EROSION CONTROL SEEDING.
3.5 MOISTURE CONTROL

3.5.1 General

The moisture content prior to compaction shall be as specified below.

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Soil Type</th>
<th>Minimum Moisture Content Percentage Points Above Optimum (ASTM D698)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Levee Embankment Fill</td>
<td>CL</td>
<td>0</td>
</tr>
<tr>
<td>Seepage Berms</td>
<td>CL</td>
<td>0</td>
</tr>
<tr>
<td>Random Fill</td>
<td>SC or GC</td>
<td>0</td>
</tr>
<tr>
<td>Utility Trench Backfill</td>
<td>CL</td>
<td>0</td>
</tr>
<tr>
<td>Ramps and Roadways</td>
<td>SC or GC</td>
<td>0</td>
</tr>
<tr>
<td>Structural Backfill</td>
<td>SC or GC</td>
<td>0</td>
</tr>
<tr>
<td>Subgrade to Receive Fill</td>
<td>SC or GC</td>
<td>0</td>
</tr>
<tr>
<td>Initial Backfill over Cutoff</td>
<td>CL</td>
<td>3</td>
</tr>
<tr>
<td>Walls</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fill that is below the specified minimum moisture content shall be moisture conditioned prior to compaction. The contractor shall add water to the fill material and by harrowing, or other approved methods, work the moisture into the material until a uniform distribution of moisture is obtained. Water applied on a layer of fill 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 the fill, compaction shall be delayed until the moisture content of the materials is reduced to an amount that allows the specified relative compaction to be met.

3.5.1.1 Drying Wet Material

Fill that is too wet to allow the specified relative compaction to be met shall be dried prior to compaction. Drying shall be assisted by discing or harrowing, if necessary, until the moisture content is reduced to an amount that allows the specified relative compaction to be met.

3.6 COMPACTION

3.6.1 Equipment

Compaction equipment shall conform to the following requirements and shall be used as prescribed in subsequent paragraphs.

3.6.1.1 Sheepsfoot Rollers

Sheepsfoot rollers shall be capable of achieving the specified compaction and shall consist of self-propelled steel-wheeled compactors such as a Caterpillar 815, Caterpillar 825, or equivalent. Alternative compaction equipment must be approved by the Agency.

3.6.1.2 Smooth-faced Steel Rollers

Smooth-faced steel rollers for compacting aggregate base shall be capable of achieving the specified compaction. Alternative compaction equipment
must be approved by the Agency.

3.6.1.3 Hand Operated Compactors

Compaction of material in areas where it is impracticable to use a roller 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 principle and shall deliver an impact of not less than 2000 lbf at a rate of approximately 2000 impulses per minute. The character and efficiency of this equipment shall be subject to the review by the Agency.

3.6.1.4 Crawler-Type Tractors

Crawler-type tractors used for spreading or track walking shall weigh not less than 20,000 pounds, shall exert a unit tread pressure of not less than 6 psi, and shall be operated at a speed not to exceed 3.5 miles per hour.

3.6.1.5 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.

3.6.1.6 Miscellaneous Equipment

Scarifiers, disks, spring-tooth or spike-tooth harrows, spreaders, and other equipment shall be suitable for use in embankment construction. Equipment used for processing fill material shall be capable of penetrating the full loose lift thickness of the specific material type.

3.6.2 Compaction of Fill

After a layer of material has been dumped and spread, it shall be harrowed to break up the fill materials to eliminate all clods and to obtain uniform moisture distribution. Harrowing shall be performed with a heavy disk 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.

Fill shall be uniformly compacted to comply with the following minimum relative compaction (maximum dry density in accordance with ASTM D 698, latest edition):

<table>
<thead>
<tr>
<th>MATERIAL TYPE</th>
<th>MINIMUM RELATIVE COMPACATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade to Receive Engineered Fill</td>
<td>97 percent</td>
</tr>
<tr>
<td>MATERIAL TYPE</td>
<td>MINIMUM RELATIVE COMPACTION</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Levee Embankment, Ramps and Roadways</td>
<td>97 percent</td>
</tr>
<tr>
<td>Initial Backfill over Cutoff Walls</td>
<td>92 percent</td>
</tr>
<tr>
<td>Structural Backfill and Utility Trench and Trench Backfill</td>
<td>97 percent</td>
</tr>
<tr>
<td>12 Inches Beneath Aggregate Base or Aggregate Surfacing</td>
<td>97 percent</td>
</tr>
<tr>
<td>Random, Non-Structural Fill within the Project</td>
<td>97 percent</td>
</tr>
</tbody>
</table>

A minimum of two passes with approved compaction equipment shall be performed over each fill layer.

In areas which are not accessible by roller, the fill 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.

3.6.3 Placement and Compaction of Initial Backfill over Cutoff Walls

The initial fill over a cutoff wall shall be placed as shown in the Plans in two equal thickness lifts for a total compacted thickness of 2 feet. Each lift shall be placed and compacted using equipment, methods, and a direction of travel to ensure that the cutoff wall is not disturbed. Fill material above this initial fill shall be placed and compacted in accordance with paragraphs 3.4.2, 3.4.3, and 3.6.2 of this specification.

3.7 STOCKPILES

Topsoil stockpiles shall be stored dry and not compacted through earthmoving operations more than is necessary for dust control and traction during placement. The only water application shall be to control dust and allow for traction of equipment.

Weeds growing on stockpiled material shall be controlled with a non-residual herbicide such as Glyphosate. Herbicides and methods of application shall be reviewed by the Agency prior to weed control.

Levee degrade material suitable as levee embankment fill may be side cast onto levee slopes during construction. Areas where materials are side cast shall be considered as stockpile areas. Levee slopes shall be restored as indicated on the plans or to preconstruction condition if not indicated on the plans.

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.

The Agency will retain a geotechnical engineering firm to provide testing and inspection of work in connection with excavating, filling, compacting, and grading. The testing program specified below shall be considered the minimum acceptable frequency of testing performed by the Agency.

3.8.2 Embankment and Fill Testing

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. Fill Material Testing

(1) Moisture Density Relationships. The moisture-density relations for soils shall be determined in accordance with ASTM D 698 latest edition, with a minimum of four points of compaction test. The moisture-density curves will be compiled to form a family of curves that will be utilized to estimate optimum properties (maximum dry density and optimum moisture content) to be used with field density tests.


<table>
<thead>
<tr>
<th>TEST METHOD</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Density Relationship (ASTM D698)</td>
<td>Minimum of five (5) test or representative samples of each type of fill material used.</td>
</tr>
<tr>
<td>Soil Gradation (ASTM D422), Atterberg Limit (ASTM D4318),and Soil Classification (ASTM D2487)</td>
<td>One test for each moisture density and relative density relationship.</td>
</tr>
</tbody>
</table>

(2) 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. One water content test may be performed for each in-place density test at the location of the in-place density test. Backfill and fills not meeting the required specifications for water content shall be retested after corrective measures have been applied.

(3) In-place Density Testing. The minimum frequency of in-place density testing is shown in the table below. The horizontal locations of tests shall be randomly staggered in the fill. Backfill and fills not meeting the required specifications for in-place density shall be retested after corrective measures have been applied.
<table>
<thead>
<tr>
<th>TEST METHOD</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear Method (ASTM D6938)</td>
<td>One (1) In-Place Density Test for every 600 cubic yards of completed fill unless otherwise specified. Additionally, at least one (1) test for each lift of fill placed and material type.</td>
</tr>
<tr>
<td>Soil Gradation and Atterberg Limit Tests</td>
<td>One (1) test for every 1,200 cubic yards of compacted fill. Minimum of one (1) test per shift and material type.</td>
</tr>
</tbody>
</table>

If soil appears to contain organics based on color or smell, the Agency may require the Contractor to test the material in accordance with ASTM D2487 to classify organic clay or organic silt (OH or OL).

3.8.3 Reporting

On a daily basis, the Contractor shall furnish the inspection records and all material testing results, the quantity of fill placed, as well as the records of corrective action taken, in accordance with Section 01 45 04.00 41 CONTRACTOR QUALITY CONTROL.

-- End of Section --
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DIVISION 31 - EARTHWORK

SECTION 31 11 00

CLEARING, GRUBBING, AND STRIPPING

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.2   SUBMITTALS

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

SD-01 Preconstruction Submittals

Work Plan

Work Plan 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 resubmittal of the Work Plan are 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 stripping, 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.

SD-06 Test Reports

Post-Construction Surveys

a. Station to station limits.

b. Transverse limits from control line.

c. Depth of stripping.
1.3 DEFINITIONS

1.3.1 Levee Stripping

Levee stripping shall consist of the removal and stockpile of crops, weeds, grass, and other vegetative materials to the ground surface and removal of surface soil to the depth specified herein and to the construction limit shown on the Plans. Refer to Section 3.3.2, "Description of Work," for additional restrictions and requirements.

1.3.2 Levee Degrade

Levee Degrade shall consist of the removal and stockpile of the levee crown and seepage berm to the grades shown on the Plans and as specified herein.

1.3.3 Unsuitable Debris

Materials containing roots greater than 1/2 inch in diameter and 6 inches in length, debris, rubble, trash or other deleterious items shall be classified as unsuitable debris.

1.4 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.

1.5 GENERAL

1.5.1 Description of Work

The work covered by this section consists of furnishing all labor, equipment, and materials necessary to perform the clearing and grubbing, stripping, asphalt and concrete roadway removal, the removal or disposal of all cleared and grubbed materials, the stockpile and respread of stripped 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. All work under this section shall comply with the requirements of EM 385-1-1.

1.6 ORDER OF WORK

a. Work shall be carried out within the project footprint 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 300 feet in advance of levee embankment construction. In locations where work on drainage structures is performed prior to levee or roadway construction, all clearing and grubbing shall be completed in advance for at least 100 feet in both directions from the structure, measured along the levee center line.

c. The Contractor shall comply with the requirements of the Special Provisions.
PART 2   PRODUCTS

Not used.

PART 3   EXECUTION

3.1   CLEARING

3.1.1   General

The clearing operations shall consist of the complete removal of all obstructions above the ground surface.

3.1.2   Levees, Seepage Berms, and Ramps

All trees, stumps, down timber, snags, brush, vegetation, old piling, rock, stone, concrete rubble, abandoned structures, and similar debris shall be cleared within the limits of construction shown on the Plans, excluding restricted habitat areas. Refer to the plans for limits of tree removal.

3.1.2.1   Vegetation

Vegetation to be removed shall consist of all heavy growth of brush and woody vegetation.

3.1.2.2   Tree Removal

Tree removal shall consist of removing the canopy, tree trunk and roots per the details shown on the Plans.

3.1.2.3   Miscellaneous Structures and Debris

The Contractor shall also remove abandoned foundations, debris, concrete rubble, and other materials in degrade areas or in areas which will be covered with embankment, and as shown on the Plans.

3.1.3   Roadwork, Structures and Ditches

Clearing requirements for roadwork, above ground structures, channels, and ditches shall be as specified in Paragraph 3.1.2 of this section.

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 removal of all stumps, roots, buried logs, old piling, old paving, and other objectionable material as defined in these Specifications and to the limits of construction shown on the Plans, excluding restricted habitat areas.

3.2.2   Levees, Seepage Berms, and Structures

The entire area within the limits of construction as shown on the Plans
(except in restricted habitat areas), existing levees to be degraded, ponding areas, ditches, structures, traverses, channels, ramps, and the areas within the limits of all structures shall be thoroughly grubbed. All tap roots, lateral roots, or other projections, encountered during levee and levee foundation excavation shall be removed. Tree root removal shall be per the details on the Plans.

3.2.3 Filling of Holes

All holes caused by grubbing operations, except in borrow areas, shall be excavated with 3 to 1 (horizontal to vertical) side slopes. 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 stripping operations.

3.3 STRIPPING

3.3.1 General

After inspection and review of cleared and grubbed areas, stripping may proceed.

3.3.2 Description of Work

Strip 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 stripping may be necessary as specified below and as determined by the Agency.

a. Except as noted below, the entire area within the limits of construction identified on the Plans shall be stripped to remove crops, weeds, grass, and other vegetative materials. Stripping shall be to a minimum depth of 0.5 feet (measured perpendicular to the levee slope). Deeper stripping may be required in areas where concentrations of organic soils or tree roots are encountered. Stripped material shall be stockpiled and respread on levee slopes in accordance with Section 31 00 00 EARTHWORK.

b. Stripping of the levee embankment fill area shall be at 1.0 feet below the existing surface.

c. All stockpile areas shall be stripped to a depth of 0.5 feet before material is stockpiled.

d. No stripped material shall be stockpiled on existing levee slopes.

e. Borrow site stripping is specified in Section 31 23 00.00 21 BORROW SITE EXCAVATION.

3.3.3 Aggregate Surfacing Removal and Salvage

The top 3 inches of the levee crown shall be stripped to remove the existing aggregate surfacing, unless otherwise shown on the Plans. Stripped aggregate surfacing shall be salvaged for respread on the levee as indicated in these Specifications, shown on the Plans, and as directed by the Agency. Aggregate surfacing shall be placed in accordance with Section 32 15 00 AGGREGATE SURFACE COURSE.
3.3.4 Relocation and Replacement of Stripped Material

The stripped surface soil shall be respread on the completed levee slope in accordance with Section 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 which are the products of the clearing and grubbing operations shall be disposed of offsite at an approved waste facility.

3.5 FIELD QUALITY CONTROL

3.5.1 Clearing and Grubbing

The Contractor shall establish and maintain quality control for clearing and grubbing operations to assure compliance with contract requirements, and maintain records of the quality control for all construction operations including but not limited to the items indicated below. These records, as well as the records of corrective actions taken, shall be furnished to the Agency in accordance with Section 01 45 01.10 QUALITY CONTROL SYSTEM (QCS).

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**DIVISION 31 - EARTHWORK**

**SECTION 31 23 00.00 21**

**BORROW SITE EXCAVATION**

01/10

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1.2.2 Surface Layer Removal and Stockpile

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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 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 D422 (1963; R 2007) Particle-Size Analysis of Soils


U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

1.2   DEFINITIONS

1.2.1   Unsuitable Debris

Material containing roots greater than 1/2-inch in diameter and 6-inches in length, debris, rubble, trash or other deleterious items shall be classified as unsuitable debris.

1.2.2   Surface Layer Removal and Stockpile

Surface layer removal and stockpile shall consist of the discing of crops, weeds, grasses and other vegetative material into surface layer and the removal, segregation, and stockpiling of the surface layer.

1.2.3   Excavation

Excavation shall consist of removal of material to the lines and grades shown on the Plans, or as otherwise directed or reviewed by the Agency and as described in Paragraph 3.3 EXCAVATION.
1.3 SUBMITTALS

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

SD-01 Data

Pre-Construction Condition;

Submit documentation and video tape of pre-construction condition of roadways at access points and along haul routes showing adequate detail of existing conditions, per Section 11-2 of the General Specifications.

Survey Data;

Submit copies of survey data in cross section and electronic forms of the borrow site after surface layer removal (prior to excavation of borrow site), and after excavation per Section 5-9 of the General Specifications. The Contractor shall submit written certification that the data is accurate and surveying was performed by a licensed surveyor authorized to practice land surveying in the State of California. Submit electronic data within 24 hours per Section 5-9 of the General Specifications. Submit cross sections within ten (10) days of performing field surveys.

Equipment Data;

Submit equipment data used for excavation, hauling, fill placement, compaction, and sprinkling equipment shall be submitted and include weights, size, and contact pressures.

Material Distribution and Stockpile Plan

Submit and Earth Material Distribution and Stockpile Plan that describes where material will be obtained, placed, and stockpiled for usage or for temporary disposal. This information shall be provided within 15 days after the notice to proceed.

Borrow Source Excavation;

Submit a written Excavation Plan a minimum of 20 days prior to the beginning of any 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. 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 rights-of-way.

b. The proposed methods for controlling surface and ground water in the borrow areas and required excavations.
c. A plan of the borrow area subdivided into areas equivalent to approximately 1,000 cubic yards of borrow. Each sub area shall be numbered and this number shall be included on the laboratory test reports and daily field reports. Plan shall be resubmitted during construction if borrow sub areas are modified.

d. Stockpiling and blending plan for embankment material before it is transported to the project site showing locations, stockpile heights, slopes, limits, and drainage around the stockpile areas.

e. The Contractor's proposed sequence of work for excavating the borrow sites with plan and cross sectional views showing starting and final work locations and clearing, grubbing and surface layer removal limits.

f. The Contractor's proposed road pattern, and plan for implementing dust control measures.

g. Plan shall outline procedures for placing/hauling different materials encountered in the borrow site to the levee, seepage berm, roadway, and other fill locations.

Borrow Source Utilization Plan;

Submit a written plan for utilization of Borrow Sources a minimum of twenty (20) days prior to beginning any excavation of the borrow source and contingent borrow sources. Plan shall describe proposed methods for adjusting extent and depth of excavations to obtain the required borrow quantity. 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.

SD-06 Test Reports

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 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 a maximum of 24 hours after completion of the test and at least 48 hours prior to placement of the fill.

1.4 GENERAL CONDITIONS

1.4.1 Description of Work

The work covered by this section consists of furnishing all plant, labor, equipment and materials, and performing all operations necessary for demolition, clearing and grubbing at borrow sites; clearing and grubbing the limits of surface layer to be removed; discing of vegetative material into surface layer; the excavation and removal of the surface layer and all unsuitable soil, and stockpiling the soils and stripped material; dewatering and control of water within borrow excavation; excavation of designated borrow sources; processing of materials; hauling materials to their point of use or disposal; disposal of unsuitable debris; constructing
ramps and fills at the borrow sites; compacting the stockpiled soils and unsuitable materials, constructing ramps and fills at the borrow sites; stabilized entrance; erosion and sediment control at the borrow site indicated on the plans; respread compaction and finished grading of the surface layer after borrow excavation; compacting of the spoil areas and unsuitable materials as specified herein and as shown on the Plans. All work under this section shall comply with the requirements of EM 385-1-1.

1.4.2 Materials

Materials excavated from the project excavations which meet or which can be processed to meet the requirements for each embankment material, or any other material required for this project, as specified herein, shall be utilized in the appropriate portion of the embankment or as backfill, unless otherwise noted. Fill materials shall meet the requirements of Section 31 00 00 EARTHWORK.

1.4.3 Haul Roads

Haul roads shall be located and constructed as shown on the Plans and as reviewed by the Agency. Prior to the commencement of excavation the Contractor shall submit for review a site plan detailing the location of all haul roads within the site limits. Haul roads shall be constructed to maintain the intended traffic, be free draining, and be maintained in good condition throughout the contract period. Haul roads constructed during the Contract duration shall be removed after work is completed and the impacted area restored to its preconstruction conditions.

1.4.4 Stockpiling

On-site stockpiles shall be kept neat and weed free. Stockpiles shall be placed in areas where surface layer removal has been completed.

1.4.5 Protection of Existing Man-Made Facilities and Natural Features

Borrow site excavation shall be conducted in such a manner as to avoid damage to trees left standing and trees outside the excavation areas, existing buildings, man-made facilities and natural features, with due regard to the safety of employees and others.

1.4.6 Drainage

Unless otherwise noted on the Plans, the Contractor shall not block or restrict the flow in a natural drain, existing culvert, ditch or channel at any time and shall bear full responsibility for any damage caused by this operation. 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.

PART 2 PRODUCTS

Not Used.

December 30, 2019
PART 3 EXECUTION

3.1 GENERAL

Except as specified herein and in Section 31 00 00 EARTHWORK, the Contractor shall obtain the borrow materials for the levee embankment and seepage berms from the borrow sources specified by the Agency. Borrow material shall be used for levee and seepage berm construction as indicated on the Plans, specified herein or as otherwise directed by the Agency.

3.2 BORROW SITE

3.2.1 General

The Borrow Area indicated on the Plans will be furnished without cost to the Contractor and shall be utilized for constructing this project. The logs of borings and test pits included in the Geotechnical Data Report represent information which the Agency has obtained at the borrow sites and are included in Volume 4 of these specifications. The logs of the borings and test pits included in the Geotechnical Data Report represent interpretations of data which the Agency has obtained at the borrow sites and are included in the reference section of these specifications. The Contractor should make their own interpretation of the data. The Agency assumes no responsibility for interpretations, conclusions, or deductions made by the Contractor from the data in the Geotechnical Data Report. Not all materials at the furnished borrow sites may meet the requirements for fill as outlined in Section 31 00 00 EARTHWORK.

3.2.2 Requirements at Borrow Sites

The Contractor's operations at the borrow site shall conform to requirements prescribed herein and as shown on the Plans. The estimated permissible depth of borrow site excavation is indicated on the Plans, but the Agency reserves the right to modify the permissible depth in accordance with subsurface conditions determined as work proceeds. Any excavation below the depths and slopes specified herein, except as shown on the Plans or directed by the Agency, shall be deemed a violation of these Specifications and the resulting cavity shall be immediately filled and compacted to the specified grade.

3.3 EXCAVATION

3.3.1 General

Excavation of each borrow site shall be in accordance with the borrow site grading plan shown on the Plans. The Contractor shall maximize the use of available, suitable soils from mandatory excavations before using soils from the borrow area.

3.3.2 Clearing and Grubbing

Clearing operations shall consist of complete removal of all obstructions above the ground surface in accordance with Section 31 11 00 CLEARING, GRUBBING AND STRIPPING. Grubbing operations shall consist of the removal of stumps, roots larger than 1/2 inch in diameter and 6 inches in length and all buried logs, old piling, old paving, and other objectionable matter within the areas to be used for borrow operations. Dispose of cleared and grubbed materials offsite.
3.3.3 Removal of Existing Facilities

Within the areas to be used for borrow operation and prior to the removal of the surface layer of native soils, the Contractor shall remove any structures, foundations, pipes, septic systems, culverts, fencing, abandoned wooden utility poles, irrigation stand pipes, debris and other materials unsuitable for use in the levee embankment.

Existing wells not to be used as a source for water during construction shall be abandoned per local, State, and Federal requirements.

3.3.4 Surface Layer Removal and Stockpile

After inspection and review of cleared and grubbed areas, removal of surface layer may proceed. Perform surveys in accordance with these specifications prior to and after surface layer removal. Disc the vegetation remaining after clearing and grubbing operations into upper portion of surface layer. Remove the top 0.5 feet of surface layer to the limits of the area to be excavated and stockpile for respread. Deeper stripping may be required in areas where concentrations of organic soils or tree roots are encountered.

Stripping of dredge tailing borrow areas shall be only as necessary to remove crops, weeds, grass, and other vegetative materials and only to the limits of fill and excavation shown on the Plans. Dredge tailing areas with no visible crops, weeds, grass, or other vegetative materials are not required to be stripped.

3.3.5 Processing Suitable Materials

The Contractor shall survey the surface upon completion of the surface layer removal as specified herein and in the General Specifications. Depending on the time of year, excavated borrow soils may be either greater than or less than the optimum moisture content. Addition of water during processing may be required to uniformly moisture condition the borrow soil to meet the moisture content specifications for compaction. Conversely, wet soils may need to be dried by aeration or other suitable means.

3.3.6 Blending

Some earthen materials are present within the borrow sites that do not meet the requirements for fill. These excavated materials shall not be classified as unsuitable or wasted, but shall be uniformly blended with suitable borrow materials so that the blended material meets the requirements for the appropriate fill type in accordance with 31 00 00 EARTHWORK. All blending of borrow materials shall be performed at the borrow site or at the stockpile areas. No blending shall be allowed on the levee embankment. Blended material used within the levee embankment or berms shall meet the material requirements in Section 31 00 00 EARTHWORK prior to spreading and compacting.

3.3.7 Unsuitable Organic Material and Unsuitable Debris

Materials which are classified as unsuitable as described in sub-part 1.2.1, Unsuitable Materials, shall be wasted. Unsuitable organic material shall be placed in the designated stockpile area. Unsuitable debris shall be removed and disposed of at an authorized disposal facility.
3.3.8 Finish Subgrade Preparation

Upon completion of excavation, the Contractor shall perform quantity surveys as specified in the General Specifications. Surfaces shall then be graded in accordance with the Plans and as directed by the Agency.

3.3.9 Surface Layer Respread

Upon completion of subgrade preparation, respread surface layer and any stockpiled unsuitable organic material uniformly over the excavated area. Finish grade site in accordance with the Plans, and as directed by the Agency. Site shall be leveled to remove surface depressions and positively drain entire site in accordance with the slopes shown on the Plans or as otherwise directed by the Agency.

Upon completion of the topsoil respread, the borrow site shall be rolled with a rubber-tired roller. Rubber-tired rollers shall have a minimum of four (4) 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 pounds per square inch 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 5 percent of the rated tire width of a single tire at the operating pressure for a 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 five (5) miles per hour.

A minimum of two passes with approved equipment shall be performed over topsoil respread. Each pass of the roller shall overlap the preceding or adjacent pass by not less than one foot. Portions of the borrow site which the roller cannot reach for any reason shall be compacted by Agency reviewed method.

3.3.10 Erosion Control Seeding

All disturbed areas of the borrow sites and all disturbed areas of the haul roads shall be erosion control seeded, as shown on the plans and as specified in Section 32 92 19 EROSION CONTROL SEEDING.

3.4 DEWATERING AND DIVERSION

Surface and groundwater control shall be accomplished in coordination with the required excavation and embankment construction activities. Seepage of water from adjacent irrigated agricultural operations and irrigation ditches should be anticipated. Such seepage shall be intercepted at perimeter of the excavation area and rerouted to drainage ditches adjacent to borrow site. Excavations at depth may encountered saturated soil conditions from perched groundwater and shall be moisture conditioned for use. Surface and/or groundwater control may necessitate the use of temporary diversion ditches, cofferdams and/or dewatering by the use of pumping. Methods for care of surface water and for controlling the surface and groundwater levels shall be the responsibility of the Contractor and shall comply with all Federal, State and local regulations.
3.5 RAMPS AND FARM ROADS AND EMBANKMENTS

Temporary ramps, constructed for the convenience of the Contractor, shall be removed prior to completing the finish grading of the borrow site. Permanent ramps and farm roads shall be constructed and compacted in accordance with the applicable provisions of Section 31 00 00, EARTHWORK. All embankments constructed at the designated borrow sites shall conform to the applicable provisions of Section 31 00 00, EARTHWORK.

3.6 SURFACE DRAINAGE OF COMPLETED AREAS

The finished surface shall be free of sharp ridges, gullies, potholes, sinkholes, and any other surface irregularities and shall drain in the direction as shown on the plans.

3.7 FIELD QUALITY CONTROL

3.7.1 General

As a part of the Contractor Quality Control (CQC) system required by Section 01 45 04.00 41 CONTRACTOR QUALITY CONTROL, the Contractor shall establish and maintain field quality control for borrow excavation, borrow soil testing, and borrow soil preparation to assure compliance with contract requirements and maintain detailed records of field quality control for all operations including but not limited to the following.

3.7.1.1 Excavation Equipment

Type, size, number of units and suitability for the construction of the prescribed work.

3.7.1.2 Borrow Soil Preparation

Methods of preparing the soils and soil testing program to confirm soils meet the requirement of Section 31 00 00 EARTHWORK.

3.7.2 Materials Testing

The Contractor shall perform sufficient testing to ensure that the borrow soils meet the requirements of Section 31 00 00 EARTHWORK. 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 the specifications.

3.7.2.1 Soil Classification Tests

Soil classification tests shall be performed consistent with the requirements of 31 00 00. One initial classification test shall be required for each different classification of material to be utilized as fill or backfill. One soil classification test shall be performed for each 1000 cubic yard of borrow material. As prescribed in ASTM D2487, grain size analyses in accordance with ASTM D422 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 to meet the requirement of Section 31 00 00 EARTHWORK. The test results shall be submitted to the Agency at least 48 hours prior to placement of the fill. Test results shall include the borrow Sub Area Number as defined in 1.3 SUBMITTALS, Excavation Part C.
3.7.2.2 Water (Moisture) Content Tests

Determination of water content shall be performed in accordance with ASTM D2216. One water content test shall be performed for each soil sample. Backfill and fills not meeting the required specifications for water content in Section 31 00 00 EARTHWORK shall be retested after corrective measures have been applied.

3.7.3 Testing by the Agency

During the life of this contract, the Agency will perform quality assurance tests. Approximately 20% of quality control testing will be selected by the Agency for quality control.

3.7.4 Reporting

On a daily basis, the Contractor shall furnish all material testing results, the quantity of borrow excavated as well as the records of corrective action taken, in accordance with Section 01 45 04.00 41 CONTRACTOR QUALITY CONTROL.

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DEWATERING

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PART 1   GENERAL

1.1   SCOPE

a. This section specifies the definition, responsibilities, and execution for control of water. Control of water shall consist of the design, furnishing, installation, operation, maintenance, monitoring, removal of a dewatering system or systems, and sheet pile cofferdam to achieve proper completion of all work performed under this Contract.

b. The Contractor shall provide, operate, maintain, and decommission the dewatering systems that consist of deep wells and/or wellpoints and a monitoring system. The Contractor shall control groundwater so as to prevent softening of the bottom of excavations, or formation of quick conditions or boils during excavation. The Contractor shall depress water levels and hydrostatic pressures a minimum of 3 feet below the excavation bottom at all times under all conditions. The Contractor shall design, install, maintain, and operate the dewatering system so as to prevent removal of the natural soils.

c. The Contractor shall provide backup systems for all ordinary emergencies, including power outage and flooding, and shall have available at all times competent workers for the continuous and successful operation of the dewatering system. The Contractor shall not disable or shutdown the dewatering system between shifts, on holidays, weekends, or during work stoppages, without written permission from the Agency. The Contractor shall be responsible for maintaining all electric power service connections to the dewatering system components and for the cost of electric power used in the operation of the dewatering system.

d. The Contractor shall control surface runoff so as to prevent entry or collection of water in excavations or in other isolated areas of the site. The Contractor shall employ sumps to pump any pocketed or undrained water not otherwise collected or removed.

e. The dewatering system shall be designed by a California registered civil or geotechnical engineer using accepted and professional methods of design and engineering consistent with sound modern practice. The Contractor shall have, or shall employ the services of, a subcontractor who has experience in the field of dewatering system design, installation, operation, and maintenance. The dewatering system design, construction, and abandonment shall conform to all applicable U.S. Army Corps of Engineers requirements.

f. Before the commencement of any dewatering, the Contractor shall obtain acceptance by the Agency for the design, materials, method, installation, and operation and maintenance details of sheet pile cofferdam, the dewatering system(s) and monitoring system the Contractor plans to install. Acceptance by the Agency of the design, materials, method, installation, and operation and maintenance details submitted by the Contractor shall not in any way relieve the Contractor...
from responsibility for errors therein or from the entire responsibility for complete and adequate design, materials, installation, operation, maintenance and performance of the system in controlling the water level in the excavated areas and for control of the hydrostatic pressures to the depths herein specified. The Contractor shall bear sole responsibility for proper design, installation, operation, maintenance, and any failure of any component of the dewatering system and sheet pile cofferdam for the duration of this Contract.

g. After initiating dewatering operations, the Contractor shall operate, maintain and monitor the dewatering system or systems for the duration of the contract until specifically authorized in writing by the Agency to cease operation, maintenance or monitoring.

h. Well construction and abandonment shall be in accordance with STATE REGULATIONS.

i. The Contractor shall install, operate, and maintain a water treatment system to provide for settling of suspended solids in the discharge from any sumping, dewatering well or wellpoint system.

j. The Contractor shall dewater and dispose of the water in a manner that will not cause injury to public or private property, or cause a nuisance or a menace to the public.

k. The Contractor shall not allow the water discharged from the dewatering system wells, wellpoints or supplemental water control systems (i.e. sumps) to degrade the water quality of the receiving waters. The Contractor shall cease all discharge to receiving waters when the discharge exceeds STATE SURFACE WATER QUALITY STANDARDS.

l. The Contractor shall pay any fines incurred as a result of discharges that exceed Surface Water Quality Standards.

1.2 DEFINITIONS

Aquifer - rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit water to pumped wells, wellpoints, eductors and sumps.

Confining layer - a body of material of low hydraulic conductivity/permeability that is stratigraphically adjacent to one or more aquifer. It may lie above or below the aquifer and has a permeability lower than the adjacent aquifer.

Dewatering System - a system that will lower the water table, piezometric or potentiometric surface adequately to permit safe and dry construction.

Groundwater - water that is found in fully saturated soils, sediments and rocks below the surface of the ground and which flows primarily in response to gravitational forces.

Confined Groundwater - groundwater under pressure that is greater than atmospheric pressure. Confined groundwater is separated from direct contact with atmospheric pressure because of overlying impermeable or relatively low permeability layers of sediments or rock.
Groundwater (unconfined) - water in an aquifer that has a water table that is at atmospheric pressure.

Groundwater Table - is a particular potentiometric surface for an unconfined aquifer.

Potentiometric surface/Piezometric level - theoretical (imaginary) surface of the static head of groundwater in an aquifer. The water table is a particular potentiometric surface for an unconfined aquifer.

Sand/Gravel pack - a sand or gravel material which is placed in the annular space between a drilled hole and the well casing and/or well screen.

Saturated zone - the part of an unconfined aquifer below the water table where the soil pores are completely filled with water.

Screen (well screen) - a cylinder of steel or plastic material with slots or perforations used to allow water to enter a well while preventing sediment or rock particles from entering the well.

Piezometer - A small diameter observation well used to measure the hydraulic head of groundwater.

Piezometric level/head - the level representing the total hydraulic head of groundwater in a confined aquifer.

Piezometric pressure - pore water pressure at a specific point.

Pore water pressure - the pressure of groundwater in a soil, measured relative to atmospheric pressure.

Pumped well - A hole in the ground with a casing in screen that includes its own motorized pump in the casing or screen to lift water to the surface.

Pumping Level - the level of water in a well casing or screen when pumping is in progress.

Observation Well - a non-pumping well used to observe changes in the elevation of the water table or the potentiometric surface/piezometric head.

Sub-grade - the finished grade level of an excavation as shown on the Plans, below any slab including excavation for foundation materials.

Wellpoint - a short slotted or perforated screen (usually steel or plastic and generally 6 inches or less in diameter and 5 feet long) attached to riser pipe and typically jetted, driven or installed in a drilled hole.

Wellpoint System - a dewatering system that includes a number of well points, vacuum header, vacuum wellpoint pump and discharge pipe.

Sheet Piling - sections of steel with interlocking joints on each edge to permit being driven edge to edge to form continuous walls to retain earth or water.
1.3 AVAILABLE SUBSURFACE DATA

The Contractor may use the information presented in the following reports:


However, the Contractor shall assume responsibility for the interpretation or use of all of the information presented in the above report. The use of the available data and information in no way relieves the Contractor from the sole responsibility for proper design, installation, operation, maintenance, and any failure of any component of the dewatering systems for the duration of this Contract.

1.4 QUALITY ASSURANCE

a. The Contractor shall include, at minimum, all of the elements necessary for furnishing, installing, operating and maintaining the dewatering system. The Contractor shall employ the services of a specialty dewatering subcontractor who has at least 10 years experience in the field of dewatering system design, installation, operation, and maintenance, and can document successful completion of at least 5 projects which include both large-diameter deep wells and wellpoints.

b. The Contractor shall employ materials, equipment, and construction methods commonly used and proven as suitable for the duration of construction dewatering. The Contractor shall provide submittals and/or product data that demonstrate the suitability of the materials and equipment proposed for use on these systems. The Contractor shall test the dewatering system to the reasonable satisfaction of the Agency and make operational any deficiency prior to excavation.

c. The Contractor shall integrate all dewatering, shoring and excavation activities to ensure that dewatering, shoring and excavation activities do not impede or conflict to the detriment of the work. The Contractor shall be responsible for any impacts to the project from conflicts between dewatering, shoring and/or excavation.

1.5 SUBMITTALS

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

SD-01 Preconstruction Submittals

Dewatering Plan

Contractor shall not begin excavation activities until the dewatering plan has been submitted to the Agency for review. If necessary, the plan shall be modified as required to meet field conditions and the modifications shall be reviewed by the agency prior to use.

No more than 10 days after the notice to proceed is given and no less than 2 weeks prior to dewatering activities the Contractor shall submit drawings and complete design data showing methods and equipment the Contractor proposes for dewatering, including relief of hydrostatic head, management of water, sheet pile cofferdam, and in maintaining the excavation in a dewatered, hydrostatically...
controlled condition. Contractor shall provide a Groundwater Control Plan (GWCP) developed by a licensed civil engineer or hydrogeologist in the State of California with a minimum of 10 years experience in the design of groundwater control systems. Agency will review submitted calculations and drawings for general compliance and layout only. The design of these facilities is the sole responsibility of the Contractor. The Contractor shall submit information sufficient for the Agency to understand the dewatering system including, but not limited to, the following:

a. Specifications and manufacturer's literature of the materials and a description of the methods proposed for use in the construction of dewatering and monitoring system.

b. Drawings indicating the location and size of berms, dikes, ditches, wells, wellpoints, sumps, monitoring wells, gravel drains, treatment facilities, discharge lines, and outfall design. The drawings shall include, at a minimum, all dewatering system elements.

c. Capacities of pumps, prime movers, and standby equipment.

d. Temporary electrical power supply for the pumps.

e. Information supporting the location and number of any wells, wellpoints, gravel drains, sumps and discharge lines, and the adequacy of vacuum header, pressure header, discharge pipe sizes, pumps, filters/gravel packs, screens and treatment facilities.

f. Information supporting the design of the dewatering wells, gravel packs, wellpoints, and water treatment systems, including boring logs at all dewatering wells and filter pack design.

g. Information supporting provisions for handling emergency situations such as power outages, equipment failures, pumping system shutdowns and the proposed response.

h. Flow meter calibration

i. The location of settlement monitoring points and a photo log of all structures including walls, slabs, exposed piping that might be affected by settlement due to lowering of the groundwater.

j. Dewatering schedule, operation, maintenance, and abandonment procedures.

k. Project descriptions for dewatering projects of similar scope and size completed in the region by the Contractor's specialty dewatering subcontractor and licensed engineer or hydrogeologist.

l. Boring and construction logs for all dewatering and observation wells (within 48 hours of completion).

m. Daily water level measurements, settlement measurements, and flow measurements.

n. Shop drawings and manufacturer's data on proposed sheet pile cofferdam.
o. Plans for cofferdam removal to minimize downstream resiling.

SD-09 Reports

Weekly Reports

The Contractor shall submit weekly reports including:

a. Daily water level measurements, settlement measurements, and flow measurements.

b. Fines (sand/silt) measurement equipment and procedures, and daily and weekly sand/silt content measurements.

PART 2  PRODUCTS

2.1 DEWATERING WELLS

Dewatering wells shall be designed by a California registered civil or geotechnical engineer in accordance with all applicable requirements. The well shall be backfilled with concrete or bentonite from the surface to the top of the minimum groundwater elevation. Filter pack should be placed only within sand layers. Bentonite may be used between the filter pack and the concrete/bentonite layer.

PART 3  EXECUTION

3.1 MONITORING SYSTEM

a. The Contractor shall install necessary monitoring facilities to ensure that the dewatering systems achieve required groundwater draw downs beneath the excavations.

All wells shall be equipped with a device to measure the quantities of fines (sand/silt) in the water discharged by the system.

Piezometers shall be installed throughout the excavation limits to monitor groundwater levels.

b. The Contractor shall provide in-line flow meters on all well and wellpoint system discharge pipes to ensure accurate measurement of the total flow from the dewatering system. The flow meters shall show flow in gallons per minute and total flow passing through the meter. The flow meter shall be sized and installed to accurately represent the flow through the meter. The Contractor shall test and document the accuracy of all installed flow meters. The Contractor shall provide flow meter calibration documentation to the Agency two weeks prior to any dewatering system pumping other than well or wellpoint development.

c. The Contractor shall install or identify settlement monitoring points on structures and survey the elevation of the monitoring points to 0.01-foot precision.

d. The Contractor shall maintain accurate and precise daily records of settlement, water level and flow measurements. The Contractor shall measure settlement point elevations and, water levels in all pumping and monitoring wells to 0.01-foot precision and flow to within 5 gallons per minute. Measurements shall be recorded on forms acceptable to the Agency.
e. The Contractor shall begin settlement point measurement 3 days prior to any pumping within 300 feet of a settlement monitoring point.

f. The Contractor shall begin water level measurements within 24 hours of any well completion and development and continue daily measurements until the well is properly abandoned or the Agency reviews cessation of measurement.

g. The Contractor shall begin water flow measurements within 4 hours of initiating pumping in any well or wellpoint system and continue measurements until the Agency reviews cessation of measurement. The Contractor shall report to the Agency, any changes in dewatering discharge flow of 25 percent or more occurring within any 24-hour period within four hours following such a change. The Contractor shall notify the Agency anytime a pump fails, or is turned off or on, for a period of more than 4 hours. Additionally, the Contractor shall note and record when any well(s) or dewatering systems are turned off and back on. The Contractor shall provide water level and flow measurement records to the Agency weekly in both hardcopy and digital form.

h. The Contractor may remove and replace or shorten the casings of monitoring wells as the work requires. However, the Contractor shall bear full responsibility for the water level information provided by those wells and any consequences stemming from the lack of or error in the information. The Agency shall be notified of any change in the measuring points of any well. The Contractor shall re-survey any shortened or lengthened observation well casing, and provide such data to the Agency.

i. The Contractor shall notify the Agency, one week prior to installation of any monitoring wells. The Contractor shall provide the Agency with driller's logs and formation samples at maximum 5-foot intervals for each well.

3.2 FORMATION PROTECTION & WELL DEVELOPMENT

a. The Contractor shall design, construct, operate, and maintain the dewatering system such that the fine fraction of the foundation soils will not be removed upon pumping.

b. The Contractor shall develop all wells and wellpoints to remove fines resulting from drilling and construction and to increase the yield and hydraulic connection with the aquifer. The Contractor shall discharge all development water to the sediment settling tanks prior to discharge. The Contractor shall not discharge any development water directly to the ground surface or surface water body.

c. The Contractor shall develop dewatering wells until the sand/silt content of the discharge water during surging is less than 10 parts per million (ppm) as determined by a centrifugal separating meter such as a Rossum SAND TESTER (Journal AWWA, 46:123, February 1954), or equivalent.

d. The Contractor shall monitor discharge from all parts of the system to ensure that the sand/silt content of the discharge water does not exceed 10 ppm as determined by a Rossum SAND TESTER or equivalent. The Contractor shall provide all of the equipment and fittings for...
monitoring sand content. The Contractor shall monitor sand/silt content daily for one week after installing any dewatering well or wellpoint and weekly thereafter. The Contractor shall take sand/silt content measurements in the presence of the Agency. The Contractor shall notify the Agency of the time of measurement and provide 24-hour notice of planned measurements.

3.3 STANDBY EQUIPMENT

The Contractor shall furnish and maintain on site sufficient power-generating and other equipment and materials to ensure continuous and successful operation of the dewatering system. The Contractor shall maintain on site, ready to operate, sufficient standby electrical generating capacity to operate all wells pumps and/or wellpoint pumps simultaneously. The Contractor shall test all backup electric systems monthly in the presence of the Agency. These tests shall include at least 24 hours of operation under full system load. The Contractor shall have on site, a backup pump for each type of pump in the dewatering system and sufficient pipe and fittings for any repair.

3.4 DISCHARGE POINTS AND PIPES

Discharge piping shall be designed and installed in a manner, which minimizes impacts to excavation or construction activities.

Discharge points shall be reviewed by the Agency.

3.5 WATER SUPPLY FOR SYSTEM INSTALLATION AND ELECTRICAL SERVICE

The Contractor shall provide water supply and electrical service needed for the dewatering systems. The Contractor shall provide a completely separate power company source for the dewatering system electric service with its own meter and which shall be dedicated solely for the dewatering system and separate from all other electric service.

3.6 DEWATERING SYSTEM PROTECTION

The Contractor shall take reasonable precautions to ensure continuous successful operation of the dewatering system. This includes establishing and/or maintaining adequate marking of all well, pump and pipeline locations. Wherever dewatering wells or discharge lines require crossing for access into, out of, or around an excavation, steel ramps shall protect the system from vehicular traffic. All ramps shall have the strength to support the heaviest equipment on site and shall provide at least one foot of clearance between the dewatering system element and the underside of the ramp. The Contractor shall clearly identify all vehicular access points across the dewatering system with brightly colored flags on 8-foot high poles on each side of the access point. The Contractor shall valve all ramped pipelines on both sides of the ramp.

3.7 SYSTEM REMOVAL

A licensed water well contractor in accordance with STATE STANDARDS shall abandon all wells, wellpoints and observation wells installed by the Contractor. The Contractor shall also abandon all existing monitoring wells shown on the Plans in accordance with STATE STANDARDS. As a minimum, the Contractor shall seal any well, wellpoint hole, sump, gravel drain or other penetrations below the excavation with a cement grout mixture exhibiting a permeability less than 1 x 10-6 centimeters per second.
The Contractor shall minimize the resiling of any channels during cofferdam removal.

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CUTOFF WALL - OPEN TRENCH SOIL BENTONITE (SB)

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PART 1   GENERAL

1.1   GENERAL

The work covered by this Specification section consists of furnishing all plant, labor, equipment, and material and performing all operations in connection with the construction of a soil-bentonite (SB) cutoff wall, all in accordance with the Plans and Specifications. The intent of the SB cutoff wall is to create a permanent, continuous, homogeneous, low permeability barrier to embankment and foundation seepage within the vertical depth limits and horizontal station limits shown on the Plans.

An active irrigation canal and buried drainage pipes exist where the cutoff walls will be constructed. Crossing locations are shown on the Plans. The Contractor must preserve and protect these facilities in place during cutoff wall construction unless they are to be removed and replaced as shown on the Plans as part of the work. If one or more of the existing facilities must be taken out of service for whatever the reason, including replacement, a temporary pump system must be installed and operated by the Contractor to maintain flow while the canal or pipe(s) is/are out of service. Upon completion of the installation of a temporary pump system at the existing irrigation canal crossing, the canal will be excavated and filled in accordance with Section 31 00 00 EARTHWORK prior to cutoff wall construction. The contractor shall coordinate the irrigation canal service relocation with the Brophy Water District.

Installation of the cutoff wall shall take place from the working surface elevation shown on the Plans unless otherwise noted in the Specifications or directed by the Agency. After the slurry wall is installed and has consolidated for the period specified, levee construction shall proceed as shown on the Plans and indicated in these specifications.

All work under this section shall comply with the requirements of EM 385-1-1

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 PETROLEUM INSTITUTE (API)

API RP 13B-1 (2009; 4th Ed) Recommended Practice for Field Testing Water-Based Drilling Fluids


ASTM INTERNATIONAL (ASTM)

Hydraulic-Cement Concrete


ASTM D1140 (2000; R 2006) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

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 D422 (1963; R 2007) Particle-Size Analysis of Soils


U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2008; Errata 1-2010; Changes 1-3 2010; Changes 4-6 2011; Change 7 2012) Safety and Health Requirements Manual

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

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 3005A (1992) Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy


EPA 5030B (1996) Purge and Trap for Aqueous Samples


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1.3 GENERAL CONDITIONS

1.3.1 Lines and Grades

The SB cutoff wall shall be constructed to the lines, grades, and dimensions shown on the Plans, unless otherwise directed by the Agency. The Agency reserves the right to increase or decrease the length and depth of the SB cutoff wall to suit actual site conditions encountered during construction. The maximum increase or decrease in depth shall be limited to 10 feet.

1.3.2 Conduct of Work

The Contractor shall maintain and protect the cutoff wall in a satisfactory condition at all times until final completion and acceptance of all work under the Contract.

1.3.3 Access and Ramps

Prior to commencing construction, the Contractor shall submit for review a plan, detailing the locations of all haul roads and access ways to and within the Project area. Access shall be limited to existing public roadways and those haul routes that have been identified on the Plans. The Contractor shall maintain the haul routes and access ways during construction in a safe manner and condition, as indicated in Section 01 50 02.00 41, TEMPORARY CONSTRUCTION FACILITIES. If needed, temporary access ramps shall be added or improved by adding material to the levee cross section. Temporary access ramps shall be removed and grade restored to preconstruction condition in accordance with 31 00 00 "EARTHWORK". Cuts into the levee, other than those specified on the project plans and indicated in these specifications are prohibited.

1.3.4 Protection of Existing Facilities

Construction shall be conducted in a manner that avoids damage to all existing facilities that are not designated for removal or reconstruction. Construction will occur during the normal growing and harvest season for surrounding agricultural fields and shall not interfere with these activities. Construction shall not interfere with the normal operation of existing irrigation canals, drainage ditches, and irrigation systems, except where the Contractor is required to install temporary water diversions if irrigation supply pipe crossings through the levee cannot be maintained in service during construction.

1.3.5 Permits

The Contractor shall obtain and pay all necessary fees for all local, state, and federal permits required of the Contractor and subcontractors to accomplish the work unless otherwise specified herein.
1.3.6 Construction Method

The cutoff wall shall be constructed using water and bentonite mixed in proper proportions with soil to achieve the permeability properties required by the Specifications. Soil for the cutoff wall mix shall be suitable soil selected from the slurry trench excavation spoil that conforms to the Specifications, supplemented, as necessary, by borrow material to provide the total quantity needed for the Project and a final product meeting the acceptance criteria.

1.3.7 Sequencing of the Work

The Contractor may use multiple headings to achieve the required schedule completion dates. The Contractor shall consult the Special Provisions for any information regarding using multiple work shifts per day to achieve the required schedule completion dates.

1.3.8 Water for Construction

Details regarding water supplies, and the pumping and conveyance of the water, are presented in Section 01 50 02.00 41, TEMPORARY CONSTRUCTION FACILITIES.

1.4 DEFINITIONS

The terms used in this Section are defined as follows:

1.4.1 SB Slurry Cutoff Wall

The minimum 36-inch-wide SB slurry cutoff wall is a low permeability barrier installed below the cutoff wall working platform using the slurry method of excavation and a properly designed mixture of soil, bentonite, and water as backfill. The required depth of the cutoff wall shall be as shown on the Plans or as directed by the Agency.

1.4.2 Bentonite Slurry

Bentonite slurry is a colloidal mixture of bentonite and water and other suitable material prepared in accordance with API Spec 13A. A minimum hydration period of eight (8) hours will be required for the bentonite slurry following initial mixing with water.

1.4.3 Bentonite

Bentonite is an ultrafine natural clay whose principal constituent is sodium cation montmorillonite.

1.4.4 SB Slurry Cutoff Wall Backfill

A homogeneous mixture of material produced by mixing soil, bentonite, water and/or other materials, which is used to construct the SB slurry cutoff wall.

1.4.5 Working Surface

The working surface is the working surface shown on the Plans and discussed in this Specification. The SB slurry cutoff wall is constructed below the working surface.
1.4.6 SB Slurry Cutoff Wall Specialist

The SB slurry cutoff wall specialist is an individual who has had a minimum of five (5) years of experience in SB slurry cutoff wall construction and has proven knowledge in all aspects of SB slurry cutoff wall construction, which includes but is not limited to:

a. Using, testing, and controlling bentonite as a slurry.

b. Mixing methods required to properly mix the slurry and backfill materials, including water, soil, and bentonite, as required.

c. Knowledge of trench excavation and backfill procedures.

d. Thorough knowledge of construction equipment to be used for slurry trench and slurry wall construction, and of the material testing required for Quality Control of the work.

The SB slurry cutoff wall specialist shall provide supervision and control of composition, mixing, placing, cleaning, and maintenance of the bentonite slurry and the trench backfill. The SB slurry cutoff wall specialist shall be on site at all times during trenching and backfilling operations.

1.4.7 Excavation Refusal

Excavation refusal will be defined as the inability of the Contractor's reviewed production excavator to excavate more than one (1) foot of depth over a bottom trench length of twenty (20) feet in a period of sixty (60) minutes with excavator equipment in proper and effective operating condition utilizing the equipment discussed in Paragraph 3.5.2 SB Slurry Cutoff Wall Construction.

1.4.8 Obstructions

The Agency shall be the sole judge of whether an obstruction has been encountered. Culverts, standpipes, and other buried piping that are shown on the Plans and that are either to be preserved and protected or removed and replaced as part of the work shall not be considered obstructions. Existing utilities shown on the Plans shall not be considered obstructions. Naturally-occurring materials such as cobbles and boulders shall not be considered obstructions.

1.5 QUALITY CONTROL AND QUALITY ASSURANCE REQUIREMENTS

The Contractor shall provide construction inspectors for bentonite slurry preparation and maintenance, trench excavation, trench logging, and SB backfill preparation and placement. The Contractor shall sample and test bentonite slurry and SB backfill as part of the Construction Quality Control (CQC) requirements.

The Agency will perform Quality Assurance testing on representative samples obtained by the Contractor of the bentonite slurry and SB backfill. The Agency testing will in no way relieve the Contractor of the responsibility of performing tests necessary to meet the CQC requirements. All routine testing procedures being conducted by the Contractor shall be available for inspection by the Agency.
1.5.1 Field Quality Control Representative (FQCR)

The individual given specific inspection tasks in this specification.

1.6 SUBMITTALS

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

SD-01 Preconstruction Submittals

SB Slurry Cutoff Wall Construction Method, Equipment and Procedures

Data on methods and equipment to be used in all sequences of the SB slurry cutoff wall construction, including excavation, the Contractor's proposed methods and procedures for constructing the cutoff wall through bends in the levee alignment, backfill placement, backfill mixing, monitoring the Quality Control parameters outlined herein, collecting samples for laboratory testing, methods for locating the wall in the field and confirming that the wall is plumb and equipment to be used in the Contractor's Quality Control testing. Include the location of the laboratory trailer/structure. The plan shall contain specifics on the Contractor's plan to ensure continuity and homogeneity of the cutoff wall throughout the limits of cutoff wall pay lines. The Contractor's plan for providing a continuous, homogeneous cutoff wall at all terminations and transition points (changes in tip elevation) greater than 5 feet in depth shall also be detailed.

SB Slurry Cutoff Wall Construction Schedule and Sequence of Operations

Submit for review the schedule, and sequence of operations for construction of the cutoff wall, including but not limited to, site access, working surface construction, wall layout, waste management, off-site disposal locations, backfill preparation, backfill placement, and final grade closure. The schedule shall also include information regarding equipment mobilization, equipment setup, SB slurry cutoff wall production installation, and Quality Control testing.

Submit for review the layout of operations including associated levee excavation for the construction of the wall. Include storage areas, backfill mixing areas, access corridor, and location and sizes of all stationary equipment.

Slurry Mixing, Storage and Delivery Methods and Equipment

Data on equipment such as mixers capable of producing a stable colloidal suspension of bentonite slurry or other mix combinations; water source, method of desanding, storage facilities including hydration ponds and methods of agitation; and delivery methods and equipment.

Results of Cutoff Wall Backfill Trial Mix Design and Testing

Prior to the installation of the SB slurry cutoff wall, the Contractor shall submit a laboratory test report along with the Contractor's proposed initial mix design for the construction of
the SB slurry cutoff wall backfill. The report shall summarize the test results and address the suitability of the proposed backfill mix design as it relates to the Specification requirements and shall include a description of mix proportions, material gradations, water test results, slump obtained, densities, and permeabilities for all the trial batches. In addition, the proposed gradation ranges (bands) for the SB slurry cutoff wall backfill and soil part of the backfill for which each mix is suitable and representative shall be submitted for review.

Qualifications

Submit for review evidence that the Contractor or subcontractor is experienced and competent in SB slurry cutoff wall construction. The Contractor shall substantiate its experience in accordance with the requirements specified in Paragraph 1.7, QUALIFICATIONS.

The Contractor shall use only an independent established commercial laboratory approved by the Agency. Supervision of tests and report preparation shall be by a professional civil or geotechnical engineer licensed in the State of California. The laboratory facilities and personnel shall comply with the requirements of ASTM D3740 and ER 1110-1-261. Also refer to 01 45 01.10 QUALITY CONTROL SYSTEM (QCS).

Pre-Construction Quality Control Reports

Prior to construction, the Contractor shall submit a proposed Daily Quality Control Report format for review by the Agency. Samples of testing data sheets and sample data reduction to obtain permeability of the SB slurry cutoff wall backfill material shall be submitted. Report formats should present data and test results in spreadsheet format, where appropriate, that can be updated as the work progresses.

Cutoff Wall Surcharge Loading

The Contractor shall submit a plan describing all surcharge loads applied to the cutoff wall excavation during construction, including all roads from the existing levee to remain in place during trench excavation and roadway traffic on adjacent roads and highways. This plan shall show the distance between all surcharge loads applied and the top of the slurry wall during slurry wall construction. This plan shall include the surcharge loads from materials and equipment and shall compare the loads against the strength of materials to be shored by the slurry trench. This plan shall also include surcharge loads from materials and equipment at approved equipment crossing points. This plan shall also include requirements for minimum cover and/or additional protective measures for the completed slurry wall.

Chain of Custody Form for Quality Control/Acceptance/Quality Assurance Samples

The Contractor shall submit a sample of the Chain of Custody Form used to keep track of all samples taken by the Contractor. The form shall include, at a minimum, who formed the samples, transfer of ownership, dates, time, batch number, and station location of the samples.
SD-07 Certificates

Bentonite Certification

The Contractor shall submit for review statement(s) signed by an authorized official to certify on behalf of the manufacturer of the materials that the products meet the requirements for "bentonite" specified herein. The statement must be dated after the Award of Contract, must state the Contractor's name and address, must name the project and location, and must list the specific requirements that are being certified.

SD-09 Contractor's Field Reports

Construction Documentation

During construction of the SB slurry cutoff wall, records shall be maintained by the Contractor for all test results, descriptions, measurements, and inspections performed to ascertain that the cutoff wall construction meets the Specifications. All data records from the mix design shall be furnished to the Agency for review prior to construction. Data shall be in both hardcopy and electronic form as Microsoft Excel and Microsoft Word files. The data records shall include, but are not limited to: all laboratory test data, test result summaries, data acquisition from instruments, production information on amount of bentonite used, volume of SB slurry cutoff wall backfill placed, production records, and all records of soundings and other measurements taken during slurry wall construction. The Contractor shall submit mix reports for the SB slurry cutoff wall backfill including water content and mix proportions for each batch prepared. The report shall indicate where each batch was used. All required reports, records, and documentation shall be furnished to the Agency by the end of the next working day.

Construction Quality Control Test Results

The results of all Construction Quality Control testing required in these Specifications shall be furnished to the Agency, including sampling and testing of all water sources used for mixing backfill, water tests, SB slurry cutoff wall backfill tests, and permeability testing of wet-bulk samples. The Contractor shall furnish records of all observations, measurements, and tests performed, identified with the location, date, and time of testing. Each test report shall be properly identified. Test methods used shall be identified and test results shall be recorded. Details of laboratory test procedures for performing permeability tests on wet-bulk samples shall be provided. These records shall be furnished no later than 24 hours after the tests, measurements, and/or observations are made.

Construction Log

The Contractor shall maintain a Construction Log of daily activities, which shall include delays encountered during construction, causes of delays, locations of affected areas, and extent of delays. The log shall also record unusual conditions or problems encountered, and the dispositions made. The Agency shall
be immediately verbally notified of unusual conditions or problems followed by a written description.

Subsurface Exploration Report

Encountered subsurface conditions, including soil classification logs, boring logs and laboratory data, obtained by the Contractor from its exploratory work or trial mix design work shall be submitted to the Agency.

Construction Records

Construction Records are reports, documentation, test results, logs, and material certificates. Construction Records shall be submitted for the cutoff wall. All information shall be submitted in electronic format and hard copy. Data/test summaries shall be in Microsoft Excel files. Text reports shall be in Microsoft Word.

Record Drawings and End-of-Construction Summary Report

Submit for review working record drawings and an End-of-Construction Summary Report prepared by a Professional Engineer and a licensed surveyor indicating the width, depth, and location of the cutoff wall in terms of Project coordinates, all Quality Control test results, all pertinent submittals, mix designs used, subsurface conditions encountered, major problems, core logs, and all construction equipment. The summary report shall summarize and compare statistically all test data to the Contract requirements.

1.7 QUALIFICATIONS

1.7.1 Contractor

The Contractor's company, subcontractor, joint venture partner (JVP), or merged company (MC) shall have experience in SB slurry cutoff wall trench construction projects of similar size and scope completed in the last five (5) years. Multiple headings on any one contract shall be considered as one construction project. The project experience must have been performed by the entity who is proposing to perform the work as defined below. An individual's experience from former companies shall qualify as SB slurry cutoff wall trench construction project experience for the Contractor, subcontractor, JVP, or MC, provided that the individual is a principal of the entity who is proposing to perform the work. Qualifying experience in slurry trench construction projects shall consist of the following:

"Satisfactorily performed the Work and completed the construction of at least three (3) SB slurry cutoff walls using the slurry trench excavation and backfill method. The cutoff walls must have had a minimum depth of fifty (50) feet and a minimum length of five hundred (500) feet. The SB slurry cutoff wall properties must include a maximum permeability of 1x10^-6 cm/sec."

Submit the data listed in Paragraph 1.6 to demonstrate the required project experience. Regarding determining qualifying experience acceptable to the Agency, the following definitions shall also apply:

Satisfactorily Performed the Work: Completed projects must include...
having prepared trial mix designs and either carried out the mixing and blending operations of the bentonite slurry and backfill or provided technical oversight and have had overall responsibility for the mixing and blending operations of the bentonite slurry and backfill.

SB Slurry Cutoff Wall: Completed projects must have included slurry supported trench, which has been backfilled with a mixture of excavated or imported soil, bentonite, and water, in which soil was the major constituent of the backfill.

1.7.2 Cutoff Wall Specialist and Cutoff Wall Equipment Operator

The Contractor shall maintain a SB slurry cutoff wall specialist and equipment operator at the site on a full-time basis while the cutoff wall is being constructed.

1.7.2.1 SB Slurry Cutoff Wall Specialist

The SB slurry cutoff trench specialist shall be experienced in providing supervision of mix design and field control composition and mixing and placing of the SB slurry backfill. The SB slurry cutoff wall specialist shall be an individual meeting the requirements of Paragraph 1.4.7 herein, and shall have cutoff wall experience for at least two completed SB slurry cutoff wall construction projects meeting the requirements in Paragraph 1.7.1 herein. Multiple headings in a single contract shall be considered as one construction project.

1.7.2.2 SB Slurry Cutoff Wall Trench Excavation Equipment Operator

The SB slurry cutoff wall trench excavation equipment operator shall have experience on two (2) previous contracts meeting the requirements in Paragraph 1.7.1 herein. Multiple headings in a single contract shall be considered as one construction project.

1.7.2.3 Qualification Submittals

The following information shall be submitted to the Agency for the SB slurry cutoff wall specialist and SB slurry cutoff wall equipment operator:

a. Name, address, and telephone number of customer and point of contact for projects forming the experience record.

b. Contract number, contract amount, date of award, and date of completion of the project forming the experience.

c. SB slurry cutoff trench length and depth.

d. Description of the type of slurry backfill.

e. A copy of the portion of the specification requirement from the reference project indicating the required wall performance standards (i.e., permeability) or a letter of reference from the owner for each project submitted that briefly describes the specification requirements.

f. Description of the method of construction and excavation equipment used.

g. Indicate which projects demonstrate past experience with the Contractor.
3. Trench Logger

The excavated material from the SB slurry cutoff wall excavation is to be described and classified as indicated within this Specification. The description and classification of the excavated material shall be performed by a trench logger who shall be a degreed geologist or civil engineer with a minimum of five (5) years of experience using ASTM D2488. This individual shall work under the responsible charge of either a California Professional Geologist or California Registered Civil Engineer. The experience information shall be submitted to the Agency for review and the Agency will independently verify classifications as part of its Quality Assurance Program. The information submitted to demonstrate the required experience shall include: project name, telephone number of customer and point of contact, date of construction, and a description of the project feature in which classification of material was performed.

4. Quality Control Laboratory

The Contractor shall use only an independent established commercial laboratory approved by the Agency. The laboratory facilities and personnel shall comply with the requirements of ASTM D3740 and ER 1110-1-261. Also refer to 01 45 01.10 QUALITY CONTROL SYSTEM (QCS). The Agency reserves the right to make inspections of the Contractor's designated laboratory facilities, including test equipment and procedures.

5. GEOTECHNICAL SITE CONDITIONS

1. Explorations

Subsurface explorations has been performed by the Agency to evaluate the nature of seepage and the nature of materials to be excavated. Approximate locations of the explorations and logs are included in the Geotechnical Data Report. The logs of the borings and test pits included in the Geotechnical Data Report represent interpretations of data which the Agency has obtained at the borrow sites and are included in Volume 4 of these specifications. The Contractor should make their own interpretation of the data. The Agency assumes no responsibility for interpretations, conclusions, or deductions made by the Contractor from the data in the Geotechnical Data Report. The Agency assumes no responsibility for interpretations, conclusions, or deductions made by the Contractor from the logs of the explorations. Local variations in the subsurface materials are to be expected and, if encountered, will not be considered as being materially different.

The Contractor may take additional exploration borings at its own expense when formulating mix designs to satisfy themselves of the types and quantities of material to be used in the backfill that will meet the gradations specified in accordance with Section 02 32 00 SUBSURFACE DRILLING SAMPLING AND TESTING.

2. Groundwater

Groundwater at the time of exploratory borings was encountered at the elevations shown on the boring logs. Groundwater levels can be expected to fluctuate in response to variations in rainfall, river stage, and irrigation of nearby agricultural areas.
1.8.3 Subsurface Conditions

The subsurface materials encountered during Agency explorations are described in the Geotechnical Data Report.

PART 2 PRODUCTS

2.1 GENERAL

The Contractor shall maintain at the job site a sufficient quantity of raw materials and other supplies such that the work can proceed uninterrupted by material shortages. The slurry and SB slurry cutoff wall backfill to be used shall be suitable for the Project. The Contractor shall, if necessary, modify the cutoff wall backfill design mixes to meet the requirements for permeability, continuity, and homogeneity specified in this Specification section. The Contractor shall undertake any additional tests necessary to assist in material selection, to verify compliance with the Specifications, and to demonstrate the characteristics of the cutoff wall.

2.2 BENTONITE

The bentonite shall be a sodium cation base montmorillonite powder (Premium Grade Wyoming-type bentonite) or equivalent that conforms to the standards set forth in API Spec 13A, Section 9 or 10. No chemically-treated bentonite will be allowed. No bentonite from the bentonite manufacturer shall be used prior to being reviewed by the Agency. All bentonite will be subject to inspection, sampling, and verification of quality by the Agency. Bentonite not meeting the Specifications shall be promptly removed from the site and replaced with bentonite conforming to Specification requirements, at the Contractor's expense. Bentonite shall be protected from moisture during transit and storage.

2.3 WATER

Refer to Section 01 50 02.00 41, TEMPORARY CONSTRUCTION FACILITIES for information on potential water supplies and the requirements that apply to providing the water supply for construction of the Project.

2.3.1 Water Standards

The water shall be clean, fresh, and comply with the standards set below:

a. A pH equal to seven (7.0) plus or minus one. Test Method API RP 13B-1.

b. Total dissolved solids not greater than 500 parts per million. Test Method EPA 600/4-79/020 Method 160.1.

c. Hardness less than or equal to 50 ppm. Water with hardness in excess of 50 ppm will be accepted for use by the Agency based upon performance in the trial mix as long as the required permeability standards specified herein are achieved. Test Method API RP 13B-1

d. VOCs less than the MCL. Test Method EPA 5030B/EPA 8260B.

e. TPH less than the MCL. Test Method EPA 8015B.

f. Metals less than the MCL. Test Method EPA 3005A/EPA 6010C.
Three Rivers Levee Improvement Authority  
200-year Goldfields Levee Project  

100% Design

g. Pesticides less than the MCL. Test Method EPA 3510C/EPA 8081A/EPA 8041A.  

(MCL = Maximum Contaminant Level)

2.3.2 Hydrants

Refer to Section 01 50 02.00 41, TEMPORARY CONSTRUCTION FACILITIES for information on potential water supplies and the requirements that apply to providing the water supply for construction of the Project. If hydrants are identified as a water source that the Contractor intends to use: (1) note the locations of hydrants for use, and (2) procure appropriate permits. The Contractor shall abide by any and all regulations and other requirements governing such use. The Contractor shall include the cost of all related fees in the bid items pertinent to the work.

2.4 INITIAL BENTONITE SLURRY MIXTURE

Testing of slurry properties shall be in accordance with API RP 13B-1. At the time of introducing bentonite slurry into the trench excavation, the slurry mixture shall have a minimum apparent viscosity of 40 seconds as measured by the Marsh funnel in accordance with ASTM D6910. The slurry density shall be a minimum of 64 pounds per cubic foot. The water loss shall not be greater than one and three-quarter (1.75) cubic inches in 30 minutes as measured by a filter press at 100 psi in accordance with the test methods stated in API RP 13B-1. Mixture adjustments shall conform to the requirements in Paragraph 2.7, ADDITIONAL BENTONITE.

2.5 TRENCH BENTONITE SLURRY MIXTURE

The minimum apparent viscosity of the bentonite slurry mixture in the trench at any time shall be 40 seconds as measured by the Marsh funnel in accordance with ASTM D6910. The minimum density of the trench Bentonite slurry mixture shall be sixty-four (64) pounds per cubic foot and the maximum density of the trench Bentonite slurry mixtures shall be eighty-five (85) pounds per cubic foot based on trench slurry density measurements. The water loss shall be measured by the filter press at 100 psi in accordance with the test methods stated in API RP 13B-1. Results of these tests shall be included in the CQC documentation but will not be used as acceptance criteria. Mixture adjustment shall conform to the requirements in Paragraph 2.7, ADDITIONAL BENTONITE. Testing of slurry properties shall be in accordance with API RP 13B-1.

2.6 ADDITIONAL BENTONITE

If required for trench stability, the Contractor shall thicken the slurry mixture to a more viscous condition than the limits specified above. The Contractor shall use additional hydrated bentonite, and the amount added shall be the amount required to stabilize the trench.

2.7 SOIL FOR CUTOFF WALL BACKFILL

Soils obtained from the slurry trench excavation, the borrow area, existing levee degrade, other required excavations, or combination thereof may be used in the SB slurry cutoff wall backfill. Gradation requirements for the soil used as backfill shall meet the following requirements:

<table>
<thead>
<tr>
<th>Sieve Size or Number</th>
<th>Percent (%) Passing by Dry Weight</th>
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<tbody>
<tr>
<td>2-inch</td>
<td>100</td>
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<tr>
<td>No. 4</td>
<td>40 to 100</td>
</tr>
</tbody>
</table>

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In addition, the soil shall be free of roots, debris, concentrations of organic materials, and all other deleterious material that may adversely affect the properties of the backfill. Screening of materials may be required to achieve the stated gradation requirements for soil to be used as backfill. The Contractor is responsible for changes in the chemistry of the soils used in the SB slurry cutoff wall construction and the effect on the desired properties of the backfill.

2.8 SOIL BENTONITE TRENCH BACKFILL

Sufficient bentonite slurry shall be added and mixed uniformly and homogeneously with the soil backfill so the SB backfill has the following properties:

a. Uniformity: The SB backfill shall be thoroughly mixed prior to placement in the cutoff wall such that the bentonite is uniformly mixed through the backfill and the mixture is homogeneous with no unmixed soil clods 2 inches in size or larger.

b. Maximum Particle-Size: The SB backfill shall not contain unmixed soil clods or rock 2 inches in size or larger.

c. Slump: The soil-bentonite backfill shall have a saturated paste placement consistency and water content corresponding to a slump cone value of 4 inches to 7 inches determined in general accordance with ASTM C143/C143M.

d. Unit Weight: The soil-bentonite backfill must have a placement saturated unit weight at least 15 pounds per cubic foot greater than the maximum in-place density of the bentonite slurry.

3. Hydraulic Permeability: See Section 3.4.1 for SB backfill hydraulic permeability requirements

2.9 MATERIAL STORAGE FACILITIES

The Contractor shall provide all necessary materials, equipment, and personnel to store bentonite and other additives to prevent moisture or other contaminants from mixing with the materials prior to use in the slurry plant.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall establish and maintain field Quality Control for SB slurry cutoff wall construction to assure compliance with Contract requirements and maintain detailed records of field and laboratory Quality Control for all operations. The Contractor shall use only an independent established commercial laboratory approved by the Agency. The laboratory facilities and personnel shall comply with the requirements of ASTM D3740 and ER 1110-1-261. The Agency reserves the right to make inspections of the Contractor's designated laboratory facilities, including test equipment and procedures. All laboratory and field equipment shall be kept in proper working order and have proof of calibration within the time limits included in ASTM D3740.
The Contractor shall perform sufficient testing to ensure the work is being accomplished as specified. The testing program specified herein represents the minimum level and frequency of testing. The Contractor is responsible for performing all additional tests, as necessary, to confirm compliance with the Contract requirements.

3.2 SITE WORK

The Contractor shall furnish all plant, equipment, labor, and materials required to construct the SB cutoff wall as shown on the Plans and specified herein, except that the Agency may at any time direct changes to the wall depth and length to accommodate conditions encountered in the field.

3.3 WORKING SURFACE PREPARATION

3.3.1 Working Surface

The Contractor shall construct a working surface as shown on the Plans. The Contractor shall prepare the working surface to a firm and essentially level condition for passage of the Contractor's machinery and equipment. A berm or other appropriate type of barrier shall be constructed within the construction limits to prevent off-site movement of waste materials, slurry spills, etc. There will be no payment for any additional excavation, fill, relocation, or cutoff wall required as the result of constructing a working surface other than the defined working surface. Upon completion of the cutoff wall installation, the levee shall be constructed to final alignment and grade as shown on the Plans.

3.3.2 Cutoff Trench

Prior to constructing cutoff wall, the Contractor shall excavate a cutoff trench along the cutoff wall alignment as shown on the Plans. The cutoff trench shall be backfilled with Levee Embankment Fill.

3.3.3 Construction Staking

The Contractor shall provide, install, and maintain all temporary benchmarks, layout staking and necessary construction staking to locate the centerline of the wall. Survey construction control staking shall be performed by a Licensed Surveyor or Registered Professional Civil Engineer authorized to perform surveying in California. All survey data shall be stamped by the surveyor/engineer.

3.4 SB SLURRY CUTOFF WALL CONSTRUCTION

3.4.1 General

The SB slurry cutoff wall shall be continuous over the length and depth shown on the Plans. The minimum wall width dimension shall be as specified below. The ends of the wall shall be vertical, except where the lead-in trench method of construction is used, in which case the lead-in trench shall extend beyond the specified cutoff wall beginning and ending limits. The SB slurry cutoff wall, as placed, shall be homogeneous and shall be constructed to the elevations, lines, grades, and cross section shown on the Plans and in accordance with these Specifications.
The SB slurry cutoff wall shall be constructed to the following dimensions and hydraulic conductivity (permeability):

a. Width: Thirty-six (36) inches (minimum).

b. Depth: Varies, as shown on the Plans, measured from the working surface shown on the Plans, and as directed by the Agency.

c. Hydraulic Permeability: 5x10^-7 cm/sec, or lower. Test Method ASTM D5084.

Final acceptance of the SB slurry cutoff wall will be based on the acceptance criteria as outlined in Section 3.10, "CUTOFF WALL ACCEPTANCE".

3.4.2 Trench Excavation

The excavation shall be by the slurry trench method. Excavation shall be conducted in a manner that provides for a continuous thirty-six (36) inch minimum width trench to the required depth, as shown on the Plans, at all points along the centerline of the excavation. The Contractor shall excavate the slurry trench from the working surface shown on the Plans. If required, a berm or other appropriate type of barrier shall be constructed within the construction limits to prevent off-site movement of waste materials, slurry spills, etc. The Contractor shall maintain slopes no steeper than 2H:1V on the lead-in trench. The Contractor shall confirm that the lead-in trench slope is stable by profiling the backfill slope in accordance with Paragraph 3.9.4.4. If the lead-in trench slope is not stable, the Contractor shall flatten the slope until stability is confirmed by the trench slope soundings. The lead-in trench shall be outside the limits of pay.

At locations within the length of cutoff wall excavation where the cutoff wall tip elevation drops in the direction of excavation by 5 feet or more, the Contractor shall cut an in-trench transition slope no steeper than 2H:1V. The in-trench transition slope shall begin in the shallow wall section and reach the trench tip elevation for the deeper wall section at the limit of work shown on the Plans. The excavation shall be carried immediately to the depth shown at the point where excavation is started. The Agency may direct the Contractor to deepen the trench a maximum of ten (10) feet based upon examination of bucket cuttings and this work shall be included in the Contract square foot bid item price. The toe of the slope of the trench excavation shall not precede the toe of the backfill slopes by less than thirty (30) feet and no more than one hundred (100) feet. The Contractor shall segregate the final bucket cuttings excavated from the trench bottom, representative of the impermeable tie-in layer, by placing them in an area adjacent to the trench (on one side only) such that they may be reviewed by Agency personnel. This temporarily stockpiled material may be removed at the end of the shift, or as otherwise directed by the Agency.

The slurry trench shall be constructed without undue interruption until complete. If extended delays in backfill operations occur for any reason, the Agency may require the re-excavation of the placed backfill. Delays in excess of 48 hours are considered extended delays. The re-excavation of the placed backfill shall consist of the removal of five (5) feet perpendicular to the slope of the backfill for the full depth of the slurry trench. The removal of backfill and replacement of backfill due to unavoidable delays as defined in the General Specifications shall be performed at no additional cost to the Agency.
If various sections of the slurry trench are constructed separately or in more than one straight line segment, re-excavation of a section of the previously constructed slurry trench backfill material will be required at the points of intersection. If a trench excavation overlaps into a slurry trench previously backfilled as part of this project, the overlapping excavation shall extend a minimum of twenty (20) feet into the previously placed SB at all depths. The contractor shall maintain slopes no steeper than 4H:1V when connecting with any previously backfilled slurry trench. Replacing the excavated backfill with new backfill in the overlapping area shall be performed at no additional cost to the Agency. The Contractor shall confirm that the lead-in trench slope is stable by profiling the backfill slope in accordance with paragraph 3.9.4.4. If the trench slope is not stable, the Contractor shall flatten the slope until stability is confirmed by the trench slope soundings. That section of the slurry trench backfill material that is removed and re-backfilled due to an intersection shall be considered incidental to the SB slurry cutoff wall pay item.

3.4.3 Material Handling

Dry material shall be stored in protective containers. The air evacuated/displaced from the protective containers during the loading process shall be filtered before being discharged to the atmosphere. Representative samples of the bentonite shall be obtained for each lot or truckload of material delivered to the site. These samples shall be stored in airtight containers until the Contract is complete, and shall be used if needed, for testing to confirm material quality.

3.4.4 Placement of Slurry

The slurry shall be introduced into the trench at the time excavation begins. The level of the slurry in open trenches shall be at all times maintained a minimum of three (3) feet above the groundwater level and a maximum of twenty-four (24) inches below the working surface until the placement of SB backfill material is complete. The Contractor shall have sufficient personnel, equipment, slurry storage areas, and stored slurry materials ready to raise the slurry level at all times in the excavated trench. To this end, the Contractor shall have personnel on call to raise the slurry level at any time this occurs, nights, weekends, and/or holidays included. Dilution of the slurry by surface waters shall be prevented. The quality of the slurry shall be maintained at all times, including periods of work stoppage, in a condition that meets the requirements set forth in Paragraph 2.6, TRENCH BACKFILL BENTONITE SLURRY MIXTURE. Conditioning of the slurry may require recirculation through shaker screens or the addition of approved additives.

3.4.5 Excavated Material

Material excavated from the trench meeting the requirements of Paragraph 2.8, SOIL FOR CUTOFF WALL BACKFILL, may be used in the backfill. Alternatively, this material may be used for levee embankment construction, provided it meets or can be processed to meet the requirements of Section 31 00 00 EARTHWORK. Material not used in the backfill or other allowable fill areas shall become the property of the Contractor and shall be disposed of off site, in accordance with all State, Federal, and Local regulations and codes, such as the Clean Water Act and the National Historic Preservation Act.
3.4.6 Treatment of Trench Bottom

Cleaning the bottom of the trench will be required if delays in the placement of backfill material for longer than 48 hours occurs or if excessive sand is found to have settled, as determined by the Agency. The trench bottom shall be cleaned by an air lift pump or other suitable equipment to ensure removal of all sand, gravel, sediment, and any other material left in the trench during excavation and/or which has settled out of the slurry. Such equipment shall be maintained on site throughout the duration of cutoff wall installation. After the Contractor cleans the trench bottom by removing all loose material, he shall then probe the trench bottom to confirm that loose material has been removed. All cleaning equipment shall be operated in such a manner to prevent removal of materials from the walls of the trench.

3.4.7 Mixing Area

Areas for mixing of backfill, preparing fill for the SB slurry cutoff wall cap, and other operations shall be located within the construction limits shown on the Plans. All mixing areas shall be cleaned up and restored upon completion of the work in accordance with Paragraph 3.4.12, CLEANUP.

3.4.8 Mixing Backfill

Stockpiled material from the project excavations, which are suitable and intended for reuse as cutoff wall backfill, shall be processed through a mixing area acceptable to the Agency. For bulk mixing of the backfill using earth-moving equipment, the Contractor shall construct a controlled volume mixing area. This area shall either be an enclosed volume, bounded on the floor and walls by structural material such as concrete or steel, or a bermed impoundment suitable for containing the backfill materials. The Contractor shall proportion the backfill mixing area to be consistent with the production requirements and mixing area location.

The backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or pockets of fines, sand, or gravel, and meeting the specified gradation and permeability requirements. The backfill material, just prior to placement in the trench, shall have a consistency to provide a slump in accordance with paragraph 2.9 SOIL BENTONITE TRENCH BACKFILL. Any damage to the SB slurry cutoff trench as a result of operating equipment near the wall or for other reasons shall be repaired or restored by the Contractor at no additional cost to the Agency.

3.4.9 Placement of Backfill

Initial SB backfill placement shall be by constructing a lead-in trench 2H:1V or flatter to allow placement from the surface by pushing or dozing the backfill in at the lead-in trench. No payments will be made for the portions of trenches that lie outside of the limits of the wall as shown on the Plans. The SB backfill shall be placed so that it will slide down the forward face of the SB backfill slope. Free dropping of SB backfill through the slurry is not permitted. Placement operations shall proceed in such a manner that the slope of the initially placed SB backfill is maintained and that the top of the backfill below the surface of the slurry shall follow a reasonably smooth grade and shall not have hollows that may trap pockets of slurry during subsequent backfilling. To this end, the face of the backfill below the surface of the slurry may require rodding, and the Contractor shall have such equipment available at the job site. Placement shall be continuous from the beginning of the trench in the
direction of the excavation to the end of the trench.

No mixing or placing of SB backfill shall be performed unless the ambient air temperature is at least 35 degrees Fahrenheit and rising. Frozen SB backfill shall not be placed in the trench and backfill material containing frozen lumps shall not be used to mix SB backfill.

3.4.10 Temporary Cap

A temporary cap shall be placed within two (2) days of completing the SB backfill over each one hundred (100) foot reach along the trench. The temporary cap shall be constructed using levee embankment fill material placed without compactive effort. The temporary cap shall be removed no sooner than twenty-one (21) calendar days after placement, except that a shorter time may be allowed by the Agency based upon monitoring of the actual cutoff wall settlement. The temporary cap shall be constructed as shown on plans. If any depression develops within the completed SB slurry cutoff wall area, it shall be repaired by placing additional trench cover soil. Trench cover soil shall be SB backfill if the depression is observed during cutoff wall construction and levee embankment fill material if the depression is observed after the removal of the temporary cap. Trench cover material shall be tested in accordance with the applicable standard for the type of fill placed. Heavy construction equipment and machinery shall only be driven over the SB slurry cutoff wall at approved heavy-equipment crossing points that are bridged to support the equipment weights.

3.4.10.1 Settlement Plate Installation and Monitoring

A settlement plate test section shall be completed by the Contractor at the start of each cutoff wall heading. The test section shall be 1,000 feet in length with five (5) settlement plates installed at 200 foot spacing. The first settlement plate shall be installed within 50 feet of the toe of the lead-in trench. Each settlement plate shall be installed as soon as the wall has reached sufficient strength to support it. Settlement plate monitoring surveys shall be completed daily for 21 days. Monitoring surveys shall be accurate to 0.01 foot and shall be accomplished by performing a closed loop level survey beginning and ending on known control points. Construction laser levels may not be used for settlement plate monitoring surveys. Monitoring surveys shall be performed by a licensed Land Surveyor or Civil Engineer authorized to perform surveying in California and shall be provided to the Agency within 48 hours after completion of the settlement plate test section.

A cutoff wall settlement period shall be determined, by the Agency, based on the settlement results from the test section outlined above. The settlement period shall hold for the given heading and no additional settlement plate installation will be required for that heading until a new test section is required. Levee embankment operations may begin at the end of the settlement period as determined by the Agency.

New settlement plate test sections are required for every one (1) mile of cutoff wall placed or where the cutoff wall height, as measured from the working platform to the bottom of the wall, changes by 20 feet or more. Results from the most current test section, for a given heading, will be used to determine and set the settlement period for the given heading.

Settlement plates shall be installed in accordance with the details shown on the Plans.
Costs for installing, monitoring and removing settlement plates shall be included in the Contractor's unit cost for cutoff wall installation.

3.4.10.2 Removal of Temporary Cap and Settlement Plates

The temporary cap and settlement plates shall be removed as shown on the Plans. The working surface shall be excavated to a minimum depth of 1 foot and extending into acceptable cutoff wall material as determined by the engineer and backfilled with levee embankment fill in accordance with 31 00 00 and as shown on the Plans.

3.4.11 Cleanup

The Contractor shall continually clean up slurry wastes, debris, and leftover materials resulting from the cutoff wall construction process. After completion of the work, the site shall be cleared of all debris that may have accumulated in the execution of the work. The Contractor shall be responsible for disposing of waste materials in accordance with all federal, state, and local regulations and codes, such as the Clean Water Act and the National Historic Preservation Act.

3.4.12 Disposal of Waste Material

Spoils generated by the cutoff wall construction that do not meet the requirement for use in the various fill areas of the project shall become the property of the Contractor and shall be disposed of off site, in accordance with all federal, state, and local regulations and codes, such as the Clean Water Act and the National Historic Preservation Act.

3.4.13 Reconstructing Levee in Case of High Water

In the event the water surface elevation of the Yuba 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 and to begin continuous operations to complete all partially completed section(s) of the cutoff wall including capping layers, as specified in Section 31 00 00, EARTHWORK. Continuous operations shall consist of expeditiously performing the required operations twenty-four hours per day until the operations are completed. Additionally, during such flood conditions, the Agency reserves the right to require the Contractor to remove all equipment from the levee upon completion of the required backfilling. Compensation including time extension for actions taken for backfilling due to high water shall be through a Contract modification based upon work directed by the Agency. The work shall only be initiated upon receiving written notification from the Agency. The Contractor shall keep levee fill material on the project site for the duration of the construction period, protected from inclement weather, for use as emergency backfill as necessary.

3.4.14 Protection of Top of Cutoff Wall

The cutoff wall working surface shall have backfill material placed to the lines and grades shown on the Plans. No construction activity on top of the cutoff wall will be permitted until the initial settlement of the backfill has occurred. Contractor shall take all necessary actions to protect the cutoff wall from disturbance and prevent the drying of the top of the cutoff trench backfill. Heavy construction equipment and machinery shall only be driven over the cutoff wall at approved equipment crossing points.
which are "bridged" with steel plates and additional cover material and transmit no loads to the cutoff wall.

3.5 EQUIPMENT

3.5.1 General

The Contractor shall furnish all necessary plant and equipment for efficiently forming the slurry-mixing and equipment-operating surface; excavating the trench; mixing and placing backfill; disposing of undesirable excavated material in accordance with other provisions of this Contract; and, preparing and placing the temporary cap on the completed cutoff wall, and for testing the materials used in such process. The Contractor shall obtain and maintain at the job site a supply of spare critical replacement parts or back-up equipment sufficient to allow the SB slurry cutoff wall construction to proceed with minimum loss of time due to mechanical breakdown or equipment failure.

3.5.2 SB Slurry Cutoff Trench Construction

Equipment for excavating the slurry trench shall be any type of earth-moving equipment capable of performing the indicated work on the Plans and as specified, herein. The equipment shall be that which reduces live-load surcharge to a level that will produce no significant contribution to the instability of the trench. Excavation of the slurry trench cutoff wall shall be accomplished by use of any suitable earth moving equipment or combination thereof designed to maintain the width of the trench and minimize raveling of the trench sides during excavation operations including long reach excavators, clam shell excavators, or other approved equipment. The excavator bucket teeth shall be replaceable with rock excavating teeth and capable of being fitted with a ripper tooth. Regardless of the equipment type used, it shall be capable of excavating the required minimum width of trench in a single pass of the excavating equipment. The equipment shall be able to reach a minimum of ten (10) feet deeper than the maximum depth shown on the Plans. In addition to the excavating equipment, the Contractor shall have available on the job site a chopping bit, ripping block, or other suitable devices as required to accomplish the trench excavation to the full required depth. All equipment and any equipment modifications shall be reviewed and certified by the equipment manufacturer.

3.5.3 Mixing and Delivering Slurry

The slurry mixing plant shall be a colloidal batch or continuous mixing plant. It shall include the necessary equipment, including a mixer capable of producing a stable, colloidal suspension of bentonite slurry, or other mix combinations reviewed by the Agency. It shall include pumps, valves, hoses, supply lines, tools, and other equipment and materials required to adequately supply slurry to the cutoff wall sites and mixing areas. The Contractor shall have sufficient hydration ponds for storage of hydrated bentonite slurry. Hydration ponds for storage of hydrated slurry shall be mechanically or hydraulically agitated. The Contractor shall submit to the Agency for review the equipment proposed for mixing and delivering the bentonite slurries.

3.5.4 Mixing and Placing SB Slurry Cutoff Trench Backfill

The equipment used for mixing and placing the SB slurry cutoff wall backfill material shall be capable of mixing backfill materials into a
homogeneous mixture conforming to the Contract requirements and suitable for placing the backfill material in the trench as specified herein. One hundred percent of the processed material shall be capable of passing the two-inch sieve. All non-complying material shall be removed and replaced at the expense of the Contractor.

3.5.5 Retaining Berms

Suitable grading and earth-moving equipment shall be available for preparing the work area for SB slurry cutoff wall installation including equipment for the construction of slurry spill retention berms or ditches.

3.5.6 Hauling Equipment

Hauling equipment shall consist of pneumatic-tired vehicles having dump bodies suitable for dumping.

3.6 MIX DESIGN TEST PROCEDURES

3.6.1 General

The Contractor shall develop a laboratory testing program to demonstrate the adequacy of the proposed mix design. Trial mix designs shall cover a range of percentages of bentonite to correlate anticipated ranges of soil gradations using the site-specific soils. Any combination of soil, water, bentonite, and approved additives can be used by the Contractor. The Contractor shall fabricate a sufficient number of samples and mix designs to support the basis for the proposed mix design. The minimum number of trial mix designs shall be three (3) per each soil type anticipated. Refer to ASTM D2488 and ASTM D2487 for description, identification, and classification of soils.

3.6.2 Field / Trial Mixes

Field / trial mixes shall be made using site-specific soils, embankment soil, foundation soil, and imported soil, which will represent the range of materials expected to be encountered along the entire extent of the project. Field / trial mixes shall also include the proposed bentonite and water from the proposed construction sources, and any other materials proposed to be used in the construction.

The Contractor may take additional exploration borings when formulating mix designs to satisfy themselves of the types and quantities of material to be used in the backfill.

The performance criteria shall include the permeability and slump requirements in accordance with the parameters and methods required in the Specifications. The trial mix design shall be developed targeting the material properties stated hereafter. Soil samples obtained by the Agency for design purposes are not available to the Contractor to develop the mix design. The Contractor's test results for each trial mix design, including soil gradation, moisture content; mix proportions; and permeability shall be submitted to the Agency within fourteen (14) calendar days following receipt of Notice to Proceed. The Contractor's test results for permeability shall be submitted to the Agency within two (2) days of completing each test. Three (3) extra/reserve test specimens shall be fabricated for each trial batch. A minimum of three (3) gallons of each batch from the trial mixes shall also be submitted to the Agency for Quality Assurance testing. The Contractor shall reference Specification...
3.6.3 Permeability

The proposed mix design shall be such that permeability testing performed on laboratory produced trial mix design specimens shall result in a maximum permeability of $5 \times 10^{-7}$ cm/sec. Acceptance criteria for the in-place cutoff wall is $5 \times 10^{-7}$ cm/sec.

3.7 TRENCH STABILITY

The Contractor shall submit a plan showing the distance between all surcharge loads applied and the top of the slurry wall during SB slurry cutoff wall construction. This plan shall include the surcharge loads from materials and equipment and shall compare the loads against the strength of materials to be shored by the slurry trench. This plan shall also include requirements for minimum cover and/or additional protective measures for the completed SB slurry cutoff wall.

The Contractor shall be responsible for ensuring and maintaining the stability of the excavated trench at all times for its full length and depth and shall be responsible for maintaining slurry densities and levels within specified limits. The Contractor shall control surcharges from all excavation and backfilling equipment, waste, berm construction, backfill stockpiles, and any other loading situations that may affect trench stability including where applicable, areas where levee degrade material is stockpiled on the levee slopes to elevations higher than the working surface elevations noted on the plans. The Contractor shall be responsible for ensuring and maintaining the stability of the excavated trench at all times for its full length and depth and shall be responsible for maintaining slurry densities and levels within specified limits. The Contractor shall monitor the cutoff wall working surface during SB slurry wall construction for cracks or deformations and shall immediately notify the Agency of any such cracking or deformation. It is the Contractor's sole responsibility to ensure that the mixing of backfill and any stockpiles do not affect the open trench stability. In the event of failure of the trench walls prior to completion of backfilling, the Contractor shall at his expense re-excavate the trench and remove all material displaced into the trench, rebuild the levee as needed, and take corrective action to prevent further deterioration. In the event of failure of the trench walls prior to completion of backfilling, the Contractor shall, at its expense, re-excavate the trench and remove all material displaced into the trench and take corrective action to prevent further deterioration.

3.8 SAMPLE COLLECTION AND TESTING

Wet-bulk sampling and testing of the SB slurry cutoff wall by the Contractor will be required as indicated below.

3.8.1 Sample Collection and Testing

Acceptance of the work will depend upon the Contractor's work demonstrating that the in-place wall is homogeneous, continuous, and has achieved the permeability requirements. Quality Assurance sample collection and testing, in addition to the testing required by the Contractor, will be conducted by the Agency. Samples shall be collected using discrete wet
bulk sampling. Results of tests performed on wet-bulk samples shall take precedence over results of other sampling methods.

3.8.2 Wet-Bulk Sampling of SB Backfill

Wet-bulk material shall be sampled and test cylinders prepared in accordance ASTM D4832, with the following exceptions. Each cylinder shall be three (3) inches in diameter and six (6) inches in length. Alternatively, samples may be taken using a one gallon zip-top plastic bag. The wet-bulk sample shall be placed in a bailer-type device that allows for complete retrieval of the mixed material without additional mixing or segregation. The retrieved sample shall be passed through a three-quarter (3/4) inch sieve prior to cylinder fabrication; no other sieving is allowed. After the sample is retrieved, additional mixing is prohibited. Laboratory permeability testing shall be performed on cylinders for the production wall. From each wet-bulk sample collected, the Contractor shall fabricate and retain a minimum of two (2) extra cylinders for possible additional "back-up" testing. Approximately 20 percent of the tested locations will be selected for quality assurance testing by the Agency. At these selected locations, the Contractor shall obtain and provide to the Agency a minimum of three (3) gallons of wet-bulk sample.

One wet-bulk sample shall be obtained for every fifty (50) linear feet of cutoff wall constructed. Normally, a minimum of three (3) test cylinders shall be prepared from each wet-bulk sample of in-situ mixed material taken at the locations selected by the Contractor and reviewed by the Agency. At locations selected for Agency Quality Assurance testing, a minimum of six (6=3+3) test cylinders shall be prepared from each wet-bulk sample.

3.8.3 Wet-Bulk Sample Permeability Testing

Laboratory permeability testing shall be in accordance with ASTM D5084. For permeability testing, the cell and backpressure states to be applied during the initial application to achieve 10 psi effective confining pressure which produce a B coefficient equal to or greater than 0.9. In no case shall the cell pressure exceed 100 psi.

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Saturation shall be confirmed by measuring the B coefficient. The initial gradient used during permeation shall be twenty (20). Plots of the ratio inflow to outflow, gradient, and hydraulic conductivity versus time shall be required for each test. Lines describing the boundary limits for the listed termination criteria shall be included on the plots. The permeate liquid shall be clean water. The specimen top cap, bottom cap, and porous end pieces shall have a diameter equal to the diameter of the test specimen plus or minus (±) two (2) percent. Head shall be increased on the inflow end at the bottom of the specimen to a pressure that will develop the gradient of twenty (20). The initial and final density shall also be reported.
3.8.4 Wet-Bulk Sample Gradation

Representative grain size distribution (gradation) shall be determined for all wet-bulk samples retrieved. The bulk sample shall be split for gradation sample prior to being passed through the 3/4 inch sieve for the test cylinders. Gradations shall be obtained in accordance with ASTM D1140 and ASTM D422. Hydrometer analyses used to determine grain size distribution of the fines are not required.

3.8.5 Rejected Cutoff Wall Section

If the specified dimensions, gradation or permeability are not achieved, the section of the cutoff wall will be rejected. The deficient section limits will be determined by the Agency. The deficient section shall be no less than the entire rig-shift's placement from which the representative wet-bulk samples were obtained. If tests fail to meet the specified requirements, the Agency reserves the right to require additional sampling and testing at the Contractor's expense. For failed/rejected sections, the Contractor shall remove and replace the SB cutoff wall within the limits specified by the Agency at no additional cost to the Agency.

3.9 QUALITY CONTROL PROGRAM

3.9.1 General

3.9.1.1 Quality Control Program

The Contractor shall develop a SB Slurry Cutoff Wall Quality Control Program that shall be in conformance with Section 01 45 01.10, QUALITY CONTROL SYSTEM (QCS), and shall include, as a minimum, the following components:

a. Continuous monitoring and recording of the following parameters:
   i. Slurry trench depth, width, and location.
   ii. Mixing plant batching and mixing for each rig shift.
   iii. Confirmation of penetration to target stratum.

b. Testing of selected samples recovered.

3.9.1.2 Report Monitoring

The Contractor shall provide all personnel and equipment necessary to implement the Quality Control Program. The Contractor shall include a Registered Professional Engineer as a part of the Quality Control organization. The engineer will observe construction and will review the Contractor's Daily Quality Control Reports and test results in order to verify that the Quality Control Program is being properly implemented and the specified cutoff wall properties are being achieved.

3.9.1.3 Program Duration

The established Quality Control Program shall be in effect for the full duration of the Contract.
3.9.2 Rig-Shift Quality Control Report

3.9.2.1 General

Contractor shall submit a Rig-Shift Quality Control Report for each rig per shift to the Agency by the end of the following shift. The Rig-Shift Quality Control Report shall document the progress on the SB slurry cutoff wall construction, present the results of the Quality Control parameter monitoring, and present the results of permeability testing on cured samples.

3.9.2.2 Data Documentation

The Rig-Shift Quality Control Report shall include, at a minimum, the results of the following real-time Quality Control parameters monitoring:

a. Identification of area of work.

b. Rig number.

c. Date and time (start and finish) of rig shift.

d. Levee stationing and reference Plan number.

e. Trench top and bottom depths or elevations.

f. Slurry viscosity measurement.

g. Test methods and results.

h. Description of obstructions, interruptions, or other difficulties encountered during installation and how they were resolved.

i. Daily plot of trench depth dimensions.

3.9.2.3 Reports

The Daily Quality Control Report shall include the Rig-Shift Quality Control Report.

3.9.3 Coordination of Testing Laboratories

The Contractor's Quality Control laboratory representative shall meet weekly with the Agency's Quality Assurance laboratory representative to coordinate all aspects of their work. Differences in sampling, handling, transporting, storing, and testing methods shall be eliminated. If discrepancies in the test results from the two labs are noted, the representative of the Quality Control Laboratory and the representative of the Quality Assurance Laboratory shall visit and inspect each other's laboratory facilities for the purpose of eliminating the differences and discrepancies. The representative of the Quality Control Laboratory shall report the findings to the Agency with recommendations for corrective action subject to Agency approval.

3.9.4 Quality Control Records

The Contractor shall be responsible for Project Quality Control Records. Observation, measurements, and tests described in these Specifications shall be performed for Quality Control. All Quality Control Records,
routine testing procedures, summaries, observations, and measurements shall be available for inspection by the Agency at any time. Final acceptance of the cutoff wall shall be based upon the results of field measurements and bulk samples collected and tested in accordance with these Specifications, and the results from the Agency's Quality Assurance inspections and testing. The Contractor's laboratory shall be an independent commercial laboratory and shall comply with the requirements of Section 01 45 01.10 QUALITY CONTROL SYSTEM (QCS).

3.9.4.1 Bentonite

Each truckload of bentonite delivered to the site shall be sampled in accordance with Section 9 or Section 10 of API Spec 13A. The samples may be tested in accordance with the procedures of Section 3 of API Spec 13A, to confirm conformance with the physical and chemical requirements of Table 12, Bentonite, Physical Requirements, or Table 13, Nontreated Bentonite Physical Requirements.

3.9.4.2 Water

Reference Section 01 50 02.00 41, TEMPORARY CONSTRUCTION FACILITIES, for potential sources for water for construction purposes. Prior to the start of construction, the source of water to be mixed with the bentonite shall be tested for pH, hardness, and oil, organic, etc. Subsequent to the start of construction, testing shall be conducted at least every two weeks, or more frequently if changes in water quality are apparent. Tests shall conform with the requirements of API RP 13B-1 and these Specifications. Testing of water and the water results shall conform to the requirements listed in Paragraph 2.3, WATER.

3.9.4.3 Slurry Properties

All tests specified in this paragraph shall be conducted in accordance with API RP 13B-1.

At the time of placing backfill into the slurry-filled trench, the bentonite slurry within the trench shall be tested for viscosity, filtration, pH, and density. The bentonite slurry in the trench shall be sampled a minimum of two times each working day, or shift, one sample at a depth of ten (10) feet, one at mid-depth, and one five (5) feet from the trench bottom. The samples shall be taken within twenty-five (25) to forty (40) feet of the advancing backfill slope. The bentonite slurry in the trench five (5) feet in advance of the backfill slope shall also be tested a minimum of one time each working day, or shift, at a depth interval of twenty-five (25) feet.

The samples shall be labeled by sample number, date, time, heading, depth, and stationing. The sampling devices used to collect samples shall be subject to review by the Agency. The Contractor shall be required to obtain additional samples for the Agency at any time or location requested. Personnel shall be provided by the Contractor for conducting the tests and they must have a working knowledge of test procedures for drilling fluids in accordance with applicable API standard procedures. Equipment for bentonite slurry testing shall be furnished and maintained by the Contractor.

3.9.4.4 Excavation and Backfill Soundings

The Contractor shall make excavation and SB backfill soundings at every 10-
foot interval along the trench centerline using a weighted tape, cable, or other devices reviewed by the Agency. The soundings shall be performed and recorded a minimum of one time at the beginning and one time at the end of each 10-hour work day, or shift, per heading, and at additional times as requested by the Agency. The length of the cutoff wall installed each day or lesser increment thereof shall be measured. The soundings at each interval shall record the following:

a. Elevation of Bottom of Excavation

Determining the depth of excavation will be made by the Contractor, using the measured depth and stationing. The minimum excavation line is shown on the Plans. The depth of excavation may increase by up to ten (10) feet or decrease by up to ten (10) feet from the Plans due to field conditions encountered, with Agency review. Continuous visual inspection of the bucket cuttings in accordance with ASTM D2488 shall be performed by the Contractors Trench Logger. Logging of soil classification at the bottom of excavation shall be performed a minimum of every twenty (20) feet. The Contractor shall determine the elevation of the bottom of the excavation. The bottom of the cutoff wall shall extend a minimum of five feet into the impervious stratum, or to such other depth as shown on the Plans or directed by the Agency.

b. Elevation of Bottom Prior to Backfilling

This sounding shall record the thickness of sediments accumulated at the trench bottom. Cleaning and additional material removal from the trench bottom prior to backfilling may be required by the Agency. This sounding may not precede the toe of the SB backfill slope more than one hundred (100) feet.

c. Profile of Backfill Slope

The SB backfill slope shall be measured at the beginning and at the end of each shift per heading and at additional times at the request of the Agency. The slope of the SB backfill shall be sounded at horizontal intervals of ten (10) feet to determine the profile of the backfill slope. For lead-in trenches in previously constructed slurry trench backfill material, two (2) sets of soundings shall be made on the lead-in trench slope at a minimum interval of two (2) hours to confirm the slope is stable. If the slope is not stable, the slope shall be flattened and the soundings repeated to confirm slope stability.

The Agency may also make independent soundings to verify the results obtained by the Contractor and for quality assurance purposes.

3.9.4.5 Slump Testing

The backfill material, just prior to placement in the trench, shall have a consistency to provide a slump four (4) to seven (7) inches in accordance with ASTM C143/C143M. Slump cone tests shall be performed a minimum of two (2) times per 8- or 10-hour work day, or shift, per heading and at additional times requested by the Agency.

3.9.4.6 As-Built Profile

An as-built profile of the trench bottom, backfill slopes including descriptions of materials encountered in the trench, and bottom of trench shall be continuously maintained by the Contractor. This profile shall
indicate the extent of excavation and the SB backfill profile at the beginning and end of each work day or shift, as determined from the soundings. The daily profile drawing shall be in AutoCAD, as well as in electronic format written for import into Microsoft Excel or in a digital format. Material encountered in the trench and bottom of the trench shall be described by the Trench Logger, in accordance with ASTM D2488 at a maximum interval trench length of twenty (20) feet. The Contractor shall furnish profile drawings, individual and summary of records of all observations, measurements, and tests performed, identified with the location and time of testing. These records shall be furnished no later than 24 hours after the tests, measurements, and/or observations were made.

3.10 CUTOFF WALL ACCEPTANCE

3.10.1 General

Final acceptance of the SB slurry cutoff wall will be based upon the Contractor's Quality Control Records as identified in the Rig-Shift Reports, Contractor's Quality Control test results, and Agency's Quality Assurance test results. Both the Contractor's and the Agency's testing shall demonstrate that the Contract requirements are met prior to acceptance of the work. If, during the course of construction, the Contractor's Quality Control testing indicates noncompliance with the Specifications, the Contractor shall immediately notify the Agency in writing. Notification shall include the remedial action to be taken by the Contractor to bring the work back into compliance.

3.10.2 Acceptance Criteria Synopsis

The following is a summarization of acceptance criteria for part but not all of the testing and procedural requirements. Refer to the entire Specifications and Plans for all the Contract requirements.

a. Wall depth: As shown on the Plans and as directed by the Agency.

b. Wall thickness: Minimum thirty-six (36) inches.

c. Bulk sample permeability: Maximum 5x10^-7 cm/s.

d. Continuity and Homogeneity: Continuity and homogeneity of the cutoff wall as evidenced by the preponderance of Quality Control and Quality Assurance test results and inspection of soil-bentonite backfill placement by the Agency.

-- End of Section --
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SECTION 32 10 00

BITUMINOUS CONCRETE PAVEMENT

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 T 230 (1968; R 2000) Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CALTRANS State of California Department of Transportation (CALTRANS) Standard Specifications

1.2   SUBMITTALS

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

SD-04 Samples
  Uncompacted mix
  Pavement Pavement cores

SD-06 Test Reports
  Trial batch reports
  Mix design
  Asphalt concrete
  Density
  Thickness
  Straightedge test
  Submit reports for testing specified under paragraph entitled "Field Quality Control."

SD-07 Certificates
  Asphalt mix delivery record

December 30, 2019
Asphalt concrete and material sources and material sources

Obtain approval of the Agency for materials and material sources 2 days prior to the use of such material in the work.

Asphalt concrete

Submit certificates, signed by the producer, that paving materials and incidental construction items conform to specification requirements.

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Provide work and materials in accordance with applicable requirements of Caltrans Standard Specifications, except that paragraphs in the Standard Specifications entitled "Measurement and Payment" shall not apply.

1.3.2 Modification of References

Where term "Engineer" is used in the Caltrans Standard Specifications it shall be construed to mean Agency.

1.3.3 Mix Delivery Record Data

Record and submit the following information to each load of mix delivered to the job site. Submit within one day after delivery on Agency-furnished forms:

a. Truck No:  
b. Time In:  
c. Time Out:  
d. Tonnage and Discharge Temperature:  
e. Mix Type:  
f. Location:  
g. Stations Placed:

1.3.4 Mix Design

Submit results of laboratory tests performed on each mix design. Testing shall have been accomplished not more than one year prior to date of material placement.

1.4 PAVEMENT DELINEATION

The existing pavement delineation and pavement markings shall be replaced with paint traffic stripe and two (2) coat pavement markings in accordance with the California Department of Transportation Standard Specifications and Standard Plans, dated May 2006. The new pavement delineation and pavement markings shall match the existing delineation. Temporary pavement delineation shall be in accordance with the California Department of Transportation Standard Specifications and Standard Plans, dated May 2006.
Transportation Standard Specifications for temporary pavement delineation, permanent pavement delineation and pavement markings shall be considered to be included in the payment for asphalt concrete and no additional payment will be allowed.

PART 2   PRODUCTS

2.1   ASPHALT CONCRETE

Provide asphalt concrete, Type A in accordance with the Caltrans Standard Specifications. Bituminous concrete to be PG64-10, in accordance with CALTRANS Section 92. Maximum aggregate size shall be 1/2-inch.

2.2   COMPOSITION OF MIXTURE REQUIREMENTS

2.2.1   Mixture Properties

Gradation of mineral aggregate shall be as specified in these Specifications. Percentage of bituminous material provided in the bituminous mixtures shall be within the limits specified.

2.2.2   Quantity of Bituminous Material

Mix asphalt cement with aggregates of corresponding mixes in the following proportions:

<table>
<thead>
<tr>
<th></th>
<th>Binder Course</th>
<th>Wearing Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 to 8</td>
<td>5 to 9</td>
</tr>
</tbody>
</table>

PART 3   EXECUTION

3.1   PREPARATION

3.1.1   Excavation and Filling

Excavation and filling to establish elevation of subgrade is specified in Section 31 00 00 EARTHWORK.

3.2   INSTALLATION

Provide construction in accordance with the applicable requirements of the Caltrans Standard Specifications, except where indicated or specified otherwise.

3.2.1   New Pavement

Construct to the lines, grades and sections as shown on the Plans and in accordance with the project Specifications and the referenced State Specifications. Place and compact subgrade per Section 31 00 00 EARTHWORK prior to placing aggregate surfacing. Install aggregate surfacing in accordance with Section 32 11 23 AGGREGATE BASE COURSE. Install a surface course of asphalt concrete in accordance with Section 39 of State Specifications. Tolerance of finished grade shall be 0.1 ft above required elevations.
3.2.2  Remove and Replace Paving

Remove existing asphalt concrete and base materials to the lines shown and to depth required for placement of new pavement section. Compact subgrade and place new aggregate surfacing and paving materials as specified for new pavement.

3.2.3  Saw Cutting

Saw cutting shall be required at locations as specified on the Plans. Saw cutting shall extend as deep as necessary to remove all existing asphalt concrete at the required locations. Asphalt concrete removed shall be disposed of in a manner consistent with these specifications.

3.3  VEHICLE PAVING REPAIR

Required for all areas damaged by construction.

3.3.1  Repairing damaged paving after completion of construction (except in areas where remove and replace paving is required)

Sawcut and remove paving to 1-foot outside of the damaged area to full depth of paving section, and in neat straight lines. Replace removed paving in accordance with Paragraph 3.2.1 New Pavement.

3.4  FIELD QUALITY CONTROL

3.4.1  Testing

The following testing shall be performed by the Contractor and be the basis of acceptance for asphalt concrete pavement.

a. Density: Determine density of pavement by testing cores obtained from the binder and wearing course in accordance with AASHTO T 230. Take three cores at location designated by Agency for each 200 feet, or fraction thereof, of asphalt placed. Deliver cores undisturbed and undamaged to laboratory and provide test results within 48 hours of each day placement of paving materials.

b. Thickness: Determine thickness of the binder and wearing course from cores taken for density test.

c. Straightedge Test: Test compacted surface of binder course and wearing course with a straightedge in accordance with Caltrans Standard Specifications. Pavement showing irregularities greater than that specified shall be corrected as directed by Agency. Pavement patches showing irregularities greater than 1/4 inch when compared to the adjacent, adjacent pavement shall be corrected as directed by Agency.

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DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 11 23

AGGREGATE BASE COURSE

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-- End of Section Table of Contents --
PART 1   GENERAL

1.1   SCOPE

The work specified herein consists of the construction of an 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 D1557 (2012) 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)


STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)


1.3 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.3.1 Aggregate Base Course

Aggregate 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 tests 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.
PART 2 PRODUCTS

2.1 AGGREGATES

The aggregate base course (ABC) shall consist of clean, sound, durable particles of crushed stone, crushed gravel, angular sand, 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

Only one source of coarse aggregate shall be used on the project. 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.

2.1.1.1 Aggregate 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 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

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Operating Range</th>
<th>Contract Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>90-100</td>
<td>87-100</td>
</tr>
<tr>
<td>No. 4</td>
<td>35-60</td>
<td>30-65</td>
</tr>
<tr>
<td>No. 30</td>
<td>10-30</td>
<td>5-35</td>
</tr>
<tr>
<td>No. 200</td>
<td>2-9</td>
<td>0-12</td>
</tr>
</tbody>
</table>

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 STOCKPILING MATERIAL

Aggregates shall be stockpiled on the cleared and leveled areas designated by the Agency to prevent segregation. Materials obtained from different sources shall be stockpiled separately. Stockpiling of cement treated aggregate shall not be allowed.

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

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loosening and removing soft or unsatisfactory material and by adding
approved material, reshaping to line and grade, and recompa
ting 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 in accordance with ASTM D1557. 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.

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SECTION 32 15 00

AGGREGATE SURFACE COURSE

04/08

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1.3   SUBMITTALS
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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 D1557 (2012) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

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


1.2 DEGREE OF COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated herein as present laboratory maximum density.

1.3 SUBMITTALS

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

SD-03 Product Data

Equipment

List of proposed equipment to be used in performance of construction work including descriptive data.

Aggregate Source

Proposed source of aggregate base with test results showing conformance to these specifications.

SD-06 Test Reports

Sampling and Testing

December 30, 2019
List of proposed equipment to be used in performance of construction work including descriptive data.

Density Tests

The Contractor shall provide the following:

1. Calibration curves and related test results prior to using the device or equipment being calibrated.

2. Copies of field test results within 24 hours after the tests are performed.

3. Test results from samples, not less than 30 days before material is required for the work.

4. Results of laboratory tests for quality control purposes, for review, prior to using the material.

1.4 EQUIPMENT

All plant, equipment, and tools used in the performance of the work covered by this section will be subject to review by the Agency 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, and meeting the grade controls, thickness controls, and smoothness requirements set forth herein.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by an approved commercial testing laboratory or by the Contractor, subject to review by the Agency. If the Contractor elects to establish its own testing facilities, approval of such facilities will be based on compliance with ASTM D3740. No work requiring testing will be permitted until the Contractor’s facilities have been inspected and reviewed.

1.6 APPROVAL OF MATERIALS

The source of the material to be used for producing aggregates shall be selected 14 calendar days prior to the time the material will be required in the Work. Review of sources not already reviewed will be based on an inspection by the Agency.

1.7 WEATHER LIMITATIONS

It shall be the responsibility of the Contractor to protect, by reviewed method or methods, all areas of surfacing that have not been accepted by the Agency. Surfaces damaged by freeze, rainfall, or other weather conditions shall be brought to a satisfactory condition by the Contractor.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregate surfacing in compliance with CALTRANS Standard Specifications (CDT Std SpecsSection 26, Aggregate Bases), Class 2

December 30, 2019
Aggregate Base (3/4 inch maximum) with a minimum bulk specific gravity of 2.68 or greater per ASTM C127.

PART 3   EXECUTION

3.1   STOCKPILING MATERIALS

Prior to stockpiling salvaged material, the storage sites shall be cleared and leveled by the Contractor. All materials, including reviewed material available from the salvage operation, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled in such a manner that will prevent segregation. Aggregates and binders obtained from different sources shall be stockpiled separately.

3.2   GRADE CONTROL

During construction, the lines and grades including crown and cross slope indicated for the aggregate surface course shall be maintained by means of line and grade stakes placed by the Contractor in accordance with the GENERAL SPECIFICATIONS.

3.3   MIXING AND PLACING MATERIALS

The materials shall be mixed and placed to obtain uniformity of the material and a uniform water content for compaction. The Contractor shall make adjustments in mixing, placing procedures, or in equipment to obtain the true grades, to minimize segregation and degradation, to obtain the desired water content, and to ensure a satisfactory surface course.

3.4   LAYER THICKNESS

The existing aggregate surfacing on levee degraded areas shall be salvaged for reuse. The salvaged aggregate shall be placed only in the bottom 3 inches of the final aggregate surfacing. The top 3 inches of aggregate surface course on levee degraded areas shall be from a source approved by the Agency as stated in 1.6 APPROVAL OF MATERIALS. The aggregate material shall be placed on the underlying course in layers of uniform thickness. For all other areas receiving aggregate surfacing, the thickness shall be a minimum 6 inches and come from a source approved by the Agency as stated in 1.6 APPROVAL OF MATERIALS.

3.5   COMPACTION

Degree of compaction is a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated herein as percent laboratory maximum density. Compact each layer of the aggregate surface course with approved compaction equipment, as required in the following paragraphs. Maintain the water content during the compaction procedure at optimum or at the percentage specified by the Contracting Officer. Compact the mixture with mechanical tampers in locations not accessible to rollers. Continue compaction until each layer through the full depth is compacted to at least 95 percent of laboratory maximum density. Remove any materials that are found to be unsatisfactory and replace them with satisfactory material or rework them to produce a satisfactory material.

3.6   SMOOTHNESS TEST

The surface of each layer shall not show any deviations in excess of 1/2 inch when tested with a 10 foot straightedge applied both parallel with and
at right angles to the centerline of the area. Deviations exceeding this amount shall be corrected by removing material, replacing with new material, or reworking existing material and compacting.

3.7 THICKNESS CONTROL

The completed thickness of the aggregate surface course shall be within 1/2 inch, plus or minus, of the thickness indicated on Plans. The thickness of the aggregate surface course shall be measured at intervals in such manner that there will be a thickness measurement for at least each 500 square yards of the aggregate surface course. The thickness measurement shall be made by test holes at least 3 inches in diameter through the aggregate surface course. When the measured thickness of the aggregate surface course is more than 1/2 inch deficient in thickness, the Contractor, at no additional expense to the Agency, shall correct such areas by scarifying, adding mixture of proper gradation, reblading, and recompacting. Where the measured thickness of the aggregate surface course is more than 1/2 inch thicker than that indicated, it shall be considered as conforming with the specified thickness requirements plus 1/2 inch. The average job thickness shall be the average of the job measurements determined as specified above, but shall be within 1/4 inch of the thickness indicated. When the average job thickness fails to meet this criterion, the Contractor, at no additional expense to the Agency, shall make corrections by scarifying, adding or removing mixture of proper gradation, and reblading and recompacting.

3.8 DENSITY TESTS

Density shall be measured in the field in accordance with ASTM D6938. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals, as directed.

3.9 MAINTENANCE

The aggregate surface course shall be maintained in a condition that will meet all specification requirements until accepted.

-- End of Section --
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    1.2.2   Reflective Media Dispenser
    1.2.3   Surface Preparation Equipment
      1.2.3.1   Sandblasting Equipment
      1.2.3.2   Waterblast Equipment
    1.2.4   Shotblasting Equipment
    1.2.5   Chemical Equipment
  1.3   SUBMITTALS
  1.4   QUALITY ASSURANCE
    1.4.1   Qualifications
    1.4.2   Traffic Controls
    1.4.3   Maintenance of Traffic
      1.4.3.1   Roads, Streets, and Parking Areas
  1.5   DELIVERY, STORAGE, AND HANDLING
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  2.2   REFLECTIVE MEDIA
  2.3   SAMPLING AND TESTING

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  3.1   SURFACE PREPARATION
    3.1.1   Pretreatment for Early Painting
    3.1.2   Cleaning Existing Pavement Markings
  3.2   APPLICATION
    3.2.1   Raised Reflective Markers
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    3.3.1   Equipment Operation
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-- End of Section Table of Contents --
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)


ASTM INTERNATIONAL (ASTM)

ASTM D4280 (2008) Extended Life Type, Nonplowable, Raised, Retroreflective Pavement Markers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325 (Rev C) Beads (Glass Spheres) Retro-Reflective (Metric)

1.2  SYSTEM DESCRIPTION

All machines, tools and equipment used in the performance of the work shall be maintained in satisfactory operating condition. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.2.1  Paint Application Equipment

1.2.2  Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph 3.2 APPLICATION, at all operating speeds of the applicator to which it is attached.

1.2.3  Surface Preparation Equipment

1.2.3.1  Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and
shall be equipped with traps that will maintain the compressed air free of oil and water.

1.2.3.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.2.4 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.2.5 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.3 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.

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.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

1.4.2 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.

1.4.3 Maintenance of Traffic

1.4.3.1 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.

1.5 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.

1.6 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

2.1 RAISED REFLECTIVE MARKERS

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors, as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 4 inches, and shall be spaced not more than 40 feet apart on solid longitudinal lines. Broken centerline marker spacings shall be in segments indicated with gaps indicated between segments. Markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more...
than 3/4 inch above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D4280.

2.2 REFLECTIVE MEDIA

Reflective media for roads and streets shall conform to FS TT-B-1325, Type I, Gradation A or AASHTO M 247, Type I.

2.3 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers in the presence of the Agency. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Agency for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

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 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.

3.2.2 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, 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.

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EROSION CONTROL SEEDING

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3.5 FIELD QUALITY CONTROL

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PART 1  GENERAL

1.1  SCOPE

Perform erosion control seeding on reconstructed levee side slopes, borrow site side slopes, and restored access and haul roads and staging areas as specified herein, as shown on the Plans, or as otherwise directed by the Agency.

1.2  QUALITY ASSURANCE

There shall be no substitutions of seed species or variety as shown in seed mix tables unless authorized by the Agency.

Seed materials, including the seed mix, fertilizer, and mulch, shall be delivered by the Contractor to the job site with durable, waterproof labels indicating the correct species, variety, percent live seed (PLS) and other certifications, and the supplier's name, in conformance to these Specifications. The Agency will observe the seed mix, fertilizer, and mulch material as it is being delivered to the site for conformity to these Specifications. Such reviews shall not impair the right of additional observations during further progress of the work.

The Contractor shall be responsible for storing and maintaining the seed mix, fertilizer, and mulch as delivered throughout the Construction Period.

1.3  SUBMITTALS

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

SD-04 Samples

SEED MATERIALS
The Agency may at any time request, test, and analyze seed materials including the seed mix, fertilizer, or mulch to ensure their conformance to these Specifications. The Contractor shall furnish, at no additional cost, the requested materials for the Agency's use. Seed materials not meeting the Agency'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. The following shall be submitted by the Contractor according to submittal procedures included in the Contract. The Contractor shall furnish, at no additional cost, the requested materials for the Agency's review.

1.  Seed mix verification by way of certified mix labels from supplier in sealed seed mix bags. In addition, the Contractor shall submit a 5 pound bag of the seed mix for review before any seeding operations.

December 30, 2019
2. Before delivery of the straw and fertilizer material to the project site, the Contractor shall provide the material order and the name, address and telephone number of the material supplier. In addition, the Contractor shall submit mulch and fertilizer material samples in 5 pound bags, each, for review before any seeding operations.

SD-07 Certificates

Invoices

Duplicate copies of invoices for all materials. Invoices for fertilizer shall show the grade furnished.

PART 2   PRODUCTS

2.1   MATERIALS

2.1.1   Seed

2.1.1.1   Seed Species and Planting Rates

The following native grass seeds shall be applied at the following Pure rates.

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achillea millefolium</td>
<td>Yarrow</td>
<td>5 lbs/acre</td>
</tr>
<tr>
<td>Bromus carinatus</td>
<td>California brome</td>
<td>5 lbs/acre</td>
</tr>
<tr>
<td>Eschscholzia californica</td>
<td>California poppy</td>
<td>5 lbs/acre</td>
</tr>
<tr>
<td>Horduem brachyantherum</td>
<td>California barely</td>
<td>10 lbs/acre</td>
</tr>
<tr>
<td>Elymus (Leymus) triticoides</td>
<td>Creeping wildrye</td>
<td>20 lbs/acre</td>
</tr>
<tr>
<td>Stipa (Nassella) cernua</td>
<td>Nodding Needlegrass</td>
<td>10 lbs/acre</td>
</tr>
<tr>
<td>Stipa (Nassella) pulchra</td>
<td>Purple needlegrass</td>
<td>10 lbs/acre</td>
</tr>
<tr>
<td>Trifolium wildenovii</td>
<td>Tomcat clover</td>
<td>10 lbs/acre</td>
</tr>
<tr>
<td>Vulpia microstachys</td>
<td>Three week fescue</td>
<td>10 lbs/acre</td>
</tr>
</tbody>
</table>
2.1.2 Fertilizer

Fertilizer shall be liquid, of the concentrations indicated below:

<table>
<thead>
<tr>
<th>Item</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen (nitrate)</td>
<td>8</td>
</tr>
<tr>
<td>Phosphorus (Ammonium Polyphosphate)</td>
<td>24</td>
</tr>
<tr>
<td>Potassium (Potassium Sulfate)</td>
<td>3</td>
</tr>
<tr>
<td>Zinc (Zinc Sulfate)</td>
<td>0.25</td>
</tr>
<tr>
<td>Sulfur (Ammonium Thiosulfate)</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Fertilizer shall be delivered in containers labeled in accordance with applicable State regulations and bearing the warranty of the producer for the grade furnished.

2.1.3 Fiber Mulch

Fiber mulch shall be dyed wood cellulose fiber specially prepared for hydroteeding.

2.1.4 Straw Mulch

Straw mulch shall be derived from rice, seedless wheat or native grass hay. The Contractor shall furnish evidence that clearance has been obtained from the County Agricultural Commissioner, as required by law, before straw obtained from outside the county in which it is to be used is delivered to the site of the work. Straw that has been used for stable bedding shall not be used. Straw shall be free of mold. Straw shall be cured and dry with no water added after baling.

2.1.5 Water

Water shall be furnished by the Contractor, in conformance with these Specifications, and shall be free of chemicals detrimental to the seed mixture.

2.1.6 Stabilizing Emulsion (Tackifier)

Stabilizing emulsion shall be in a dry powder form, may be re-emulsifiable and shall be a processed organic derivative of Plantago insularis used as a soil binder.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 General

The Contractor shall be responsible for coordinating all site preparation and seeding operations with seasonal water levels.

3.1.2 Debris Removal

Prior to ground surface preparation operations, Contractor shall remove and dispose of all wire, rubbish, stones, and other material that might hinder proper grading and subsequent maintenance.
3.1.3 Surface Preparation

Slopes shall be prepared consistent with 31 00 00 EARTHWORK, section 3.4.4 "Topsoil" prior to application of seeding. 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 Agency.

3.2 METHOD OF SEEDING

3.2.1 Hydrosseeding

The seed and fertilizer shall be mixed with cellulose fiber and water to form a slurry. Mix the slurry in tanks having continuous agitation so that a homogeneous mixture is discharged hydraulically through hoses on the area to be seeded.

a. Apply seed, fertilizer, and mulch in suspension at the following rates:

- Seed - At rates specified in the Seed Mix Tables
- Fertilizer - 150 pounds per acre
- Fiber Mulch - 500 pounds per acre

b. Following the application of seed mix, straw mulch shall be pneumatically applied to the area seeded, at a rate of 3,000 pounds per acre.

c. Following the application of straw mulch, a stabilizing emulsion and fiber mulch mixture shall be hydraulically applied to the area strawed, at the following rates:

- Stabilizing emulsion - 100 pounds per acre
- Fiber Mulch - 1,000 pounds per acre

3.3 ESTABLISHMENT

3.3.1 Period

The Contractor shall be responsible for the proper care of the seeded areas until May 1 of the year following the seeding, or until the desired stand of vegetation is established. The desired stand of vegetation is defined as a minimum of 85 percent coverage of the area seeded. The need for repairing and reseeding (as described herein) within the establishment period shall be as determined by the Agency.

3.3.2 Protection

Protect areas susceptible to vehicular or heavy foot traffic by erecting suitable barricades immediately after seeding is completed and/or by placing warning signs of a type reviewed by the Agency.

3.4 REPAIR

3.4.1 General

When any portion of the ground surface becomes rilled, gullied or otherwise...
damaged following seeding within the period of Contractor's responsibility, repair the affected portion to re-establish the condition and grade of the soil prior to planting and then reseed as specified for initial planting, all at no cost to the Agency.

3.4.2 Reseeding

When it becomes evident that the seeding has been unsuccessful, the Agency will require that these areas be reseeded with the same seed and quantity as specified for the initial seeding. Complete reseeding within fifteen (15) days following notification. Prepare the area to be reseeded as directed by the Agency. Reseeding due to damaged or deficient seed material or improper application will be completed at no additional cost to the Agency.

3.4.3 Replacement of Straw Mulch, Fiber, and Tackifier

Slopes of 3:1 or steeper where erosion has occurred, or where straw mulch has blown or washed away within the period of Contractor's responsibility shall have straw, fiber, and tackifier reapplied at the rate and method described in Sections 3.3.1 at no additional cost to the Agency.

3.5 FIELD QUALITY CONTROL

During the course of work or upon completion of the Project, a check of the quantities of materials will be made against the areas treated, and if the minimum rates of application have not been met, the Agency will require the distribution of additional quantities of those materials to make up the minimum applications specified.

-- End of Section --
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DIVISION 33 - UTILITIES

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OBSERVATION WELLS

04/08

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PART 1   GENERAL

1.1   SCOPE

The work covered by this Section consists of furnishing all labor, equipment, and materials for installing new observation wells in accordance with these Specifications and applicable Drawings. Installation of the observation wells includes but is not limited to the following:

   A. Drilling wells.
   B. Installing observation wells and associated components.
   C. Developing observation wells.
   D. Performing pumping tests.

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)


AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA A100 Standard for Water Wells

1.3   QUALITY CONTROL

1.3.1   General

The Contractor shall have personnel sufficient in number and qualifications to monitor at all times the observation well construction activities. The observation well construction must be performed by a licensed well driller holding a valid California C-57 Contractors license.

1.3.2   Inspection

The Contractor shall be responsible to observe and control, for compliance with the Specifications, all observation well construction including, but not limited to, the following:

   A. Survey Layout
   B. Materials and material storage
   C. Drilling
   D. Well pipe assembly and installation, including joints, centralizers, and end cap
   E. Filter pack installation
   F. Cleaning, development, and pumping tests

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Observation of observation well construction will also be performed by the Agency.

1.3.3 Sampling and Testing

The Contractor shall verify that all observation well materials conform to these Specifications before delivery to the project.

1.3.4 Corrective Action

When quality control monitoring or testing detects non-conformance with these Specifications, corrective action shall be taken. The details of the non-conformance and the actions taken to correct them shall be reported immediately to the Agency and shall be included in the daily Contractor Quality Control report. Corrective action shall include steps taken to assure against recurrence of the non-conformance.

1.3.5 Protection

Completed observation wells shall be protected against damage and contamination.

1.4 DEFINITIONS

1.4.1 Observation Well

Observation wells as used in this Section refer to vertically installed wells that include a well screen surrounded by a filter material that is designed to prevent in-wash of foundation materials into the well.

1.4.2 Well Driller

Well Driller shall be a Contractor licensed in accordance with the provisions of the California Contractors Licenses Law (Chapter 9, Division 3, of the Business and Professional Code) and holding a valid California C-57 Contractors license.

1.4.3 Observation Well Specialist

An observation well specialist is an individual who has had five (5) years of experience in the drilling and installation of observation wells or water wells and has knowledge in all aspects of observation well construction, which includes, but is not limited to:

A. Drilling and setting of large diameter conductor casings as specified in Paragraph 3.1.3;  
B. Drilling of large diameter observation wells as specified in Paragraph 3.1.4;  
C. Installation of well casing and screen assembly as specified in Paragraph 3.2;  
D. Placing gravel filter as specified in Paragraph 3.3;  
E. Development of completed wells as specified in Paragraph 3.4;  
F. Conducting of pumping tests as specified in Paragraph 3.6.

1.5 SUBMITTALS

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

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Qualifications

Resumes or statement of qualifications for project manager, observation well specialist, and well driller.

Observation Well Installation Plan

Provide a plan for observation well construction. The plan shall include, but not be limited to:

A. Well driller, equipment and methods of drilling for foundation sampling and observation well boreholes.

B. Sources and manufacturers' information for all materials to be used and details of construction or installation methods. This includes but is not limited to well screen, gravel filter pack material, method for placing filter pack material, and grout mixture proportions.

C. Length of time between ordering and delivery to the site (lead time) for observation well screens, casing pipe, gravel pack materials, and other components of the observation wells that require a lead time of more than 1 week.

D. Methods and equipment proposed for developing the well and for performing pumping tests.

E. Details of specific methods to be employed to control potential contamination or pollution arising from well installation activities.

F. Concrete mix design and material information for concrete collars to be placed at the top of the well.

G. Copies of all applicable permits.

H. Grain size distribution for filter pack, as specified in Paragraph 2.4.

SD-11 Closeout Submittals

Upon completion of the installation of the observation wells, the Contractor shall submit to the Agency, As-Built Drawings which shall accurately depict details of the observation well construction. The As-Built Drawings shall include:

A. Well casing and screen details including materials, size, length, slot size, and installation details;

B. Well headdetails;

C. Pumping test data.

1.6 PERMITS

All work shall conform to the requirements of the State of California,
1.7 OBSERVATION WELL DESIGN

The typical observation well design is shown on the Drawings. The Agency anticipates that the screen locations and screen lengths may differ from those shown on the Drawings. As such, the Contractor shall be prepared to adjust depths and lengths of well screen, filter pack, and annular seals, as requested by the Agency.

1.8 DISPOSAL OF DEBRIS

The Contractor shall legally dispose of all debris resulting from observation well construction operations off-site.

PART 2 PRODUCTS

2.1 WELL SCREEN AND CASING

2.1.1 General

Well screen and casing shall be of the type and dimensions specified in this Section and as shown on the Drawings. Screen openings shall be uniform in size and pattern and shall be spaced approximately equally around the circumference of the pipe. Before installation, all well screen shall be reviewed by the Agency.

2.1.2 Well Screen and Casing

2.1.2.1 General

The well casings and screens shall be nominal 6-inch diameter, schedule 80 PVC, as shown in the Plans. All well casing shall be flush-threaded. Minor modifications to well screen depths are possible. Stainless steel screw clamp style centralizers will be placed on the blank well casing.

2.1.2.2 Materials

All pipes, couplings and any other fittings shall be PVC material from the same manufacturer. Centralizers such as Johnson stainless steel adjustable centralizers, Part No. 240335, or pre-approved equal shall be used.

2.1.2.3 Well Screen

1. Well screens shall be nominal 6-inch inside diameter, flush threaded, schedule 80 ASTM F-480, PVC slotted well screen. Well screen shall have a slot size of 0.060 inches (60 slot). Male and female flush threaded ends shall have four threads per inch (4 TPI) and O-rings. The slotted casings shall be provided in nominal 5- and 10-foot lengths. The well screen shall have the dimensions as shown on the plans.

2. All screen material will be new and steam-cleaned prior to delivery on-site. The screened interval may need to be lengthened or shortened from that shown on the Drawings, subject to Agency direction.
2.1.2.4 Blank Well Casing

The blank casing shall be nominal 6-inch inside diameter, flush threaded, schedule 80, ASTM F-480, PVC blank casing. Male and Female flush threaded ends shall have four threads per inch (4 TPI) and O-rings. The blank casings shall be provided in nominal 5, 10, or 20-foot lengths. In all cases, the blank casing used in conjunction with the screen shall have the same inside diameter and wall thickness as the screen to ensure that the inside diameter of the blank casing matches the inside diameter of the screen. All casing material shall be new and shall be delivered to the site as packaged from the manufacturer. The pipe roundness, wall thickness, and straightness shall meet the applicable ASTM specifications. Discharge details at the top of the casing are shown on the Drawings.

2.1.3 Well Sump

The observation well shall be fitted with a 5-foot long well sump with flush-threaded end cap below the well screen as shown in the Drawings. The well sump shall be the type of PVC material used for the casing.

2.1.4 End Cap for Well Sump

The bottom for each well sump shall be a flush-threaded cap made of the same material and at least the same minimum thickness and outside diameter as the well sump.

2.1.5 Check Valve

The tip of the PVC well casing shall be fitted with a check valve to prevent water from entering the well. The check valve shall be fabricated in accordance with details shown on the drawings and as specified herein. The check valve will be designed such that it will not be mechanically attached to the casing. The check valve will set freely on top of the casing with a portion of it sliding into the casing as shown on the Drawings. As water rises to the top of the observation well, uplift pressure will lift the valve, allowing water to flow out of the casing. As water subsides, the check valve will reseat and seal the casing.

2.2 OBSERVATION WELL HEAD

Provide locking steel riser to protect the well components according to the sizes and materials shown on the Drawings.

2.3 FILTER PACK MATERIALS

2.3.1 General

Material for the filter pack around the casings and screens shall be washed sand composed of hard, non-carbonate, durable particles free from adherent coating. The filter pack material shall not contain detrimental quantities of organic matter or soft, friable, thin, or elongated particles.

2.3.2 Filter Pack Gradation

Gradation of filter pack for the wells shall be Lapis Luster 6 Mesh (6 x 12 gradation) or equivalent conforming to the following:
2.3.3 Particle Size Distribution Testing

The filter pack material and its gradation shall be reviewed and approved by the Agency before it is placed in the well.

2.4 PUMPING TEST EQUIPMENT

2.4.1 Pump

The Contractor shall provide a deep-well, submersible pump capable of producing 150 gallons per minute from a depth of 50 feet, considering head losses, sufficient to satisfactorily perform the pumping test specified. The Contractor shall provide, without additional cost to the Agency, the discharge pipe, electrical power, control box, and the necessary wiring, which shall be removed at the completion of the pumping test.

2.4.2 Water Level

The Contractor shall provide means for accurately determining the water level in the well to within 0.01-foot, under all conditions.

2.4.3 Flow Meter

The Contractor shall furnish and install a recently (less than 3 months prior to use on the project) calibrated flow meter of standard design for the purpose of measuring the discharge from the well during the pumping test. The flow meter shall be equipped with 6-digit totalizer and instantaneous read out in gallons per minute.

2.4.4 Rossum Sand Tester

The Contractor shall furnish and have thorough knowledge of the use of an approved Rossum centrifugal sand tester and appurtenant piping and valving for accurate determination of the discharge sand content.

2.5 CONCRETE

2.5.1 Cast-in-Place Concrete

The Contractor shall submit mix designs for bentonite-cement grout (neat cement) and for the concrete collar. Concrete shall conform to ASTM C94, as a minimum, unless otherwise reviewed by the Agency.
PART 3  EXECUTION

3.1  DRILLING

3.1.1  General

The Contractor will ensure that the execution of the work shall be by competent workmen and performed under the direct supervision of an experienced well driller and the general supervision of the observation well specialist. The observation well boring shall be drilled straight, plumb, and circular from top to bottom. The project geologist will collect formation samples during drilling to develop the final design of each well.

3.1.2  Formation Sampling and Grain Size Distribution Testing

   A. During the drilling of the bore hole, the Contractor shall assist the geologist to collect and preserve for the Agency, samples taken continuously from the ground surface to the bottom of the hole. The sampling system shall be manufactured such that if an obstruction is encountered, the drilling system can drill through the obstruction. Pilot holes blocked by obstructions due to the lack of proper equipment shall be destroyed and redrilled and sampled at no additional expense to the Agency. The Contractor shall use a core barrel with a maximum length of five feet. The Contractor shall provide core boxes of adequate size and number to accommodate all of the soil core samples collected. An accepted core box includes pre-manufactured water-resistant cardboard boxes such as the Longyear model 79738HQ box, or an approved alternative.

3.1.3  Observation Well Drilling

   The wells shall be drilled using 12-inch diameter Sonic drilling methods with casing override and continuous sampling. The Agency's representative will collect formation samples and log the borings.

3.1.4  Obstructions Encountered

   If obstructions are encountered which, in the opinion of the Agency, render it impracticable to complete the well to the directed depth, the Agency may adjust the depth to conform to that of the obstruction. Alternatively, the Agency may direct the Contractor to destroy the well and construct another well at an adjacent site. Where obstructions are encountered, drilling shall be continued until it is demonstrated to the Agency that further efforts to advance the drill hole are impracticable.

3.1.5  Conditioning of Drilling Fluids Prior to Well Construction

   In the event of adverse drilling conditions, drilling fluid additives must be NFS 60 approved and common for use in the water well industry. Products subject to bacteriological degradation will not be allowed.

3.2  INSTALLATION OF WELL CASING, SCREEN AND SUMP

3.2.1  Assembly

   All material to construct the well casing, screen, and sump shall be in new and good condition before installation and all couplings and other necessary parts shall be securely fastened in place. The successive lengths of pipe shall be arranged to provide accurate placement of the
screen sections in the soil strata. The well casing, screen, and sump assembly shall be equipped with centering guides above and below the well screen section as shown on the plans.

3.2.2 Casing Joints

Casing pipe joints shall be designed and constructed to have the strength capable of supporting 10 times the weight of the observation well casing assembly as it is lowered into the hole.

3.2.3 Installation

The well casing, screen, and sump assembly shall be placed in the hole in such a manner as to avoid jarring impacts and to ensure that the assembly is not damaged. After the casing assembly has been placed and suspended in tension from the surface at all times during backfilling, a filter pack shall be installed around the screen section as specified in Paragraph 3.3, and the well developed as specified in Paragraph 3.4. The Contractor shall be responsible for ensuring that the top of the casing is at the elevation designated by the Agency prior to placement of the filter pack and that the top surface of the casing pipe is machined to be perpendicular to the axis of the casing pipe to facilitate an adequate seat between the casing pipe and the check valve.

3.3 PLACING OF FILTER PACK

3.3.1 General

After the well casing, screen, and sump have been placed, the Contractor shall place the filter pack using the tremie method. Prior to backfilling the annular space around the casing, the Contractor shall "tag" inside the casing to verify the bottom of the casing and verify its total depth. If for any reason the casing cannot be placed in the correct position, or at a depth acceptable to the Geologist, the Contractor shall construct another well immediately adjacent to the original location and complete this well in accordance with the specifications and drawings at no additional cost to the Agency. The abandoned hole shall be properly sealed at the Contractors expense.

3.3.2 Installation of Filter Pack

The approved filter pack shall be constructed around the screen by filling the annular space between the casing assembly and the borehole to the depths designated on the Drawings or as directed by the Agency. The filter pack shall have a minimum thickness of not less than 3-inches between the outside of the well screen and the outside of the filter pack. The filter pack shall be installed continuously and without interruption until it has been installed to the specified level. Prior to and during placement of the filter pack the top of the well casing shall be covered or otherwise shielded to prevent the filter pack from entering the casing. Line swabbing shall be performed to consolidate the filter pack before placing the seal.

3.3.2.1 Measurement

The Contractor shall provide a weighted tape or other approved means of measuring the filter pack depth in the borehole. The Contractor shall continuously measure the depth to the top of the filter pack during the entire filling process to insure it is installed to the proper depth and
bridging does not occur.

3.4 Grouting

Acceptable methods of grouting are detailed in AWWA A100. No method will be approved that does not install the grout using a tremie pipe installed to within 5-feet of the bottom of the borehole maintaining a positive displacement with a cement grout pump during placement. Grouting shall be done continuously in such a manner as will ensure that the entire annular space is filled in one operation.

Excavated material shall be disposed of as specified in 02 41 00 DEMOLITION AND DECONSTRUCTION

3.5 DEVELOPMENT

3.5.1 General

Following placement of filter pack material the Contractor shall develop the observation well by swabbing and simultaneous pumping. At the time of development, the well shall be free of drawdown or surging effects due to pump testing, developing or drilling at another location. The Contractor shall be responsible for maintaining the needed access and work areas at the observation well and the necessary clearance in the observation well to accomplish development. The Contractor shall furnish, install or construct the necessary discharge line and troughs to conduct and dispose of the discharge a sufficient distance from the work areas to prevent damage. Development shall be conducted to achieve a stable well of maximum efficiency and shall be continued until sand-free clear water is provided. As development proceeds, filter pack material shall be added to the annular space around the screen to maintain the specified elevation. If at any time during the development process it becomes apparent, in the opinion of the Agency, that the well may be damaged, operations shall be immediately curtailed. The Agency may require a change in method if the Contractor's method does not accomplish the desired results. If after initial development and 6 hours of additional development, a well continues to produce excess sand, the Agency may order the Contractor to abandon the well as specified in paragraph 3.8. All materials pulled into the well by the development process shall be removed prior to performing the pumping test.

3.5.2 Well Development Methods

3.5.2.1 Scope of Work

Work shall include the following:

- Developing each well by bailing, double swab air lifting, and pump-swabbing for the minimum times specified, or until each well meets the sand requirement, whichever is longer.

- Removing foreign material and sediment from each monitoring well.

3.5.2.2 Materials and Equipment

3.5.2.2.1 Bailing Equipment

- Bailing equipment shall be capable of removing sediment in well sump. Bailing equipment shall be adequate to perform all well development as
specified.

3.5.2.2.2 Pump-Swab Tool

The pump-swab tool shall attach to a 4-inch drop pipe, and shall consist of two (2) rubber flanges. The rubber flanges shall be spaced no more than 5 feet apart. The outside diameter of the rubber flanges shall be no more than 1/8-inch smaller than the inside diameter of the well screen. A double swab air lift tool shall consist of a perforated pipe with rubber flanges no more than 5 feet apart.

3.5.2.2.3 Dispersant Chemical

The only approved dispersant chemical is Baroid Industrial Products AQUA-CLEAR PFD or Johnson NuWell 220 Clay Dispersant. No other dispersant chemical may be used without the pre-authorization of the Agency.

The Contractor shall pre-mix with water one (1) quart of dispersant chemical, spot and swab throughout the screen section of each well.

3.5.2.2.4 Water Level Measurement Device

Water level measurement device shall be capable of measuring water levels to the nearest 0.01 foot.

3.5.2.2.5 Stop Watch

Stop watch or other similar device shall be capable of measuring the elapsed time during well development to the nearest second.

3.5.2.2.6 Water Volume Measurement Device

Water volume measurement device shall be capable of measuring the volume of water produced during well development to the nearest ten (10) gallons per minute.

3.5.2.2.7 Sediment Removal Equipment

The Contractor shall bail all sediment out of the well sump after pump-swab development.

3.5.2.2.8 Well Pump

A submersible pump, capable of pumping 150 gallons per minute with a lift of 50 feet.

3.5.2.3 Methods

3.5.2.3.1 Record-Keeping

The Contractor shall maintain detailed records during well development, and shall make records available to the Agency upon request. Static water level shall be recorded at the beginning of each day of well development, before any water has been moved. The following parameters shall be recorded at least every 30 minutes during well development:

- Time, measured to the nearest minute.
- Flow rate, measured to the nearest gallon per minute.
Water level, measured to the nearest 0.1 foot.

Any observations of unusual or changed conditions, including: odor, gas, color, or other conditions.

3.5.2.3.2 Well Development

Well development, consisting of bailing, double swab air lifting, and pump-swabbing, shall continue for a minimum of eight (8) hours for each well. The Contractor shall commence well development with bailing, and shall continue bailing until all drilling fluid is removed from the well. Air lifting or pump-swab development shall begin at the bottom of the screen section and work upward. Double swab air lifting shall be conducted by rapidly raising and lowering the swab tool in short strokes (5 to 10 feet) and simultaneous air lifting using an air-line inside the eductor pipe. Pump-swabbing shall be conducted by moving pump-swab tool uniformly up and down over the screen section.

3.5.2.3.3 Removal of Sediment

The Contractor shall bail the sediment at the conclusion of pump-swab well development.

3.5.2.3.4 Development Pumping

The Contractor shall install the test pump and conduct pumping and surging for a minimum of six (6) hours for each well. The pumping water level and sand production shall be measured for each pumping cycle.

3.6 WELL SEALING

After each new well has been developed and pump tested and the results have been reviewed by the Agency, a concrete pad shall be placed around the well casing as shown in the Plans.

3.7 WELL TESTING

3.7.1 Scope of Work

Perform well testing in accordance with the specifications.

3.7.2 Materials and Equipment

The equipment shall be the same as provided in Paragraph 3.4.

3.7.3 Methods

3.7.3.1 General Testing Requirements

Well testing shall begin within 2 to 60 hours of well development. The well shall not have been pumped within 2 hours of the beginning of any well and aquifer test. The pumping equipment shall be capable to provide a constant rate sufficient to produce a discharge between 25 and 150 gpm for a duration of 300 minutes. Testing shall be followed by a 2-hour recovery test. No test pumping of a well will be permitted concurrently with drilling or pumping of any other well within 500-feet therefrom. If, at any time during the test, the flow rate does not fall within this range, the Contractor shall discontinue the test, allow for full water level
recovery, and restart the test at a lower capacity as directed by the Agency. Double swab air lifting shall be conducted by rapidly raising and lowering the swab tool in short strokes (5 to 10 feet) and simultaneous air lifting using an air-line inside the eductor pipe. No payment will be made for the discontinued test. If any interruptions in pumping occur that are longer than one (1) percent of the elapsed duration of the test, the contractor shall discontinue the test, allow for full water level recovery, and restart the test. No payment will be made for the discontinued test.

3.7.3.2 Record-Keeping

The Contractor shall maintain detailed records during well and aquifer testing, and shall make records available to the Agency upon request. The actual time when each measurement is made shall be recorded, even if it differs from the measurement schedule. The following measurements shall be recorded at the beginning of each well and aquifer test, before any water has been pumped:

- Static water level, measured to the nearest 0.01 foot.
- Totalizer reading, measured to the smallest unit on the totalizer gauge.

The following measurements shall be recorded during well and aquifer testing:

- Elapsed time, measured to the nearest 15 seconds.
- Flow Rate, measured to the nearest ten (10) gallons per minute.
- Totalizer reading, measured to the smallest unit on the totalizer gauge.
- Water level, measured to the nearest 0.01 foot.
- Drawdown from static water level, calculated to the nearest 0.01 foot.
- Sand production, to the nearest 0.01 cubic centimeters.
- Any adjustments to the flow rate, interruptions in pumping, or other changes in testing conditions.

3.7.3.3 Measurement Schedule

The times specified in this section are elapsed times since the pump is started or stopped. Measurements shall continue for the specified duration of pumping and recovery. Elapsed time and water level measurements shall be made according to the following schedule:

- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 minutes.
- 14, 16, 18, and 20 minutes.
- 25, 30, 35, 40, 45, 50, 55, and 60 minutes.
- 70, 80, 90, 100, 110, and 120 minutes.

Sand production measurements shall be made at least once every ten (10) minutes for the duration of each test. Flow rate and totalizer measurements shall be made during pumping at least once for every three (3) water level measurements, or once every hour, whichever is more frequent. A final

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measurement shall be made after the pump is turned off.

3.7.4 Additional Testing

In addition to the test described above the Agency may direct the Contractor to perform additional testing. Such additional testing shall conform in general to the requirements specified above with the exception that the duration of the tests and the approximate drawdown will be determined by the Agency. The test, to be successful, shall be continuous throughout the specified period.

3.7.5 Sand Test

Sand content of pumped water shall be measured at 100 gallons per minute, unless otherwise determined by the Agency. Sand content of pumped water shall be measured with a centrifugal ("Rossum") sand tester in accordance with ANSI/AWWA A100-97. The average sand content of water pumped over any five (5) minute period shall not exceed five (5) parts per million over the 120 minutes of pumping.

3.7.6 Additional Pumping Test Measurements

In addition to the measurements and record-keeping required of the Contractor, the Agency or its representative may require access to the well to perform additional water level measurements in the pumped well and nearby observation wells.

3.7.7 Records

The Contractor shall obtain and furnish to the Agency for record purposes the data specified in Paragraph 3.6.3.2, recorded on a standard form reviewed by the Agency.

3.8 CHECK VALVE INSTALLATION

The check valve shall be temporarily installed on top of the casing pipe during installation of the casing pipe until the total length of the casing pipe is installed and immediately after completion of the development pumping, and thereafter shall be kept in place on the pipe at all times, except during pumping and cleaning operations. Immediately after the casing pipe is installed to final height, the top of the casing pipe shall be modified for proper fitting of the check valve.

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DIVISION 33 - UTILITIES

SECTION 33 40 00

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02/10

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SECTION 33 40 00

STORM DRAINAGE AND IRRIGATION; GRAVITY
02/10

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)


AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)


ASTM INTERNATIONAL (ASTM)


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1.2 SUBMITTALS

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

- SD-03 Product Data
  - Placing Pipe
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  - Pipe for Culverts and Storm Drains
- SD-07 Certificates
  - Resin Certification
  - Pipeline Testing
  - Hydrostatic Test on Watertight Joints
  - Determination of Density
  - Frame and Cover for Gratings

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow...
these instructions unless directed otherwise by the Engineer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M or shall be of standard design reinforced concrete pipe meeting requirements of AASHTO M 198, ASTM C76, and ASTM C443 as shown on the plans.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 5,000 psi concrete under Section 03 30 00.01 10 CAST-IN-PLACE CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231/C231M. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D1751, or ASTM D1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 0.5 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The
mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Brick

Brick shall conform to ASTM C62, Grade SW; ASTM C55, Grade S-I or S-II; or ASTM C32, Grade MS. Mortar for jointing and plastering shall consist of one part portland cement and two parts fine sand. Lime may be added to the mortar in a quantity not more than 25 percent of the volume of cement. The joints shall be filled completely and shall be smooth and free from surplus mortar on the inside of the structure. Brick structures shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. For square or rectangular structures, brick shall be laid in stretcher courses with a header course every sixth course. For round structures, brick shall be laid radially with every sixth course a stretcher course.

2.3.5 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.6 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer. Manholes shall be complete with frames and cover, or frames and gratings.

2.3.7 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.8 Joints

2.3.8.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.
b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Engineer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.8.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.8.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2 B3, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.9 Automatic Drainage Gates

Automatic Drainage Gates shall be heavy-duty with circular opening and double-hinged. Top pivot points shall be adjustable. The seat shall be one-piece cast iron with a raised section around the perimeter of the waterway opening to provide the seating face. The seating face of the seat shall be bronze. The cover shall be one-piece cast iron with necessary reinforcing rib, lifting eye for manual operation, and bosses to provide a pivot point connection with the links. The seating face of the cover shall be bronze. Links or hinge arms shall be cast or ductile iron. Holes of pivot points shall be bronze bushed. All fasteners shall be either galvanized steel, bronze or stainless steel.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.
2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, IRRIGATION LINE, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 18 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Agency.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 31 00 00 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Engineer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Agency.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.3 PLACING PIPE

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.
Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 3 feet apart, whichever is less.

3.4 JOINTING

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 6 inches.
Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 12 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Agency. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to reviewal. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D698 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Engineer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 10 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Engineer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 102 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall be zero (0). When leakage exceeds zero, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed...
limits in paragraph PLACING PIPE above as percent of the average inside
diameter of pipe. Determine whether the allowable deflection has been
exceeded by use of a laser profiler or mandrel.

a. Laser Profiler Inspection: If deflection readings in excess of the
allowable deflection of average inside diameter of pipe are obtained,
remove pipe which has excessive deflection, and replace with new pipe.
Initial post installation inspections of the pipe interior with laser
profiling equipment shall utilize low barrel distortion video equipment
for pipe sizes 48 inches or less. Use a camera with lighting suitable
to allow a clear picture of the entire periphery of the pipe interior.
Center the camera in the pipe both vertically and horizontally and be
able to pan and tilt to a 90 degree angle with the axis of the pipe
rotating 360 degrees. Use equipment to move the camera through the
pipe that will not obstruct the camera's view or interfere with proper
documentation of the pipe's condition. The video image shall be clear,
focused, and relatively free from roll static or other image distortion
qualities that would prevent the reviewer from evaluating the condition
of the pipe. For initial post installation inspections for pipe sizes
larger than 48 inches, visual inspection shall be completed of the pipe
interior.

b. Pull-Through Device Inspection: Pass the pull-through device through
each run of pipe by pulling it by hand. If deflection readings in
excess of the allowable deflection of average inside diameter of pipe
are obtained, retest pipe by a run from the opposite direction. If
retest continues to show excess allowable deflections of the average
inside diameter of pipe, remove pipe which has excessive deflection,
replace with new pipe, and completely retest in same manner and under
same conditions. Pull-through device: The mandrel shall be rigid,
nonadjustable having a minimum of 9 fins, including pulling rings at
each end, engraved with the nominal pipe size and mandrel outside
diameter. The mandrel shall be 5 percent less than the
certified-actual pipe diameter for Plastic Pipe, 5 percent less than
the certified-actual pipe diameter for Corrugated Steel and Aluminum
Alloy, 3 percent less than the certified-actual pipe diameter for
Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by
manufacturer. When mandrels are utilized to verify deflection of
flexible pipe products, the Agency will verify the mandrel OD through
the use of proving rings that are manufactured with an opening that is
certified to be as shown above.

c. Deflection measuring device: Shall be approved by the Engineer prior
to use.

d. Warranty period test: Pipe found to have a deflection of greater than
allowable deflection in paragraph PLACING PIPE above, just prior to end
of one-year warranty period shall be replaced with new pipe and tested
as specified for leakage and deflection. Inspect 100 percent of all
pipe systems under the travel lanes, including curb and gutter. Random
inspections of the remaining pipe system outside of the travel lanes
shall represent at least 10 percent of the total pipe footage of each
pipe size. Inspections shall be made, depending on the pipe size, with
video camera or visual observations. In addition, for flexible pipe
installations, perform deflection testing on 100 percent of all pipes
under the travel lanes, including curb and gutter, with either a laser
profiler or 9-fin mandrel. For flexible pipe, random deflection
inspections of the pipe system outside of the travel lanes shall
represent at least 10 percent of the total pipe footage of each pipe
size. When mandrels are utilized to verify deflection of flexible pipe products during the final post installation inspection, the Agency will verify the mandrel OD through the use of proving rings.

3.8.3 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment. One hundred percent of all flexible pipes (HDPE, PVC, CMP) shall be checked for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and final post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.9 FIELD PAINTING

After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Apply a coat of primer, to a minimum dry film thickness of 6.0 mil; and apply a top coat to a minimum dry film thickness of 6.0 mils, color optional. Painting shall conform to Section 09 90 00 PAINTS AND COATINGS. Do not paint surfaces subject to abrasion.

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DIVISION 35 - WATERWAY AND MARINE CONSTRUCTION

SECTION 35 20 16.53

VERTICAL LIFT GATES

01/08

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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)


Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D413 (1998; R 2007) Rubber Property - Adhesion to Flexible Substrate


U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-W-410 (Rev G) Wire Rope and Strand

1.2 SUBMITTALS

Agency reviewal is required for submittals with a "EN" designation; submittals not having a "EN" designation are for information only. When used, a designation following the "EN" designation identifies the office that will review the submittal for the Agency. The following shall be submitted in accordance with Section 01 33 00.00 41 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; EN

Detail drawings, as specified.

SD-03 Product Data

Materials

System of identification which shows the disposition of specific lots of approved materials and fabricated items in the work before completion of the contract.

Welding; EN

Schedules of welding procedures for structural steel.

Materials

Material orders, material lists, and material shipping bills.

SD-06 Test Reports

Tests, Inspections, and Verifications; EN, ; EN

Certified material test reports with all material delivered to the site.

Acceptance Trial Operation and Test

Operation and test results before completion of the contract.
1.3 QUALIFICATION OF WELDERS AND WELDING OPERATORS

Qualification of welders and welding operators shall conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 General

Perform delivery, handling, and storage of materials and fabricated items conforming to the requirements specified.

1.4.2 Rubber Seals

Store rubber seals in a place which permits free circulation of air, maintains a temperature of 70 degrees F or less, and prevents the rubber from being exposed to the direct rays of the sun. Keep rubber seals free of oils, grease, and other materials which would deteriorate the rubber. Rubber seals shall not be distorted during handling.

PART 2 PRODUCTS

2.1 MATERIALS

Materials orders, material lists and material shipping bills shall conform with the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.1.1 Metals

Structural steel, monel, steel forgings, steel castings, stainless steel, bronze, aluminum bronze, brass and other metal materials used for fabrication shall conform to the requirements as shown and as specified herein.

2.1.1.1 Structural Steel

Structural steel shall conform to ASTM A36/A36M.

2.1.1.2 Structural Steel Plates

Structural steel plates shall conform to ASTM A36/A36M.

2.1.1.3 Steel Pipe

Steel pipe shall conform to ASTM A53/A53M, Type S, Grade B, seamless, black, nominal size and weight class or outside diameter and nominal wall thickness as shown, welded or threaded ends.

2.1.1.4 Stainless Steel Bars and Shapes

Stainless steel bars and shapes shall conform to ASTM A276, UNS S 20910, Condition A, hot-finished or cold-finished, Class C; or ASTM A564/A564M, UNS S 17400, Condition A, age-hardened heat treatment, hot-finished or cold-finished, Class C.

2.1.1.5 Stainless Steel Plate, Sheet, and Strip

Stainless steel plate, sheet, and strip shall conform to ASTM A240/A240M, UNS S 20910. Plate finish shall be hot-rolled, annealed or heat-treated,
and blast-cleaned or pickled. Sheet and strip finish shall be No. 1.

2.1.2 Rubber Seals

Rubber seals shall be compounded of natural rubber, synthetic polyisoprene, or a blend of both, and shall contain reinforcing carbon black, zinc oxide, accelerators, antioxidants, vulcanizing agents, and plasticizers.

2.1.2.1 Physical Characteristics

Physical characteristics of the seals shall meet the following requirements:

<table>
<thead>
<tr>
<th>PHYSICAL TEST</th>
<th>TEST VALUE</th>
<th>TEST METHOD SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>2500 psi (min.)</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Elongation at Break</td>
<td>450 percent (min.)</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>300 percent</td>
<td>900 psi (min.)</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Durometer Hardness (Shore Type A)</td>
<td>60 to 70</td>
<td>ASTM D2240</td>
</tr>
<tr>
<td>*Water Absorption</td>
<td>5 percent by weight (max.)</td>
<td>ASTM D471</td>
</tr>
<tr>
<td>Compression Set</td>
<td>30 percent (max.)</td>
<td>ASTM D395</td>
</tr>
<tr>
<td>Tensile Strength (after aging 48 hrs)</td>
<td>80 percent of tensile strength (min.)</td>
<td>ASTM D572</td>
</tr>
</tbody>
</table>

The "Water Absorption" test shall be performed with distilled water. The washed specimen shall be blotted dry with filter paper or other absorbent material and suspended by means of small glass rods in the oven at a temperature of 70 degrees C plus or minus 2 degrees for 22 hours plus or minus 1/4 hour. The specimen shall be removed, allowed to cool to room temperature in air, and weighed. The weight shall be recorded to the nearest 1 mg as M subscript 1 (M subscript 1 is defined in ASTM D471). The immersion temperature shall be 70 degrees C plus or minus 1 degree and the duration of immersion shall be 166 hours.

2.1.2.2 Fabrication of Rubber Seals

Rubber seals shall have a fluorocarbon film vulcanized and bonded to the sealing surface of the bulb. The film shall be 0.060 inches thick Huntington Abrasion Resistant Fluorocarbon Film No. 4508, or equal, and shall have the following physical properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength</td>
<td>2,000 psi (min.)</td>
</tr>
<tr>
<td>Elongation</td>
<td>250 percent (min.)</td>
</tr>
</tbody>
</table>

The outside surface of the bonded film shall be flush with the surface of the rubber seal and shall be free of adhering or bonded rubber. Strips and corner seals shall be molded in lengths suitable for obtaining the finish lengths shown and with sufficient excess length to provide test specimens for testing the adequacy of the adhesion bond between the film and bulb of the seal. At one end of each strip or corner seal to be tested, the
fluorocarbon film shall be masked during bonding to prevent a bond for a length sufficient to hold the film securely during testing.

2.2   MANUFACTURED UNITS

Bolts, nuts, washers, screws and other manufactured units shall conform with the requirements as shown and as specified.

2.2.1   Bolts, Nuts and Washers

Bolts, nuts, studs, stud bolts and bolting materials other than high-strength shall conform to ASTM A307, Grade A, hot-dip galvanized or ASTM A320/A320M, Ferritic Steel, Grade 8. Bolts 1/2 inch and larger shall have hexagon heads. The finished shank of bolts shall be long enough to provide full bearing. Washers for use with bolts shall conform to the requirements specified in the applicable specification for bolts.

2.2.2   Screws

Screws shall be of the type indicated.

2.2.3   Sheaves

Sheaves shall be of cast steel conforming to ASTM A27/A27M, sized for the wire rope used.

2.2.4   Wire Rope

Wire rope shall conform to FS RR-W-410, Type I, Class 2, Construction 1, wire size, as indicated.

2.2.5   Wheels

Wheels shall be short hub or long hub, rigid type, heavy duty steel casters fabricated with steel castings conforming to ASTM A148/A148M. Wheels shall be of the size and load capacity shown. Wheel shall be provided with lubrication fittings, roller bearings, and removable axle or shaft. Wheel treads shall be machined-finished as shown. Unless otherwise specified or shown, shafts for wheels shall be stainless steel conforming to ASTM A276, UNS S 30400.

2.3   FABRICATION

2.3.1   Detail Drawings

Detail drawings, including fabrication drawings, shop assembly drawings, delivery drawings, and field installation drawings, shall conform to the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.3.1.1   Fabrication Drawings

Fabrication drawings shall show complete details of materials, tolerances, connections, and proposed welding sequences which clearly differentiate shop welds and field welds.

2.3.1.2   Shop Assembly Drawings

Shop assembly drawings shall provide details for connecting the adjoining
fabricated components in the shop to assure satisfactory field installation.

2.3.1.3 Delivery Drawings

Delivery drawings shall provide descriptions of methods of delivering components to the site, including details for supporting fabricated components during shipping to prevent distortion or other damages.

2.3.1.4 Field Installation Drawings

Field installation drawings shall provide a detailed description of the field installation procedures. The description shall include the location and method of support of installation and handling equipment; provisions to be taken to protect concrete and other work during installation; method of maintaining components in correct alignment; plan for prestressing gate leaf diagonals, which shall include descriptions of connections, riggings, anchorages, and measuring equipment; methods for installing quoin and miter blocks, including checking and maintaining alignments of the blocks during concreting and placement of epoxy filler; procedures and equipment used for heating and placing of the zinc filler; and methods for installing other appurtenant items.

2.3.2 Structural Fabrication

Structural fabrication shall conform to the requirements as shown and specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Dimensional tolerances shall be as specified and as shown. Splices shall occur only where shown. Pin holes shall be bored in components after welding, straightening, stress-relieving, and threading operations are completed. Brackets, eye bar sections, and other components requiring straightening shall be straightened by methods which will not damage the material. Bushings shall be press-fitted with supporting components. Bolt connections, lugs, clips, or other pick-up assembly devices shall be provided for components as shown and required for proper assembly and installation. Provisions shall be made for the installation of cathodic protection system devices and other appurtenances as required.

2.3.2.1 Welding

Welding shall conform with the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Welds shall be of the type shown and approved detail drawings. Radiographic examination is required on the major shop and field welds of the type and location indicated and as follows: . Welds which have been designated to receive radiographic examination and are found to be inaccessible to a radiation source or film, or are otherwise situated where radiographic examination is not feasible may be examined, with written reviewal, by dye penetrant, magnetic particle tests, or ultrasonic tests. Components shall be stress-relief heat treated after welding where shown. Stress-relieving of components shall be performed prior to the attachment of miscellaneous appurtenances.

2.3.2.2 Bolted Connections

Bolted connections shall conform with the requirements specified in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.3.2.3 Machine Work

Machine work shall conform with the requirements specified in Section
2.3.2.4 Miscellaneous Provisions

Miscellaneous provisions for fabrication shall conform with the requirements specified herein and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.3.3 Slide Gate Leaf

Slide gate leaf shall be of single-component structural fabrication. Slide gate shall be shop fabricated and shall be provided complete with gate stem, stem guides, leaf nut, leaf nut spanner wrench, bar seals, seal collars, and other appurtenant items as required for installation. Surfaces of leaf framing elements to which skin plates are to be welded shall not vary from a true plane by more than $\frac{2}{16}$ mm 1/16 inch to provide uniform bearing. The outside surfaces of skin plates welded to framing elements shall not vary from a true plane by more than 1/16 inch. Splices in skin plates shall be located only where shown. The overall width and height of the fabricated gate leaf shall not vary from the respective dimensions shown by more than 1/16 inch. Gate leaf shall be stress-relieved prior to the attachment of bar seals. Surfaces where bar seals are attached shall be accurately machined to provide uniform bearing for the full contact dimensions. Top and side bar seals shall be firmly butted together at the corners. The ends of side bar seals shall be flush with the bottom seating surface of the gate leaf. Final machining of bar seals shall be performed after they are attached to the gate leaf. The bottom seat of the gate leaf shall be machined for a tight fit with the gate frame sill.

2.3.4 Slide Gate Frame and Bonnet

Slide gate frame and bonnet shall be shop fabricated. Guiding and seal surfaces of slide gate frame and bonnet shall be in a true vertical plane and shall be machined finished. Unmachined surfaces exposed to water flow shall match at joints between component parts, shall not depart from true planes shown by more than 1/16 inch and shall be free of offsets or irregularities greater than 1/16 inch. Allowable offsets or irregularities less than 1/16 inch shall be ground to a bevel of not greater than one on twenty-four. The bottom seat of the gate leaf shall be machined for a tight fit with the gate frame sill. Gate frame and bonnet shall be stress relieved prior to the attachment of bar seals. Surfaces where bar seals are attached shall be accurately machined to provide uniform bearing for the full contact dimensions. Top, side, and invert bar seals shall be firmly butted together at the corners. Final machining of bar seals shall be performed after they are attached to the gate frame and bonnet. Babbit shall be poured in the gate frame sill and peened before machining the frame. When machining the gate frame sill, the tool travel shall be parallel to the long dimension of the babbit.

2.3.5 Slide Gate Bonnet Cover, Pedestal and Base Plate

The flanges of the bonnet cover, pedestal and base plate for the supporting the operating machinery for the slide gate shall be accurately machined and drilled to match mating flanges and provide the required true alignment. Unmachined oil-contacting surfaces of bonnet cover and pedestal shall be coated with alkyd resin as specified for the unmachined oil-contacting surfaces of hydraulic cylinder heads. Base plate dimensions may be altered to fit the operating machinery furnished, provided the basic configuration,
plate thickness, and number and sizes of fasteners are equal to that shown and the altered dimensions are approved.

2.3.6 Wheel Gate Leaf

Wheel gate leaf shall be of single-component structural fabrication. Wheel gate leaf shall be shop fabricated and shall be provided complete with lifting brackets, wheel assemblies, seal assemblies, and other appurtenant items as required for installation and proper operation. Check the design center of gravity of the gate leaf prior to fabrication and notify the Engineer if an unreasonable amount of counter-weighting is required to attain the center of gravity as designed. Surfaces of leaf framing elements to which skin plates are to be welded shall not vary from a true plane by more than 1/16 inch to provide uniform bearing. The outside surfaces of skin plates welded to framing elements shall not vary from a true plane by more than 1/16 inch. Splices in skin plates shall be located only where shown. The overall width and height of the fabricated gate leaf shall not vary from the respective dimensions shown by more than 1/16 inch. Gate leaf shall be stress relieved prior to the attachment of seal assemblies and other appurtenant items.

2.3.6.1 Wheel Gate Leaf Lifting Brackets

Fabrication details of wheel gate leaf lifting brackets shall be closely coordinated with the details of the to assure proper operation.

2.3.6.2 Wheel Gate Leaf Wheel Assembly

Wheel assemblies shall be products of a manufacturer regularly engaged in the manufacture of such products. Each wheel assembly shall be provided complete with wheel, shaft, roller bearing, lock washer, lock nut, bearing cover, seal housing, grease seal, seal retainer, shaft lock plate, lubrication fittings, fasteners, and other accessories as required for complete and proper installation. Wheel diameter and thickness shall not be changed from that shown. The dimensions and tolerances of other components may be changed as required for compatibility with the manufacturer's product.

2.3.6.3 Wheel Gate Leaf Seal Assembly

Seal assemblies shall consist of rubber seals, stainless steel retainer and spacer bars, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. All vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Stainless steel retainer bars shall be field-spliced only where shown and machine finished after splicing.

2.3.7 Wheel Gate Frame and Guides

Exposed unmachined surfaces of wheel gate frame and guides shall match at joints between component parts, shall not depart from true planes shown by more than 1/16 inch, and shall be free of offsets or irregularities greater
than 1/16 inch. Allowable offsets or irregularities less than 1/16 inch shall be ground to a bevel of not greater than one on twenty-four. Surfaces of frames and guides to receive seal bars and wheel track bars shall be accurately machined to provide uniform bearing for the full contact dimensions. Seal bars shall be firmly butted together at corners. Bearing surfaces of wheel track bars and sealing surfaces of seal bars shall be machined to the tolerances shown to provide uniform bearing and sealing at all points of contact. Final machining of seal bars and wheel track bars shall be performed after they are attached to the gate frame and guides. Anchor bolt holes for gate frame and guides shall be accurately located using Agency-furnished templates which provide the installation location of anchor bolts.

2.3.8 Wheel Gate Lifting Sling

Wheel gate lifting sling shall be of wire rope with thimble and socket fittings attached to the wire rope in a manner that develops the full strength of the wire rope.

2.3.9 Wheel Gate Lifting Beam Assembly

Wheel gate lifting beam assembly shall be fabricated as shown for automatic engaging and disengaging with the lifting brackets of the gate leaf. The lifting beam shall be stress relieved prior to final machining and attachment of the roller and counterweight assemblies.

2.3.10 Tractor Gate Leaf

Tractor gate leaf shall be of single-component structural fabrication. Tractor gate leaf shall be shop fabricated and shall be provided complete with roller train assemblies, lifting brackets, seal assemblies, guide and other appurtenant items as required for installation and proper operation. Check the design center of gravity of the gate leaf prior to fabrication and give notification if an unreasonable amount of counterweighting is required to attain the center of gravity as designed. Surfaces of leaf framing elements to which skin plates are to be welded shall not vary from a true plane by more than 1/16 inch to provide uniform bearing. The outside surfaces of skin plates welded to framing elements shall not vary from a true plane by more than 1/16 inch. Splices in skin plates shall be located only where shown. The overall width and height of the fabricated gate leaf shall not vary from the respective dimensions shown by more than 1/16 inch. Gate leaf shall be stress relieved prior to the attachment of seal assemblies and other appurtenant items.

2.3.10.1 Tractor Gate Leaf Lifting Brackets

Fabrication details of tractor gate leaf lifting brackets shall be closely coordinated with the details of the to assure proper operation.

2.3.10.2 Tractor Gate Leaf Roller Train Assemblies

Roller train assemblies shall consist of roller guides, track plates, roller train, and roller train cover. Roller guides shall be adjustable and removable without dismantling the roller train. Turned bolts, jack screws, shims for mounting and adjusting roller guides, and cap screws for attaching track plates shall be provided as shown. Track plates shall be attached to the gate leaf so that the side faces of the track plates are parallel to a vertical plane within 1/16 inch. The track surfaces of track plates shall be machined finished to a plane parallel to a common plane...
within 1/16 inch after being attached to the gate leaf. Roller train shall be provided complete with pins, link bars, retaining rings, and other appurtenances as shown and as required for proper installation and operation.

2.3.10.3 Tractor Gate Leaf Guide Shoes

Guide shoes shall be attached to the gate leaf for drilling and reaming for bolting. Guide shoes shall be accurately located on the gate leaf in a true vertical plane with each other in the upstream-downstream direction. Lines passing through face of guide shoes on each side of leaf shall be parallel within 1/16 inch.

2.3.10.4 Tractor Gate Leaf Seal Assemblies

Seal assemblies shall consist of rubber seals, stainless steel retainer and spacer bars, and fasteners. Rubber seals shall be continuous over the full length. Seals shall be accurately fitted and drilled for proper installation. Bolt holes shall be drilled in the rubber seals by using prepared templates or the retainer bars as templates. Splices in seals shall be fully molded, develop a minimum tensile strength of 50 percent of the unspliced seal, and occur only at locations shown. Vulcanizing of splices shall be done in the shop. The vulcanized splices between molded corners and straight lengths shall be located as close to the corners as practicable. Splices shall be on a 45 degree bevel related to the "thickness" of the seal. The surfaces of finished splices shall be smooth and free of irregularities. Stainless steel retainer bars shall be field spliced only where shown and machine finished after splicing.

2.3.11 Tractor Gate Frame and Guides

Exposed unmachined surfaces of tractor gate frame and guides shall match at joints between component parts, shall not depart from true plane shown by more than 1/16 inch, and shall be free of offsets or irregularities greater than 1/16 in. Allowable offsets or irregularities less than 1/16 inch shall be ground to a bevel of not greater than one on twenty-four. Surfaces of frames and guides to receive roller track plates and seal plates shall be accurately machined to provide uniform bearing for the full contact dimensions. Seal plates shall be firmly butted together at corners. Roller bearing surfaces of track plates and sealing surfaces of seal plates shall be machined to the tolerances shown to provide uniform bearing and sealing at all points of contact. Final machining of track plates and seal plates shall be performed after they are attached to the gate frame and guides. Anchor bolt holes for gate frame and guides shall be accurately located using Agency furnished templates which provide the installation location of anchor bolts.

2.3.12 Tractor Gate Lifting Sling

Tractor gate lifting sling shall be of wire rope with thimble and socket fittings attached to the wire rope in a manner that develops the full strength of the wire rope.

2.3.13 Tractor Gate Lifting Beam Assembly

Tractor gate lifting beam assembly shall be fabricated as shown for automatic engaging and disengaging with the lifting brackets of the gate leaf. The lifting beam shall be stress relieved prior to final machining and attachment of the roller and counterweight assemblies.
2.3.14 Appurtenant Items

The fabrication requirements for gate leaf pier guides, and other appurtenant items shall conform to the details shown.

2.3.15 Shop Assembly

Shop assembly requirements for gate, gate frame and appurtenant items shall be as shown and as specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Gate, frame, guides, and appurtenant items shall be assembled completely in the shop to assure satisfactory field installation. The matchmarking of unassembled components shall be carefully preserved until the components are assembled. Adequate support shall be provided during assembly to maintain components within 1/16 inch of actual installation planes. Mating surfaces and machined surfaces shall be coated with a rust preventive coating until assembled. Other connecting surfaces which are not required to be disassembled for shipment shall be thinly coated with an approved rust preventive coating before being joined. Adjoining components shall be fitted and bolted together to facilitate field connections. Shop assembled components shall be delivered assembled, if practically permitted by shipping and field installation conditions. Assembled components shall be shop welded in their final positions as much as delivery and field installation conditions allow. Shop assembly and disassembly work shall be performed in the presence of the Engineer unless otherwise approved. The presence of the Engineer will not relieve the Contractor of any responsibility under this contract.

2.3.15.1 Gate Leaf

Shop assembly of the gate leaf shall be in the vertical position and horizontal position with the skin side of the gate leaf facing down. Shop assembly shall include the attachment of all accessories to the gate leaf. The wheel gate leaf and tractor gate leaf shall be lifted by the lifting brackets and inspected for balance about the center of gravity after being shop assembled. If the gate leaf is out of plumb by more than 1/4 inch in the total length in a vertical plane in the upstream-downstream direction, or by more than 1/16 inch in the total width in a vertical plane perpendicular to the vertical plane in the upstream-downstream direction, it shall be balanced by counterweighting or some other method as approved at the Contractor's expense.

2.3.15.2 Wheel Assemblies

The gate leaf shall be supported in the horizontal position for adjusting wheel assemblies so that the wheels of the attached wheel assemblies are free to rotate to allow the proper adjustment. Attached wheel assemblies shall be adjusted so that the wheels remain perpendicular to the gate leaf and the contact surfaces of the wheels on each side of the gate leaf are in a single plane within 0.005 inch when rotated 360 degrees. The final adjustment of wheel assemblies shall be made after the gate leaf is assembled with the gate frame and guides in the horizontal position. The top of each wheel shall be tapped to insure that the weight of the wheel assembly has caused the shaft to bear firmly on the supporting framing of the gate leaf. Wheel assemblies shall then be adjusted so that the tolerance on the distance between the plane through the downstream faces of the wheels and the plane through the downstream machined surfaces of the side bar supports for the seal assemblies shall not exceed 1/32 inch. After wheel assemblies have been adjusted, they shall be locked in position by
drilling the lock plate, support plate, and shaft and installing cap screws as shown. Wheel assemblies shall be lubricated after being locked in position with a lubricant that is suitable for underwater operation, equal to the lubricant recommended by the manufacturer of the wheel roller bearings, and as approved. Additional lubricant shall be applied at regular intervals until final acceptance of the work.

2.3.15.3 Roller Train Assemblies

Roller trains shall be mounted on the track plates with the gate leaf in the vertical position. Roller guides shall be adjusted so that the roller trains are in alignment and can traverse freely without binding and with a maximum sag of 3/4 inch at the bottom. After the roller trains are mounted, the gate leaf shall be maintained in a vertical position unless the roller trains are securely restrained from sagging.

2.3.15.4 Guide Shoes

Guide shoes shall be drilled and reamed for bolting to the gate leaf while attached to the gate leaf. Guide shoes shall be accurately located on the gate leaf in a true plane with each other in the upstream-downstream direction and parallel to the plane established by the downstream machined surfaces of the side bar supports for the seal assemblies. Shims shall be provided as required.

2.3.15.5 Seal Assemblies

Seal assemblies shall be attached to the gate leaf during shop assembly and removed for shipment. The rubber seals of the assemblies shall be accurately fitted, drilled to match the seal retainers, match marked, and removed for shipment.

2.3.15.6 Lifting Beam Assembly

The lifting beam assembly shall be completely shop assembled in the sequence and manner shown. The balance of the completed assembly shall be checked by lifting the assembly by the pick-up pin. If the lifting beam is out of true horizontal by more than 3/8 inch, counterweighting or some other method approved shall be used to balance the assembly at the Contractor's expense.

2.3.15.7 Dogging Devices

Dogging devices shall be completely shop assembled. Pin holes shall be drilled in base plates and dogs with these components in assembly.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

Tests, inspections, and verifications for materials and fabricated items shall conform to the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

2.4.1 Testing of Rubber Seals

The fluorocarbon film of rubber seals shall be tested for adhesion bond in accordance with ASTM D413 using either the machine method or the deadweight method. A 1 inch long piece of seal shall be cut from the end of the seal which has been masked and subjected to tension at an angle approximately 90 degrees to the rubber surface. There shall be no separation between the
flourocarbon film and the rubber when subjected to the following loads:

<table>
<thead>
<tr>
<th>THICKNESS OF FLUOROCARBON FILM</th>
<th>MACHINE METHOD AT 2 INCHES PER MINUTE</th>
<th>DEADWEIGHT METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.030 in.</td>
<td>30 lbs per inch width</td>
<td>30 lbs per inch width</td>
</tr>
<tr>
<td>0.060 in.</td>
<td>30 lbs per inch width</td>
<td>30 lbs per inch width</td>
</tr>
</tbody>
</table>

2.4.2 Inspection

Shop assembled components shall be inspected for accurate fit and compliance with dimensional tolerances. Sealing, guiding, and connecting surfaces shall be inspected to determine if their planes are true, parallel, and in uniform contact with opposing surfaces. With the gate leaf closed and uniformly blocked in the sealing position, gate leaf wheels, rollers, bar seals, and rubber seals shall be inspected to determine if they are in continuous contact with track and seal plates. It shall not be possible to insert a feeler gauge of greater than 0.003 inch thickness at any point between bar seals and seal plates.

2.4.3 Operation Tests

The operation of the shop-assembled gate assembly shall be tested by opening and closing the gate several times by use of the operating machinery. The force used to operate the gate shall be the minimum required to open and close the gate. Since the sill of the unembedded gate frame is not fully supported during the operation tests, special precaution shall be taken to prevent the application of excessive force on the gate leaf and frame when the gate is closed. The operation of the lifting beam shall be tested by engaging and disengaging the lifting beam several times. Adjustments shall be made as required until operations are satisfactory. The gate assembly shall be tested hydrostatically by applying a hydrostatic pressure of 80 psi, measured at the sill of the gate frame, to the upstream side of the gate leaf in the closed position. For conducting the hydrostatic testing, the gate frame shall be bulkheaded or restrained by some other method as approved. Under hydrostatic testing, the gate seals shall be sufficiently tight to prevent water leakage.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform with the requirements specified and in Section 05 50 14 STRUCTURAL METAL FABRICATIONS. Gate and appurtenant items shall be assembled for installation in strict accordance with the contract drawings, approved installation drawings, and shop match-markings. Bearing surfaces requiring lubrication shall be thoroughly cleaned and lubricated with an approved lubricant before assembly and installation. Components to be field welded shall be in correct alignment before welding is commenced.

3.1.1 Embedded Metals

Frames, bases, and other embedded metal items shall be accurately installed to the alignment and grade required to ensure accurate fitting and matching of components. Shims, jackbolts, or other supports required to align and hold components rigidly in place until embedment concrete has attained the
specified strength shall be provided. Anchors shall be installed as shown. Embedded metals shall be given a primer coat of the required paint on all surfaces prior to installation in concrete forms. Items requiring two concrete pours for installation shall be attached to the embedded anchors after the initial pour, adjusted to the proper alignment, and concreted in place with the second pour.

3.1.2 Gate Frame and Guides

Gate frame and guides shall be connected to embedded anchors, aligned, and rigidly blocked in place prior to the placement of second-pour concrete. The sealing surfaces of the slide gate frame seal bars shall serve as the reference plane for the installation alignment. Alignment shall be to two theoretical control planes described as control plane "A" and control plane "B". Control plane "A" is a vertical plane that is normal to the water passageway and is located at the sealing surface of the gate frame seal bars. Control plane "B" is a vertical plane that is parallel to the water passageway and is located at the centerline of the water passageway. The gate frame shall be aligned to within 0.015 inch of control planes "A" and "B". A taut piano wire and an electric micrometer or some other approved method shall be used to measure the vertical alignment tolerances. The alignment of wheel gate frame and guides shall be such that planes through the bearing surfaces of track plates and the sealing surfaces of seal plates shall be within 1/16 inch of the alignment shown. Gate frame and guides shall be tested for proper alignment and clearances prior to being embedded in concrete by lowering and raising the gate leaf through the full operating range.

3.1.3 Gate Leaf

Gate leaf shall be completely assembled, including the attachment of all components and accessories, prior to being placed in the gate frame. All necessary precautions shall be taken to avoid distortion of the gate leaf and attached components during installation. Rubber seals shall be fastened securely to metal retainers. Before operating the gate, a suitable lubricant shall be applied to the rubber seal rubbing plates to protect the rubber.

3.1.4 Operating Machinery

Operating machinery for the gate assembly and supporting components, including bonnet, bonnet cover, pedestal, and base plate, shall be positioned and aligned to the installed location of the gate frame and guides and anchored in place. The location of the slide gate stem shall be projected to and scribed on the sill of the installed gate frame to serve as a reference point for the alignment of operating machinery and supporting components. Operating machinery and components shall be aligned to within 0.030 inch of the reference point. Prior to being embedded in concrete, an alignment template shall be bolted to the bonnet, bonnet cover, marked, and drilled to match the exact center point of the gate stem.

3.1.5 Concrete and Concrete Grout Placement

The embedment of the gate frame and other components in concrete shall be performed in an approved manner to fill all voids, secure anchorage, prevent seepage, and provide uniform finish surfaces. After embedment concrete has cured for at least 7 days, any voids around embedded components shall be filled by pumping concrete grout around the components. After the pumped grout has cured for at least 7 days, hammer
blows to the components shall be used to detect any remaining voids. Where remaining voids are located, 1 inch diameter grout holes shall be drilled in the components and the voids shall be filled by pressure grouting through the grout holes. Grout holes in the components shall be plugged by welding and shall be ground flush.

3.1.6 Painting

Exposed parts of the gate and appurtenance components, except machined surfaces, corrosion-resistant surfaces, surfaces of anchorages embedded in concrete, and other specified surfaces, shall be painted as specified in Section 09 97 02 PAINTING: HYDRAULIC STRUCTURES.

3.2 ACCEPTANCE TRIAL OPERATION AND TEST

After the gate assembly has been installed, including operating machinery, the Engineer will examine the complete system for final acceptance. Operation and test results shall be furnished to the Engineer. The assembly will be examined first to determine whether or not the workmanship conforms to the specification requirements. Operate the gate throughout its full operating range a sufficient number of times to demonstrate proper operation. The initial operation of the gate assembly shall be conducted in the dry. The second trial operation and testing of the gate assembly shall be conducted with the reservoir normal operating pool hydrostatic pressure. The workmanship in the fabrication and installation of the gate assembly shall be such that the gate leaf shall form a watertight barrier when lowered to the seated position. Adjustments shall be made to the operation and control apparatus until all components function as required. The lifting beam assembly, lifting sling, and other appurtenances will be inspected to assure proper operation. Required repairs or replacements to correct defects, as determined by the Engineer, shall be made at no additional cost to the Agency. The trial operation and testing shall be repeated after defects are corrected.

3.3 PROTECTION OF FINISHED WORK

Protection of finished work shall conform to the requirements of Section 05 50 14 STRUCTURAL METAL FABRICATIONS.

-- End of Section --